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AN ANALYSIS OF FAMILY FARM GROWTH IN WESTERN MANITOBA - A SYSTEMS APPROACH

by

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ABSTRACT

This study deals with the process of family farm growth in Western Manitoba. Many people believe that the long run objective of Canadian agriculture should be the development of rural communities based upon the maintenance of the economically viable family farms. The means of achieving this objective are influenced by the technological changes in agriculture. The technological changes and increased use of machinery have changed the internal dimension of family farming. The present study attempts to identify these changes and provide a guideline to achieve the objective of maintaining the economically viable family farm.

Several studies have been done in the area of farm growth using various methods. These can be grouped into three, namely; traditional theory of the firm, behavioural theory of the firm, and systems approach. Present study takes the systems approach to study the process of growth of the family farm system. The system view is an overall view which implies that an isolated study of the parts of system will not be adequate to understand the complete system. A system is a set of components that works together for achieving the overall objective of the system. The components of the system are linked in an interchanging manner, therefore, a study of the isolated parts would not provide a complete view of the system.

The growth of the net-worth is taken as the performance measure of the system. The major components of the family farm system, which affects the growth, are production and consumption. These two components compete for the available resources. Within the production component, crop and livestock operations compete for the resources. Production generates income which is available for consumption and re-investment for future production. The allocation of resources among consumption and investment is one of the major factors which decide the growth rate and therefore, the viability and competitiveness of family farms. The other factor which is affected by this allocation decision is the standard of living of the farm family. These interrelations between standard of living, investments, growth and therefore, future production and future standard of living make it difficult to understand the system by studying the parts of the system.

An econometric model was formed on the basis of systems approach to study the system. The model consists of three estimated equations for production, consumption and investment. An equation of performance measure, or of growth, is formed combining the models of production, consumption and investment. This combined equation links the production and consumption components and investment pattern of the system. The Solow's model is used to determine the technological change in Western Manitoba agriculture.

The data for the study were taken from 23 members of the Western Manitoba Farm Business Association. The analysis of data shows that the farmers have increased production by expanding the size of operations and increasing the use of machinery and material inputs. The growth of net-worth in 1961-69 period in terms of current dollar value was 184 percent. The major factors affected by this high rate of growth are increased use of factor inputs including land and extensive use of credit.

The econometric results and a significant test with 99 percent probability indicate that the industry was at constant return to scale during 1961-69 period. The farmers have carefully expanded the size and increased the use of machinery and material inputs during 1961-67 period. These inputs have been used productively in this period. However, the results indicate that the heavy investments on land and machinery in 1968 have not been productive. The material inputs have been used productively almost throughout the period, however, the labour was not used productively. The analysis of MVP/Price of input ratios indicates that the farmers were not able to coordinate resources to obtain the maximum possible net income from the operations.

The analysis of performance measure shows a 118.2 percent growth of net-worth during 1962-69 period, in terms of 1961 constant dollar value. This is an average rate of 14.78 percent per year. The major factors that influenced

this high rate of growth are expanded operations, increased use of factor inputs and extensive use of credit. The analysis of technological change shows an increase in technological index from 1 in 1961 to 1.8773 and 1.5228 in 1969 in net and gross measures respectively.

The analysis is extended to 1974 by means of forecasting. The forecasting results have shown that the model has a good forecasting power. The 1974 values of the economic variables show an increase in production and factor inputs used. However, these values include the price hikes experienced in 1973-74 period. The rate of growth of net-worth is a result of high production and low consumption.

The overall analysis of 23 Western Manitoba farms has shown that the solution to the problem of poverty among farmers is the expansion of the size of operations. The programmes for improving managerial ability of farmers would be helpful in achieving the objective of a viable competitive farming industry.

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CHAPTER I

INTRODUCTION

"The family farm has long been presented as a goal by politicians and others seeking to win friends among rural folk. Yet it is becoming a more qualified goal. For instance, James Bentley, then first vice-president of the Canadian Federation of Agriculture said in 1959, 'The long term objective of agriculture in Canada should be the development of rural communities based upon the maintenance of the family farm'. In 1969 Charles Munro of C.F.A. changed the emphasis to economically viable family farm."[1]

The Federal Task Force on Agriculture considers the family farm as a means to achieve higher goals such as income, personal fulfilments and various social and cultural values. It further has suggested that an examination of family farms can reveal to what extent it was and is a suitable means for achieving the higher objectives.[2]

Income is closely related to the survival of the business, in farming as well as in other industries. This means that the survival of farms especially those capable of financing a way of life depends upon increased efficiency. If the

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[1] Report of the Federal Task Force on Agriculture. Canadian Agriculture in the Seventies. (Queen's Printer for Canada, Ottawa, 1970), p. 33-34.

[2] Ibid., p. 34.

industry in general is in the phase of increasing return to scale, expansion of size of farms will result in lower unit cost of production. This means more efficient use of resources than before.

In this aspect, consideration should be given to the factors causing the growth of farm firm. Like in any other industry the growth of farm firms heavily depends upon the amount of capital investment. A major source of investment fund is the income generated within the farm. However, in family farm business operation, all the income generated within the farm is not available to plow back into reinvestment in the farm. A substantial portion of income has to be allocated for consumption purposes of farm family. Only the savings is reinvested in the farm. New investments, that would increase the efficiency of factors of production, are required for rapid growth. On the other hand most of these new investment expenditure has to be generated within the farm. Therefore, family farm should be viewed as both the cause and effect of growth. When making plans and decisions to maximize objectives such as increasing income or the quality of life of farmers, these factors should be taken into consideration and a series of plans, instead of an optimum plan, should be outlined.[3] The decisions made by farmers are influenced by uncertainties of future

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[3]Eisgruber, L. M. and G. E. Lee. "A Systems Approach to Studying the Growth of the Farm Firm". In Systems Analysis in Agricultural Management. J.B. Dent and J.R. Anderson (eds.) (John Wiley & Sons, Australia Pty. Ltd., Sydney), 1971, p. 330.

and lack of knowledge in specific areas. Often correct decisions are not made. A knowledge of factors affecting the growth and a quantitative examination of the process of capital accumulation on farms would be helpful in making correct decisions. The factors affecting growth and capital accumulation in farms can be analyzed by examining the past growth pattern and the forces influencing the growth. For this purpose the growth pattern of a specific group of farms in a given time period can be studied.

The Problem

The Task Force states that only about a third of 430,000 farms in Canada in 1966 were large enough, by today's standards, for long run viability. The remaining two-thirds fall into two groups; a middle stratum of moderately well off, and a bottom stratum of about 100,000, who live in poverty. It further states, that it is likely that technological changes will continue to push the farming units which are not suited to rapid change into low income levels.[4]

The technological innovations, increased capital investment and somewhat improved managerial ability of farmers have changed the internal dimension of modern farming. These changes in internal dimension demand an increase in the size of farms for the new techniques and equipment can profitably be used only in large scale operations. In addition to these internal requirements, the Task Force states, that inflation

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[4] Ibid., p. 409.

and cost-price squeeze imply that farmers must continually expand and improve efficiency in order to maintain or improve income. Unfortunately, most family farms earn very little income and are unable to save or to justify borrowing sufficient funds to finance the required expansion. They fall behind in the competitive race even though some improvements in production are made.[5] The general economic conditions of those farmers, who were not able to make the necessary changes forced them to leave farming, and, so migrated to the urban centers looking for more favourable living conditions.

The Task Force further states that those who manage to maintain competitive ability, continually expanded and rapidly improved their farm businesses. This made their farm business more complicated and therefore, it became extremely difficult for a farmer to combine all the necessary skills from production technology, through managerial ability, to marketing. Sometimes they make their own problems by borrowing too much, investing excessively on expensive machinery and so forth.[6]

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[5] Ibid., p. 21.

[6] Ibid., p. 22.

The situation that farmers were facing was rising input costs and constant or declining product prices. This situation has changed during the past few years. The world food crisis resulted in higher incomes for farmers. However, at present, farmers are again facing rising input prices and unstable product prices, especially in livestock operations. The cost of machinery and equipment inputs, chemical and fuel has gone up. Especially in the livestock industry, many farmers are forced to abandon their livestock operations due to low product prices and high input costs. In Manitoba, the situation is so severe, the government had to intervene to protect livestock operation by paying subsidies to producers. Consequently, the critical problem is low income. In order to increase net income, under these circumstances total production must be increased and the average cost per unit of product must be reduced, or at least, held constant.

Many farmers and economists argue that the per unit cost of production can be reduced by increasing the level of production. This will result in growth of farm firm. Therefore, understanding the farm growth process might be helpful in making plans for cost reductions. Also it will enable to make more reliable policy recommendations. The nature of farm growth process can better be understood by analyzing detailed information on the process. The nature of farm growth will be understood only when the internal

determinants of growth are quantified.

Another reason for the need for more research in this area is the government involvement in improving the living conditions of farmers. Many steps have been taken in Manitoba to improve the quality of life in rural area. These include programmes under the Agricultural and Rural Development Act 1961 (ARDA), the Fund for Rural Economic Development 1966 (FRED), the Small Farm Development Programme 1972 (SFDP) and Farm Diversification Programme. Some of these programmes are not directed only towards the agricultural sector. They alter the resource base available to agriculture and production techniques, and consequently change agricultural output. The main objective of all these programmes is improving the living standards of rural population including farm families. Net income is one of the most influential factors in the standard of living. The net income of farmers can be increased by increasing production. Any attempt to increase production by increasing the size of operation results in farm growth. Therefore, the family farm firm growth is one of the tools that can be used to improve the quality of life among farmers. This can be done by directing government programmes towards the improvement of factors influencing farm growth. This requires a better understanding of the determinants of farm growth which can only be gained by studying the past growth process and factors that influenced it.

Another factor that should be considered at this point is programmes for improving managerial ability of farmers. The main objectives of these programmes is to improve the knowledge of farm managers to increase the efficiency of factor inputs. This objective can better be achieved by correcting farmers' weaknesses in decision making. A study of farm growth may reveal these deficiencies. This information can be used in formulating a training programme for farm managers.

Objectives of the Study

The basic objective of this study is to examine the nature of the growth process of the family farm business in Western Manitoba. Farmers in this specific area were selected for analysis because of the availability of detailed data, from the farm records maintained by members of the Western Manitoba Farm Business Association since 1961. This data comprise of quantitative information on production, resource use, household expenditures and capital investments. Consistent data were available for 23 farms for each year from 1961 to 1969. These data are used in the analysis because of the need for detailed information, over a substantial period of time on individual farms, for examining the complex process of farm growth.

The study is directed towards the identification of internal determinants of farm growth in order to aid decision

making by farmers and policy makers in their efforts to increase net income. The reason for directing the study towards internal determinants is that they are more easily controlled by farmers than the external factors. A crucial element in growth that is considered in this study is the interrelationship between farm and household. The competition between these two sections for resources is taken into consideration.

The specific objectives of the study are;

(1) To formulate an econometric model, on the basis of system approach, to study production, consumption and investment components and to evaluate the factors affecting these components in family farm system.

(2) To analyze the effects of resource utilization, consumption, investment, credit utilization and management on farm growth.

(3) To provide a framework for planning and implementing policies to increase net farm income and to overcome some social and economic problems faced by many farmers.

In this chapter the problem, the necessity for research study in the field and the objectives of the study are discussed. The following chapter critically looks into the studies already done in the field, and discusses the improvements in the present study.

CHAPTER II

A REVIEW OF LITERATURE IN THE AREA OF FARM FIRM GROWTH

Farm firm growth is an area which has received much attention of agricultural economists. Several approaches namely, traditional, behavioural and system approaches, have been used in these studies.

Traditional approach refers to the maximizing behaviour. Main attention under this approach is given to the maximization or minimization of objectives such as profits and costs.[7] The other activities are considered as means of achieving these objectives and they are not given as much attention as that to the main objective.

Behavioural theorist argue that the traditional theory of the firm fails to reflect the nature of the important interfirm relationships and possible differences which may exist among firms. "Behavioural theory" connotes a theory of manner of response. In economics, we may say that a behavioural theory of the firm would show how changes in the internal characteristics of the firm resulting from the relative importance of the various goals would cause a firm to respond differently to the same condition at different times.[8]

The systems approach looks at the system as an entity. A study of one or two sections or components of the system does not provide a solution to the problem. The components of the system are interrelated. Therefore, the essence of the systems

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[7] Eisgruber, L. M. and G. E. Lee, op. cit., p. 331

[8] Ibid., p. 332.

approach is to study the system as a whole. In family farm system this includes the study of the subsystem of family as a whole. These two subsystems correspond to the production and consumption respectively.

Gillis

A study of family farm firm growth in Carman area of Manitoba has been done by Gillis.[9] The major objectives of his study were to find the factors affecting production, consumption and investment within the agricultural firm household in the Carman area and to analyze the effects of resource productivity, tax rate, technology, consumption and credit on farm growth.

The debt equity ratio has been taken as the criteria for the growth. He has hypothesized that the farm operator's basic goal is to own the entire capital comprising the farm business. The rate of capital accumulation in family farm business depends upon the income generated in the farm and that which is withdrawn for family consumption. Another factor that influences the growth is tax rate.

It is explained that the unit cost of production depends, among other things, on capital; i.e., scale of operation. The smaller the capital stock the higher the unit cost of production and vice-versa. As farmer gets more experience and accumulates more capital the production

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[9]Gillis, R.J. Growth of the Family Farm Business in the Carman Area of Manitoba with Particular Reference to Farm Household Interrelationships and Efficiency within the Farm; 1957-67. Unpublished M.Sc. Thesis, Univ. of Manitoba, 1972.

increases faster and so does the net-worth.

In this study consumption is assumed to be a function of disposable income. Also the size of family and previous years' consumption influence the level of consumption expenditure. The farmer has to allocate his income among family consumption and re-investment in the farm. Therefore, the consumption expenditure is a major factor that influences the rate of capital accumulation.

Farm-household relationships are explained on the basis of a theoretical analysis provided by Heady in 1952.[10] The analysis involves the use of indifference curves and production possibility curves to arrive at the optimum allocation of income between consumption and investments.

The allocation of income between consumption and re-investment depends on the farm family's desire for the utility of the discounted future returns from investments of current savings against the satisfaction of current income spent on consumption. This is equivalent to the indifference curve relationship in consumer theory. At the low levels of income, a high value is placed on present consumption compared to later consumption; i.e., average propensity to consume is high. As the income rises, current consumption is given less value as compared to future consumtpion or capital accumulation.

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[10]Heady, Earl O. Economics of Agriculture Production and Resource Use (New York: Prentice Hall, 1952), p. 417-424.

To generate future income for consumption and investment the farmer must invest a part of his current income. There are two possible things that can be done with the income. The farmer can consume the whole income or invest it or he can do any combination of these two. This situation is equivalent to production possibility frontier.

The final allocation of income between consumption and investment is determined at the point where the farmer's desire and possibility are equal. There are different points like this for different income levels. The curve going through such points represents the optimum growth path of the farm over time.

An econometric model was formulated to study the growth pattern. The model consists of four equations. 1) The production function; to estimate the parameters of production function Cobb-Douglas formulation was chosen. The Solow's model[11] was extended to include three independent variables in the equation formed to measure the impact of technological changes. 2) The consumption function; a consumption function, in the form of Cobb-Douglas formulation, was formed with disposable income, family size and previous years consumption as independent variables.

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[11]Solow, R. M. "Technical Change and the Aggregate Production Function." Review of Economics and Statistics. Vol. 39 (1957), pp. 312-320.

3) The investment function; an investment function in the linear form was formulated with savings and credit as independent variables. 4) The farm business growth equation; this equation incorporated the factors which affect the farmer's potential to increase their equity. It included the income tax rate, the rate of return on total investment, interest rate and debt to equity ratio.

The model was used to study the farm growth process in Carman area of Manitoba. The following conclusions were arrived at.

1. Farm income will rise if the scale of operation and use of material inputs are increased. However, good farm management is essential to growth.

2. Given the farmer is a good manager, it will be profitable to expand land and building base. However, he should base his decisions on the amount of savings generated from the farm unit.

3. Financial leverage or the use of credit can be helpful in the growth process, but the farmer should always examine his re-payment capacity before going into debt.

4. Diversification is a good means of reducing risk and the fluctuation in annual income. However, the individual farmer must decide on the best use for the land.

5. The importance of material inputs strongly suggests that all farmers must utilize this input to increase their gross profit.

6. Since good management is of major importance, the government must continue to provide courses which will increase the farmer's managerial ability.

In general his model consists of three functions for production, consumption and investment and one equation of growth. The interrelationships between these four factors are not clearly explained. This can be done by taking the link among these sectors into account. Only a systematic study of growth can explain these links and their effects on growth. The main objective of the present study is to study these links and their effects on growth. The model of the present study explains the method of achieving this. In this respect, one weakness in Gillis's study is not taking the effects of growth on consumption, investment and indirectly on production. Growth is not for the sake of growth only. The growth in family farm should be accompanied with an improvement in quality of life of farmers. Unless this is the case, the growth does not mean much when considering the welfare of the family. The effects of growth can be known only if the growth is included in the model as an independent variable.

A major defficiency in his study fall in the area of family consumption. The consumption of farm products are not counted in estimating the consumption function. They are not included in the farm income either. This is a major deficiency in a study of family farm growth because most of the

foods that are consumed by farm family come from farm itself. In fact, if the value of these items is not included, a study on family farm will not be complte.

Another area I would like to discuss in his study is the growth equation. His growth equation is unnecessarily general. It explains the effects of the consumption rate, tax rate, interest rate and the rate of return on capital on growth. These are generally accepted factors affecting growth. However, a study on a particular area should explain the specific factors affecting the growth in the area, along with these general considerations. Knowledge gained on regarding these specific factors would be more helpful, for policy formulation, than for use as a general guideline.

Patrick and Eisgruber

Another study in this area was done by George F. Patrick and Ludwig M. Eisgruber.[12] The objective of their study was to develop a model of farm firm behaviour in a dynamic environment with elements of uncertainty and with particular emphasis on the effects of changes in the managerial ability of the farm operator and in the capital structure.

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[12]Patrick, G. F. and L. M. Eisgruber. 'The Impact of Managerial Ability and Capital Structure on Growth of the Farm Firm'. Journal of Farm Economics, Vol. 50, 1968, p. 491-506.

The study is based on the behavioural theory of the firm. It is argued that the traditional theory of the firm fails to reflect the nature of the important intrafirm relationships and possible differences which may exist among firms. Human behaviour is goal oriented. Different members of the farm family may have different goals or objectives. Even if they have the same objectives the relative importance attached to them by members of the family may differ. Selecting a plan which attains all these goals at the minimum level of satisfaction, constrains the possibility of maximization of a single goal at the expense of all others.

Imperfect knowledge with regard to future forces the farmer to rely on his expectations in planning. The expectations change as he acquires more knowledge and it may be a function of managerial ability. Limitation of time and computational ability cause the farmer to consider only available alternatives. These may be determined by personal, institutional factors and factors related to business. As a theory of the manner of response, behavioural theory of the firm focuses primarily on the decision maker and his environment. At various points new information may cause a farmer to re-define his problem, seek more information, set up other alternatives, or accept a previously evaluated alternative.

A simulation model was constructed on the basis of behavioural theory and emperical findings of past research. Managerial ability and the capital structure were considered as controlled variables. The relationships among goals, expectations and other endogenous dynamic variables were specified in the model. Four major groups of farm family goals were identified: 1. living standards (current consumption), 2. farm ownership (re-investment), 3. leisure-children (desire for leisure and children) and 4. credit using risk-taking behaviour (willingness to sacrifice security and accept risk in the farm operation in order to achieve other goals). The relative importance that a farm family gives to these various goals depends upon the age of the farm operator, net-worth, size of farm and size of family.

All of the income from farming is not available for consumption. Part of it should go into re-investment. Consumption is assumed to be an increasing function of income, and also depends upon the family size, and the age of the operator. Expectations link the present and future in the economic world. The model considered short run price and yield expectations to be functions of the past three years experience.

In farm planning, the alternatives considered by the decision maker are determined, in part, by the relative importance of goals held by the farm family and by the firm's

resources. The plan promising the highest level of overall satisfaction is selected and implemented in the farm business.

Federal income tax has a major impact on farmers ability to increase net worth. This factor was explicitly taken into account. Price cycles and trends in crop and livestock production were considered. The model was simulated for a hypothetical farm. The controlled variables were managerial ability and capital structure.

The results of analysis showed managerial ability is the major factor that determined the growth. Higher interest rates forced the farmer of average managerial ability out of business. The effects of long run and short run loan limits also differ according to the managerial ability.

The mathematical model is not given. The study includes almost all the factors affecting growth. Managerial ability is given much attention, however, it is not the only factor affecting growth in most cases. The major weakness in this study as in Gillis's study, is the lack of coordination between various sectors. Particularly the effects of growth on other components such as consumption and investment are not given attention. The lack of coordination between sectors is due to the conceptual guidance used in the study. This can be improved by taking interrelationships among various sectors, and effects of growth on these sectors can

be explained in a study done by using system approach as the conceptual framework.

Eisgruber and Lee

L. M. Eisgruber and G. E. Lee have done another study of farm firm growth. The main objective of their study was to develop a plan for farm growth using systems approach.[13] The traditional theory of the firm and behavioural theory of the firm, which have been used in the analysis of farm growth process, are in lack of complete theoretical approach to the problem. The size, complexity and ill structure of the models developed by using the traditional and behavioural theories of the firm have created a substantial demand for modelling and deriving solutions to understand the growth process.

A farm firm should be viewed as an organizational system which changes over time. These changes may occur due to external changes in technical or market relationships or due to internal changes brought by entrepreneurial moves. From this it follows, that a plan for farm firm should not be formed with a view of optimal production, but a plan should be formed with the aspect of a growing farm, explicitly recognizing the endogeneous as well as exogeneous

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[13]Eisgruber, L.M. and G. E. Lee. "A Systems Approach to Studying the Growth of the Farm Firm." Systems Analysis in Agricultural Management. J. B. Dent and J. R. Anderson (eds.) (John Wiley & Sons Australia Pty. Ltd. Sydney) 1971, pp. 330-347.

variables that affect the farm firm in different ways and different points of time.

Theoretically the growth depends upon three sets of factors: 1) Actions which can be taken by the firm. 2) The state or nature of the variables beyond the control of the firm. 3) The character of the entrepreneur. The evaluation criteria necessary to make any analysis of the system depends upon the difference in outcome associated with using the resources in production rather than exchanging. In a theoretical sense, the dimensions of the firm's objectives are of little consequence. More important are the characteristics of these objectives, such as transitivity, additivity, etc. Given these sets for every action of the firm, of given level and point of time in a given setting, a particular level of result is forthcoming. The relationships between them are not known. They exist, and the attempt is to know them in the most efficient manner.

Given that these sets, objective and outcome were completely specified as well as the relationship between them known, complete prediction would be possible. Assuming the sets are controllable the decision unit would select the levels, for those controllable sets, which provide the best outcome. In fact such complete specification is usually not possible. Even if possible a complete search of all alternatives is unlikely to be efficient. A realistic alternative is the reduction of the size of the sets and

the simplification of the mapping or transformation to a degree which makes the specification of such a system conceptually possible as well as operationally or analytically feasible.

Investment or the accumulation of capital was taken as the criterion for growth. Consumption behaviour is not explained in the model, but a certain amount of capital-net income - was allowed to be withdrawn for consumption. The decision problem in this growth model was to choose values of decision variables that will maximize the net worth over a certain period subject to production function, available assets, investment funds, and borrowing capacity. The system was formulated as a simulation model. The system simulator and associated solutions were applied to a case farm. It was found that labour is obviously the resource which limits the growth. The growth is accomplished by means of investing in additional facilities and larger equipment. The growth rate is at the level of 4.6 percent over the ten year planning period.

The systems approach was used to take the systems performance, environment, resources, components and management into account. The simulation was used because of the high cost of obtaining a solution from the other methods.

The major deficiency of this model is that it does not explain the consumption behaviour of farm family. Consumption is taken as given to the model. This is mainly

due to the nature of the study. The study attempts to formulate a plan for future growth of a particular farm. Determination of future consumption needs of a single family is not a difficult task. Therefore, considering the past consumption expenditure, a maximum limit has been set on future consumption. However, since consumption expenditure is a major leakage of funds from farms, this factor should be included as an endogenous variable in any model used to study family farm growth.

Another factor that is not taken into account in all these studies is off farm income. Farmers are involved in off-farm activities for two reasons. Firstly, they do off-farm work to spend their idle time productively. Particularly, those farmers who do not have livestock operations, fall into this category. The other reason is to reduce the risk. In this aspect, farmers invest some of their money on off-farm ventures as well as do off-farm jobs. This does not reduce the risk involved in farming but it reduces the risk involved in earning an income.

Conceptual Considerations

Three different approaches have been used in the studies reviewed. Gillis has used the approach of traditional theory of the firm. Some scholars argue that the traditional theory of the firm does not provide the theoretical basis for studying the firm growth and they have

conducted their studies on the basis of behavioural theory of the firm. They challenge the assumptions of profit maximization and perfect knowledge in traditional theory. Another challenge relates to the fact that traditional theory of the firm was developed for the purpose of explaining the behaviour of the market more so than the behaviour of the firm.

Proposed substitutes for the challenged concepts and orientation are: 1) Explicit emphasis on intrafirm relationships, and the firm's organizational structure, 2) multiple goal function, 3) satisfying rather than maximizing, and 4) the search for information.[14] Patrick and Eisgruber have taken the approach of behavioural theory of the firm in their study.

Again, some other economists argue neither the traditional theory of the firm nor behavioural theory of the firm provides a sound theoretical basis for studying the growth of the firm. Their argument is that the two approaches are not essentially different from each other.[15]

Considering these criticisms on traditional and behavioural theories, Eisgruber and Lee have taken the view of systems approach to study the farm firm growth. This is one of very few studies done, on the basis of systems approach, on farm growth. It has opened the door for further

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[14] Ibid., p. 332.

[15] Ibid., p. 332.

studies, in the area of farm growth, by using the system approach. They have used the systems approach to formulate future growth plan for a particular farm. The present study will use the systems approach for studying the past grwoth pattern and internal factors affecting the growth of family farms in Western Manitoba.

The conceptual and methodological differences in various studies in the field of farm growth were discussed in this chapter. The next chapter will explain the conceptual framework and theoretical background considered in the present study.

CHAPTER III

Conceptual Framework and Theoretical Considerations

Systems Approach

The basic objective of this study is to look at farming as a system and study the internal determinants of the growth of family farm sub-system. The system view is an overall view which implies that an isolated study of parts of the system will not be adequate to understand the complete system. This is because the separate parts are linked in an interchanging manner.[16] Farming systems are characterized by the fact that man is attempting to control biological system in an uncertain environment to achieve his economic objectives. The complexity of farming and the uncertainty associated with the decision making process are features which indicate that a systems approach to studying the farm growth could be particularly useful.

The systems approach serves three main purposes. The objectives of systems research may be to predict the behaviour of a system, or more commonly, to improve control over existing systems or to design new systems.[17] According to Wright, the two major fields of activity in system research

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[16]Dent, J.B. and J. R. Anderson, 'Systems Management and Agriculture' in Systems Analysis in Agricultural Management. J. B. Dent and J. R. Anderson (eds.) (John Wiley & Sons, Australia Pty. Ltd., Sydney, 1971), p. 3.

[17]Wright, A. 'Farming Systems, Models and Simulation' in J. B. Dent, et al., op. cit. p. 17.

are analysis and synthesis. Systems analysis represents an attempt to understand the complete complex system. Systems synthesis is usually concerned with using the knowledge gained from analysis to modify the original system or to design entirely new systems.

The System

A system can be defined as a complex of interacting elements. The term systems has been defined as "a set of components that works together for achieving the overall objective of the system."[18] The behaviour of one component is neither independent of the values and characteristics of other components nor without any effect on other components of the system. They all are interrelated in such a manner so that an isolated study of one component does not provide a complete view of that component or does not help to understand the system. The relationship between components are spatial as well as inter-temporal. That is the results of any change in one component is dependent upon the values and characteristics of other inter-related components and also upon the happenings in the past.

The whole is more than the sum of the parts. This means that inter-related characteristics are not explainable

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[18]Yeh, M. H. "A Systems Approach to Agricultural Development in Latin America". (Unpublished discussion paper Department of Agricultural Economics, University of Manitoba, October 1974), p. 9.

from the characteristics of isolated parts. If, however, we know the total of parts contained in a system and the relation between them, the behaviour of the system may be derived from the behaviour of the parts. We can also say: while we can conceive of a sum as being composed gradually, a system as total of parts with its inter-relation has to be conceived of as being composed instantly.[19]

Family farming is a sub-system of the whole farming system. This includes the farm families whose main income source is farming. In the family farming system the family and farm should be considered as a whole. These two parts are heavily interdependent. The decisions made on farming activities are not independent of family activities. The resources available to the farmer should be directed towards both family farm and farm family. Each and every activity on farm and family are inter-related to each other. The living standards of the farm family depends upon the income generated within the farm. The income generated in the farm depends on the amount of input used and amount of capital invested. The amount of capital invested depends upon the amount of savings which in turn depends on farm income and family consumption expenditure levels.

These inter-relationships among various factors affecting family farming activities make it difficult to study farm growth by analyzing isolated parts of the system.

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[19]Ludwig von Bertalanffy, General Systems Theory. (George Braziller Inc., New York, 1968), p. 5.

Therefore, system approach is called for.

Churchman has outlined five basic considerations that must be kept in mind when studying a system.[20]

1. The total systems objectives and, more specifically, the performance measure of the whole system.
2. The systems environment, the fixed constraints.
3. The resources of the system.
4. The components of the system, their activities, goals and measures of performance.
5. The management of the system.

The Objectives - Performance Measure of the System

The objectives of the family farming system is a logical place to begin, because so many mistakes may be made in other steps of systems approach when the objectives of the whole system are not clearly understood. In the studies of business enterprises, normally the profit maximization is considered as the objective of operation. In the commercial farming sub-system of the farming system this may be the sole objective. But in family farm business the farm operator is not only an enterpreneural decision maker but a household decision maker as well.

Identifying the objectives of a system is a very difficult task. "The declared objective of an operation may not be the sole objective. The test for the objective of a

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[20]Churchman, C. W. The Systems Approach (Dell Publishing Co., Inc., New York, 1968). The following sections in this chapter heavily draws from Churchman.

system is the determination of whether the system will knowingly sacrifice other goals in order to attain the objective.[21] In the family farm operation, the farm operator sometimes has to sacrifice the maximization objective to attain the goals of household. "No longer can it be said that the individual farmer uses his resources irrationally when he does not maximize profits in a single period.[22] Therefore, from the system scientist's point of view the profit maximization is only one part of the objective of the whole family farming system. On the other hand, sometimes the household has to sacrifice its objectives in order to attain the goals of farm operation. So, the maximization of welfare of the household is, also, a part of the objective of the family farming system, from the system scientist's point of view. In order to clarify the matter it is needed to move from the vague statement of objectives to some precise and specific measures of performance of the overall system. This is a long run phenomena.[23] With this in mind, from the system scientist's point of view, the performance of the system can be measured in terms of accumulated net-worth of the family farm. To a certain extent this measure of performance takes the two objectives of the family farm into consideration.

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[21] Churchman, C. W., op. cit., p. 31.

[22] Heady, E. O., op. cit., p. 316.

[23] Churchman, C. W. op. cit., p. 31.

The profit maximization objective is attained through actions taken in the production process. In modern farming the capital investment plays a major role in production. The accumulation of net-worth or capital, therefore, becomes an indirect attempt to increase production and profits. On the other hand, if the other objective, maximization of welfare of the household is considered from the long run point of view, capital accumulation becomes a means of retirement plans. From the short run point of view the farmer may be sacrificing the household consumption in order to increase the accumulated net-worth. This accumulated capital increases the future production capacity, therefore, the household may be better off in the future due to the rise in income, a part of which can be spent on consumption. Another objective of the capital accumulation is to save a portion of current income for the purpose of spending on consumption needs after retirement. The amount of capital or wealth available at the retirement is a major determinant of the living standards of retired farmer and household. The retired farmer may spend his accumulated wealth, or income from wealth, or he may do any combintion of these. No matter what actions are taken, the living standards mostly depend upon the retirement fund. It is not unjustifiable, therefore, to take the accumulated net-worth as the performance measure of the system.

The measure of performance of a system is a score that tells how well the system is functioning. The higher

the score, the better the performance. Eisgruber and Lee in one of their studies, have given more emphasis to the characteristics of objectives such as transitivity and additivity, than to the dimensions of the objectives.[24] That is, for the purpose of comparison of the systems performance under various levels of control variables, the objectives of the system should be able to be measured in terms of some verbal or numerical scale. The accumulated net-worth as a measure of performance of the system satisfies this condition. The performance of the system between any two time periods can be compared as well as the performances of two systems in a given time period by using the accumulated net-worth as the measure of performance.

Environment of the System

Given that the accumulated net-worth is a good measure of performance, the next step of the system approach is to identify its environment. The environment of a system is what lies outside of the system. Not everything outside the system falls into the environment. Determining the environment is not an easy matter. The environment has to be determined from the system's management point of view. Everything that affects the performance of the system and which is beyond the control of the management of the system is

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[24] Eisgruber, L. M. and G. E. Lee, op. cit., p. 334.

environment.[25]

In agricultural systems one of the major components of the environment is climatic conditions. The climatic environment influences plant and animal production relationships and provide essential system input, such as water, light and heat. This is obviously beyond the control of the management to a certain extent no matter what constitute the system. For commercial farming as well as family farming sytems the climatic environment is beyond the control. Some factors, which look like environment are controllable to a certain extent. The major source of water is climatic environment, but man can control the flow of water by using irrigation system and utilize them according to his needs. Then it is no more a component of environement. It is a component of the resources of the system. However, this depends on the availability of water, again, which is beyond the control of management.

The institutional decisions that affect the system's performance may, to a certain extent, be regarded as the environment of the system. The decisions made by financial institutions on interest rate fall into this category. For a moment we have to be careful about this classification. As Hutton[26] states, it is not wise to consider interest rate as given to the farmer. The lenders

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[25]Churchman, C. W., op. cit., p. 36.

[26]Hutton, R. F. 'Discussion: Models of Farm Growth', J.F.E. (Vol. 48, No. 5, December 1966), p. 1510-1512.

may differenciate their policies according to asset composition and equity position of the borrower. In the long run point of view, the management of the system can make changes in the composition of assets and equity position to obtain favourable terms in borrowing. Here, the interest rate, and therefore, the availability of credit becomes a component of resources. However, the dependence on borrowed fund in making long run favourable conditions and the influencial capacity of the lender in making final decision, keep the decisions made by lending institutions in the environment of the system.

The government policies regarding factors affecting farmers, such as taxation, compensation in case of crop failure or destruction, marketing boards, may also be influenced indirectly by management. In a democratic society, the farmers can influence the policies by expressing their opinions during an election time. The strength of this depends upon the importance of their votes compared to total voters. In the present study this can be neglected, because the number of voters involved in the study is insignificant compared to total population. The decisions made by government and government agencies are, therefore, considered as components of the environment of the system.

Socio-economic environment is another component of the systems environment. The socio-economic environment provides system inputs in the form of goods and services,

provides income by absorbing output of the system and determines the economic outcome of the systems operation. Socio-economic conditions also influence the farmer and help determine his goals or objectives and these are incorporated into management policies for operating the system.[27]

This is worth evaluating. In family farming system the farmer is facing a competitive situation in the factor market and product market. The family farm is only a small unit of production in the whole industry. The demand for factor inputs by one production unit is very small compared to the total demand for inputs. The decisions on production expansion of such a unit, therefore, does not affect very much the conditions in the factor market. The condition in factor market is given to that unit. This is the situation in product market as well. Therefore, the conditions in factor and product markets become the components of socio-economic environment of the family farming system.

Resources of the System

The next aspect of the systems approach given in the Churchman's list of consideration, is the resources of the system. Resources, as opposed to the environment, are the things the system can change and use to its own advantage.

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[27]Wright, A. "Farming Systems, Models and Simulation", in J. B. Dent et al., op. cit., pp. 17-18

Typically the resources which are found inside the system, are measured in terms of money, of man hours and of the equipment.[28]

From the family farming system's point of view the internal determinants of the growth can be considered as the systems resources. The major components of the resources is the available capital funds. Funds may be available from two sources. The most important source, from the point of view of firm growth is internal savings of the family farm. The farm operator can decide on how much to save and how much to spend for consumption purposes. There is no argument regarding the consideration of internal savings as a resource of the system. However, the other source of capital, external funds or loans from outside is worthwhile clarifying. As already considered, the decisions made by institutions fall into the environment of the system. Given the environmental situation discussed earlier, the final decision regarding whether the external funds should be used or not is made by the farm operator. Also, once the funds borrowed, the decision on how to use them is made by the farmer. In that sense, external funds also can be considered as a resource of the system.

Given the availability of funds, the farm operator can make decisions on how to allocate them between various methods of investments. Funds can be spent to purchase more land, equipment, livestock, material inputs or to hire

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[28]Churchman, C. W., op. cit., p. 37.

services. This takes us to the other components of resources. The available land, equipment, labour, livestock and material inputs at a point of time are resources of the system. The farmer can control these factors and make decisions regarding how to use them to attain the objectives. Resources of the system are considered as the major determinations of the growth, because the degree of the control over the system mainly depends on available resources.

Components of the System

Having discussed the environment and resources of the system, now it is time to turn to the components of the system. Components refer to the divisions or sub-systems of the system. A fair argument can be raised at this point. The essence of system approach is to study the system as a whole because of the deficiencies of other methods which study only certain aspects of the system. Hence why do we need to have components of the system at all. As Churchman has pointed out, there are several reasons for this sub-division. By analyzing a sub-system, the worth of an activity for the whole system can be estimated.

> The system scientist would like to look at each choice of the whole system in a direct way, without having to sub-divide the choice. But this is not feasible. Consequently, the real reason for the separation of the system into components is to provide the analyst with the type of information he needs in order to tell whether the system is operating properly and what should be done next.[29]

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[29]Churchman, C. W., op.cit., p. 40.

In the family farming system the crop and livestock production and consumption can be regarded as the components. In production, the productivity of resources and the contribution to the net-worth can be taken as the measure of performance. Productivity performance measure will be a good indicator of the performance of resources. The contribution to total net-worth as a measure of performance will give a guide line to make decisions on expanding activities on various components. The consumption component is related to the welfare of household. The performance measure of this component should be accepted as the system's measure of performance in terms of characteristics. The systems performance is measured in terms of increase in net-worth. The greater the increase in net-worth, the greater the performance. If we choose the amount on consumption expenditure as the measure of performance in the consumption component, then the greater the amount spent, the greater the performance. This conflicts with the systems performance. Some other measure of performance, therefore, should be used for the consumption component.

Since maximizing household welfare is one of the objectives of family farming, the performance measure should have the property of expansion attached to the maximum. The proportional increase in consumption can be used as a measure. If the proportional increase in consumption is less than the proportional increase in income, both objectives of the farm operator are satisfied. The welfare of household

as well as the net-worth of family farm increase as the total net income from the operation increases. This conclusion is subjected to some other condition. The assumption is that as the expenditure on consumption increases, total utility increases.

The Management of the System

These considerations bring us to the last aspect of the system approach, i.e., systems management. Heady[30] has identified two aspects of management, namely coordination and supervision. Coordination, the important one of these two, is required because of the uncertainty of the future. Supervision, as explained by Heady, is a human activity of the 'lower order'. Coordination includes formulation of expectation of future conditions, formulation of plan for future activities on the basis of expectations, and putting the plan into action. Management bares the responsibility of accepting consequences of these actions. Management sets the component goals, allocates the resources and controls the systems performance. In the family farming system, the farm operator makes decision and enjoys the outcome of his operation. Therefore, automatically he takes the risk and responsibility of his decision.

The management of a system, not only makes decisions and plans, but also must make sure that the plans are being

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[30]Heady, E. O., op.cit., pp. 465-499.

carried out in accordance with its original ideas. However, this not only means the examination of whether plans are being carried out correctly, it also implies an evaluation of the plans and consequently a change of plans. This requires an information feed-back, which makes it easy to change the plans if the outcomes of plans are not directing the system towards the objectives of the operation.[31]

Growth

The objective of present study is to identify the determinants of the family farm firm growth.

> The term 'growth' is used in ordinary discourse with two different connotations. It sometimes denotes merely increase in amount; for example, the increase in output, sales, export, etc. At other times, however, it is used in its primary meaning implying an increase in size or an improvement in quality as a result of a development.[32]

Halter has explained the growth as an internal process of the firm through which the productive opportunities of the firm are used to expand its size. For some enterprising firms there is a continuous incentive to expand and there is no limit to their absolute size. However, it is hypothesized there is a limit to the growth rate, i.e., the productive opportunities of the firm are limited in any period.[33]

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[31]Churchman, C. W., op. cit., p. 45.

[32]Penrose, E. T. The Theory of the Growth of the Firm. (John Wiley and Sons Inc., New York, 1959), p. 1.

[33]Halter, A. N. 'Models of Farm Growth' J.F.E. Vol. 48, No. 5, Dec. 1966, p. 1503.

For the purpose of the present study, the growth is considered as an increase in size of the farm firm in the context of accumulated net-worth. Under this assumption the basic objective of the farm operator is to own the entire amount of capital comprising the farm business. Therefore, the implied objective of this study is to examine the capital accumulation process in family farms in Western Manitoba and to study the determinants of the growth process.

The process of growth is of utmost complexity and there is a large number of formulas on the market which claim satisfactorily to represent observed growth data and curves.[34]

Bertalanffy has developed one of the well recognized systems growth theories.[35] It is assumed that the growth is based on a counteraction of anabolic and catabolic processes. The organism grows when building-up surpasses breaking-down, and becomes stationary when both processes are balanced.

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[34]Ludwig von Bertalanffy, General System Theory. (George Braziller Inc., New York 1968), p. 171.

[35]Ludwig von Bertalanffy, "Principles and Theories of Growth". Fundamental Aspects of Normal and Malignant Growth. W. W. Nowinski (ed.), (Amsterdam, 1960). His growth theory was mainly developed for biological systems. However, there is a similarity between the growth of a biological system and an economic system. In both systems, the growth is determined by the difference between generation and degeneration. In biological system this refers to organism whereas in economic system it is wealth. The growth is measured by the change in size in both cases.

The growth rate (GR) of an economic system may, quite generally, be expressed by a balance equation of the system.[36]

$$\frac{ds}{dt} = GR = \text{Generation} - \text{Degeneration}.$$

where $\frac{ds}{dt}$ = growth in size over time.

In the family farm system the growth in size is represented by the difference between processes of generation of wealth by means of production, and degeneration of welath by means of consumption and depreciation.

Generation and degeneration of wealth are functions of several variables. With regards to family farming these variables will be explained later in this chapter and in the model.

Competition

General systems theory in the narrower sense is trying to derive from a general definition of "system" as a complex of interacting components, concept characteristics of organized wholes such as interaction, sum, mechanization, centralization, competition, finality, etc., and to apply them to concrete phenomena.[37]

Among the concepts one that mostly influences the growth is competition. System competition theory assumes

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[36] von Bertalanffy, L.V., op. cit., p. 172.

[37] Ibid., p., 91.

and explains the competition among components or parts within the system. Also, it assumes the competition between sub-systems within the system, e.g., the competition between commercial farming and family farming. Examples for competition between components within family farm system are, the competition between family farm and farm family for the resources for production and consumption respectively. Within production component itself, there is a competition for resources between various sectors such as livestock operation and crop production. Under the system growth and competition theory it is assumed that competition eventually leads to the extermination of the activities or sectors with the smaller growth capacity. This may explain why some farmers wind up their livestock operation after being in the business for a while.

A point of philosophical interest should be mentioned. If we are speaking of "systems" we mean "wholes" or "unities". It seems paradoxical that, with respect to a whole, the concept of competition between its parts is introduced. In fact, however, the apparently contradictory statements both belong to the essentials of the system. Every whole is based upon the competition of its elements and presupposes the struggle between parts.[38]

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[38]Von Bertalanffy, L. V., op. cit., p. 66.

Growth and Family Farm

Boulding has classified growth phenomena into simple growth, population growth and structural growth.[39] The growth of organizations such as family farm fall into the third category. He has formulated five principles to explain the much more complex structural growth.

The first of these is called the principle of nucleation, following a term which comes originally from physics. Any structure has a minimum size which is its nucleus. Once a nucleus has been formed, it is not too difficult to understand how additions to the structure are made. In the family farm business the capital investment of beginning farmer can be considered as the "nucleus".

The second general principle of structural development is called the principle of non-proportional change. As any structure grows, the proportion of its parts and of its significant variables cannot remain constant. It is impossible to reproduce all the characteristics of a structure in a scale made of different size. This is related to the common economic concept of return to scale.

The importance and the relationships of these two principles, along with the other principles, to the growth of family farm is described as follows.

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[39] Boulding, K. E. "Toward a General Theory of Growth", General Systems. L. von Bertalanffy and Anatol Rapoport (eds.) Vol. I, 1956, pp. 66-75. The following section in this chapter heavily draws from Boulding.

The process of accumulation of capital and therefore net-worth, is associated with the change in farm size, which is a process along the expansion path or the scale line. The process of farm growth is a result of the plans and actions of the farmer at different stages of growth.

In the early stages of the farm family "biological cycle", with an initial amount of net-worth which generate an output, it is expected that the farmer is able to save and obtain credit. The credit can then be invested on the farm to produce a greater output. The additional investment changes the farm size and scale of operation. At this stage, assuming increasing returns to scale exists, the unit cost of production is less than the unit cost before. The new stage is assumed to be associated with the middle stages of the biological cycle. The lesser unit cost of production implies that this stage is more efficient than the previous one. In the stages of growth process the farmer can choose different levels of operation depending upon the availability of resources.

The farmer makes short run plans to expand the farm. These short run plans finally takes him to a long run growth path. To remain competitive the farmer should expand his capital investment up to the level which gives an output in the long run at the minimum unit cost. This size is characteristic of many farms at the end of farm family "biological cycle" or the retirement phase. Even

though this size represents an economically efficient stage of production, it might not be the efficient stage from the farmer's point of view. As the farmer gets older he may have other objectives besides maximizing profits.

Boulding's third principle, which follows somewhat from the second is called D'Arcy principle. It is the principle that at any moment the form of any object, organism or organization is a result of its law of growth up to that moment. For example, economic and technological development follows patterns which in turn determine the structure of an economy. Growth creates form, but form limits growth. This mutuality of relationship between growth and form is perhaps the most essential key to the understanding of structural growth.[40] The effect of this principle was explained in the analysis of long run cost curve. The structure of next year's farm operation and cost pattern depends upon present level of capital investment and cost structure.

The fourth principle is called "carpenter principle". In building any large structure out of small parts one of two things must be true if the structure is not to be hopelessly misshapen. Either the dimension of the parts must be extremely accurate, or there must be something like a

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[40] Ibid., pp. 72.

carpenter or a bricklayer following a "blue print" who can adjust the dimension of the structure as it goes along.

The fifth and last principle is called the principle of equal advantage. It governs the distribution of "substance" of a structure among the various parts of the structure.

These last two principles are related to the management component of the system. Management has to formulate a "blue print" or a plan, which will be useful in making decisions.

Given the production possibilities, and factor and product prices, the farm operator can make decisions on allocating resources among various products to attain the objective of the family farm firm. The rational farm business operator makes production decisions to maximize profits. In the family farm business this rational behaviour is subjected to the objectives of the farm family. The objective of the farm operator is to maximize satisfaction or welfare of family. The farm income is no longer available for re-investment alone. It has to be shared with the consumption needs of the farm family. Therefore, the consumption behaviour of the family is also a factor affecting the rate of family farm firm growth.

The farmer receives his gross income from farm business operation. A portion of this income has to be paid for the inputs used in generating the gross income. Now

the farmer is left with net income or the profit of operation plus any income he has earned from non-farm employment. Income tax has to be paid on total net income, so finally, the farmer is remaining with disposable income, which has to be allocated between consumption and investment. There is another financial resource available to the farmer, which a rational farmer does not consider as an income that can be spent on consumption. This is the depreciation allowance which should be re-invested in the farm business to replace the capital used in production. So the farmer has to make his allocation decision only on disposable income.

Consumption Behaviour

Consumption is one of the factors affecting the re-investment in family farm business. In this respect farming can be viewed as a means of life as well as a way of life. In a subsistence economy all the consumption requirements are met within the family. But in a present day complex economy the situation is different. The farmer sells most of his products and spends the income on other consumption goods. The saving is the difference between income and consumption. Therefore, the invested amount of income depends on, among other things, the consumption pattern of the farm family.

The concept of consumption function was introduced by John Maynard Keynes.[41] He explained that the amount spent on consumption is a function of real income. Another two concepts introduced in this respect are average propensity to consume (APC) and marginal propensity to consume (MPC). APC explains the relationship between total disposable income and total consumption expenditure. This ratio is usually less than unity. That means, people do not spend all their current income on current consumption. Portion of income is saved. MPC explains the change in consumption as a result of a change in income. Keynes has explained that this ratio is always less than unity and positive. As income increases both APC and MPC ratios fall. "...as income increases people tend to spend a decreasing percentage of income or conversely tend to save an increasing percentage of income."[42]

In the present study the farm income as well as off farm income is taken into consideration in the analysis of consumption component of the system.

It is hypothesized that the consumption behaviour is influenced by consumption habits. Once people get used to a certain consumption pattern they try to maintain it.

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[41] Keynes, J. M. The General Theory of Employment Interest and Money. (MacMillan and Co. Ltd., London, 1970), p. 96.

[42] Keynes, J. M. op.cit., p.

Previous year's consumption is included as an independent variable in emperical studies to take the effects of consumption habits into account. In the present study, consumption habits are taken into consideration by including previous year's consumption expenditure of farm families.

Another hypothesis on consumption behaviour is that the family size influences the household's consumption pattern. As the number of members in the family grows, the consumption requirements of the family increases. In the family farm business, as the number of members of the family increases, the farmer has to allocate more and more income for consumption.

Wealth is assumed to be another factor affecting the consumption behaviour. It is assumed that the people who have a large accumulated wealth spend more of their current income on consumption expenditure compared to those who have less wealth. In the family farm business, the beginning farmer usually starts with a small amount of capital. Therefore, at the beginning stage of the farm business, the farmer has to allocate more income for re-investment on the farm. As he accumulates more and more capital over time, the requirements for re-investment decreases, and more income can be allocated for consumption expenditure.

Investment Function

So far we have seen that the farmer generates income by means of farming and a portion of this income is consumed and remaining portion is saved and later re-invested in the farm business. The level of income generation, which is allocated between consumption and savings is affected by the capital invested on farm. This investment may take several forms. The farmer may invest his savings and money obtained from other sources in land, buildings, equipment, livestock or any combination of these. The determinants of investments, regardless of the form, are discussed in this section.

One of the factors which affect the current level of investment is the current financial liabilities. The greater the current farm business financial liabilities, the lesser the opportunity to borrow money from outside. This is related to the net-worth of the farm business. The greater the net-worth, the greater the collateral that can be used against an additional loan. As the farm grows over time the increasing net-worth increases the opportunity of borrowing outside funds.

Internal savings of family farm business is another source of funds for investment. Savings, as explained earlier, is the difference between income and consumption. Income is generated from the production on farm, the level of which is affected by the level of capital invested.

The greater the previous year's income, the greater the savings and current investment.

Farm Household Relationship

The growth of the firm is affected by the income generated in the firm. In the family farm business, all the income generated is not available for re-investment. Part of the income should be allocated to the household consumption. There is a definite relationship between family farm firm growth and consumption behaviour of the household. A theoretical analysis of this relationship has been done by Heady.[43]

Under this situation maximization of satisfaction or utility (welfare) of the family becomes the objective of the family farm business operation. This is a process that takes place over time. The firm and household come into conflict over the allocation of income on current consumption and future consumption or re-investment. The household is concerned with the utility that can be derived by spending the income now and in future. The allocation of income between present consumption and future consumption (re-investment) depends on the desire of the farm family for any of these alternative utilities.

At a low level of income, large portion is spent on consumption. As the income increases both current consump-

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[43]Heady, E. O., op.cit. pp. 416-435.

tion and savings increases, but the rate of increase in savings tend to be higher than the rate of increase in current consumption.

The behaviour of farm operator in allocating income between consumption and investment affects the growth of the farm firm. The decisions concerning the allocation of income between consumption and investment should be made with careful attention so as to ensure an optimum growth rate.

So far, the objectives and conceptual considerations of the study have been examined. The model which is developed on the basis of these objectives and conceptual consideration is explained in the next chapter.

CHAPTER IV

THE METHODOLOGY AND MODEL

Methodology

An econometric model is formulated to study the growth of the system. There are three main goals of econometrics.[44] 1. analysis i.e., testing of economic theory; 2. policy making; i.e., supplying numerical estimates of the coefficients of economic relationships, which may be then used for decision making; 3. forecasting, i.e., using the numerical estimates of the coefficients in order to forecast the future values of the economic magnitudes. Of course, these goals are not mutually exclusive.

Econometrics may be distinguished into two branches, theoretical econometrics and applied econometrics. Applied econometrics which is our major concern, includes the application of econometric methods to specific branches of economic theory. It examines the problems encountered and the findings of applied research in the fields of demand, supply, production, investment, consumption and other sectors of the economic phenomena and forecasting economic behaviour.

Applied econometric research is concerned with the measurement of the parameters of economic relationships and

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[44] Koutsoyiannis, A. Theory of Econometrics, (Macmillan Press Ltd., London, England, 1973), p. 8.

with the prediction (by means of these parameters) of the values of economic variables.

Econometric method takes the stochastic nature of economic phenomena into consideration. Usually, an estimated function fails to explain the exact relationship between dependent and independent variables. This may be attributed to factors such as 1) ommission of variables from the function, 2) random behaviour of the human beings, 3) imperfect specification of the mathematical form of the model, 4) errors of aggregation and 5) errors of measurement.

In order to take the above sources of error into account, a random variable denoted by the letter "u" is introduced and is called error term or random disturbance term or stochastic term of the function.

Regression analysis is based on certain assumptions, some of which refer to the distribution of the random variable u, some to the relationship between u and the explanatory variables and finally some refer to the relationships between the explanatory variables themselves. Introduction of u term into the functions gives the randomness to the model. The importance of this u term in various functions will be discussed in the model.

The mathematical forms of the equations are determined on the basis of observations of scatter diagrams of the relationships between dependent and independent variables,

and "a priori" considerations. The Cobb-Douglas formulation was chosen to derive production function and consumption function and linear form is used in deriving investment function. The equations for each of production, consumption and investment functions were estimated using multiple regression analysis or ordinary least squares method.

The Model

The following model is formulated to study the growth of family farm system.

Maximize:

$$\Delta Nw = Y - OE + OFI - T - C$$

Subject to;

Product function;

$$Y = A_1 K^{b_1} L^{b_2} MI^{b_3} U_1$$

Consumption function;

$$C = A_2 Y_d^{b_1} C_{t-1}^{b_2} F^{b_3} NW_{t-1}^{b_4} U_2$$

and Investment function;

$$I = A_3 + b_1 S_{t-1} + b_2 CR_t + b_3 NW_{t-1} + U_3$$

The performance measure is,

$$GR = (\Delta NW_t / NW_{t-1}) * 100$$

Definitional equations;

$$Yd = Y - OE - D + OFI - T$$

$$S = Yd - C + D$$

NW_{t-1} = Net-worth at the end of the previous time period.

ΔNW_t = change in net-worth during time period t. This is equal to the amount earned during the period minus amount spent during the period or savings.

Therefore,

$$\Delta NW = S = Yd - C + D$$

Substituting for Yd

$$\Delta NW = Y - OE - D + OFI - T - C + D$$

$$= Y - OE + OFI - T - C$$

The functional relationships of internal determinents of growth are as follows:

$$\Delta NW = Y(K, L, MI) - OE + OFI - T - C\ (Ydt, C_{t-1}, F, NW_{t-1})$$

and,

$$K = K(I(S_{t-1}, CR_t, NW_{t-1}))$$

where;

Y = Total gross production (income)

OE = Operating expenditure

OFI = Off-farm income

T = Income Tax

C = Consumption expenditure

K = Capital; composed of machinery and equipment, land and buildings, and livestock. The amount

of capital used in production is determined by the amount invested on capital goods and land. Therefore, K=K(I), where I = investment.

L = Labour

MI = Material inputs

D = Depreciation

Yd = Disposable income

F = Family size

NW = Net-worth

S = Savings

CR_t = Current farm business liabilities

GR = Growth rate

C_{t-1} = Lagged consumption

NW_{t-1} = Lagged net-worth

b_i = estimated coefficients.

Data Used in the Study

The data were taken from farm records of 23 farmers in Western Manitoba. The values of variables were measured at 1961 constant prices. There are two categories of indices available, which can be used in present study.[45] One for Canada as a whole and the other for Western Canada. The

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[45]Statistics Canada, Prices and Price Indexes - SEPTEMBER 1971. (Information Canada, Ottawa, Vol. 49, No. 9, pp. XX - XXXI and 61).

indices for Western Canada are used, whenever available, in arriving at constant dollar values. The derivations and definitions of variables are explained in the remaining sections.

The Objective Function

The objective function that is to be maximized is the change in net-worth. It is assumed that the farm operator's ambition is to own the entire capital stock that forms the farm business. The investment consists of two types of capital. One is capital borrowed from outside persons and organizations, and the other is equity capital of farmer. Therefore, the farmer can select one of three ways to increase his net-worth. He can pay off debts or buy more assets with his own money, i.e., money he has saved,or can do any combination of these two. Hence a farmer whose intention is to increase the net-worth of farm business, must attempt to increase the positive difference between the income coming from all sources and all kind of expenditure and payments. The objective function of the model considers these factors by taking the following variables into account.

Gross Farm Income

This includes the income generated within the farm from crop and livestock production. Also, in arriving at

this value, the inventory adjustments should be taken into account. This value represents the income generated within the farm in a given time period, but not only the cash receipts of that period. Cash receipts may be greater than, equal to or less than income generated depending upon the sales practices and credit and marketing systems. The value of gross farm income was deflated by using composite animal and crop price index for Western Canada to find the total farm income in terms of constant dollar value.

Operating Expenditure

The value of inputs used in production is included in this category, i.e., the total value of hired labour, material inputs such as seeds, feed, fertilizer, chemicals, fuel, etc., and depreciation allowance on buildings, machinery and equipment used in production. These are the inputs used in generating farm income and therefore, should be deducted from gross farm income in arriving at net farm income. In addition to the above mentioned inputs another input that should be considered is family labour. This is an important source of labour in family farm operation, but in this study the value of it is not deducted in arriving at net farm income. This is because we are studying not only the net farm income of family farm but also the income of farm family. Therefore, even if we deduct the value of the family labour from gross income we have to add it again to the family income. The

value of operating expenditure was deflated by using a composite price index for material inputs used in farm production.

Off-Farm Income

There are two major sources of off-farm income. One is the income earned by undertaking off-farm employment and the other is the income earned from off-farm investments. Off-farm employment is undertaken mostly by small farm operators and those who do not have livestock operations. They engage in off-farm employment to supplement their farm income and to spend their idle time productively; particularly during the winter season. Off-farm investment income comes mainly from the interest received on the balance in savings accounts in the banks, and other financial institutions. Most of the time the farmers receive their income in lump sum amounts but the expenses do not follow the same pattern. Therefore, the income received is deposited during the time period between receiving time and paying time, and an interest is earned on it. The value of off-farm income is deflated using consumer price index for Winnipeg.

Income Tax

Income tax paid is one of the cash outflows which falls into a particular category. Unlike other expenses, the farmer is obliged to pay tax on his income but it does

not directly improve the income or welfare of farm family. Instead, as the income increases, the outflow of cash on tax increases. This affect the net-worth and welfare of family farm and farm family. The tax is calculated on the deflated income.

Consumption Expenditure

This includes the amount spent for purchasing goods and services for the purpose of family consumption. Also, the value of farm products consumed is included in this category. This is one of the most important category of expenses that influence the change in net-worth or savings. Unlike other expenditure categories, the farmer can control these expenses to a larger extent. The ability of controlling this expenditure gives the farmer freedom to chose the growth rate, to a certain extent. This value is deflated by using consumer price index for Winnipeg.

The objective function does not attempt to explain how the objective of the farmer is achieved, i.e., it does not distinguish between paying off debts or acquiring new assets as a way of increasing net-worth. Any of these two methods can be used once the funds are available to the farmer. Therefore, main emphasis is given to the generation of internal funds for re-investment in the farm.

A criticism that may be aimed at this objective function is that the farmers do not always intend to increase

net-worth. The point of those who criticize this objective may be that the farmers would spend their money on consumption goods and services rather than on re-investment. In fact, this is true in some cases. When farmers get older, very often their children leave the family and therefore, the farmer is free of domestic problems. Also at this stage the farmer owns most of the capital invested on the farm. This situation influences his consumption decisions. In the present model it is attempted to take the behaviour of the farmer, other than associated with the objective of increasing net-worth, into account by including the net-worth in the consumption function, which deals with the welfare objective of farm family.

As already has been explained in the theoretical considerations, rich people spend most of their current income on current consumption, compared to poor people. This is called the wealth effect on consumption. In the present model, the net-worth component in the consumption function takes the wealth effect into account, and may explain the behaviour of farmers related to factors other than increasing net-worth of the farm. Therefore, though the maximization of the change in net-worth is taken as the objective of the farmers, for the purpose of this study, an allowance has been made for other objectives as well in the model.

Production Function

Four types of production functions are estimated. They are;

1) Production functions for each year using cross sectional data and capital in aggregated form.

2) Production functions for each year using cross sectional data with capital in dis-aggregated form and all the variables in terms of per labour units.

3) Production function for the farms using panel data,[46] i.e., combined cross sectional time series data, with capital in aggregated form.

4) Production function for farms using panel data with capital in dis-aggregated form and all variables in terms of per labour units.

The production function with dis-aggregated capital and all the variables in terms of per labour units takes the following form:

$$\frac{Y}{L} = A_4 \left(\frac{RE}{L}\right)^{b_1} \left(\frac{ME}{L}\right)^{b_2} \left(\frac{LVK}{L}\right)^{b_3} \left(\frac{MI}{L}\right)^{b_4} u$$

where;

RE = Land and buildings (real estate input)

ME = Machinery and equipment

LVK = Livestock

This method is used mainly for two reasons. 1) Variables, taken in terms of unit per labour used, eliminate the

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[46] Koutsoyiannis, A. op. cit., p. 17.

labour input as a variable without affecting its influence on production and gives an additional degree of freedom for the estimates. 2) The Solow's or geometric model is used to estimate the technological changes. This requires the output and input used in terms of units per labour used. Therefore, production functions estimated with variables in terms of units per labour would be useful in forecasting future technological changes.

The Solow's model[47] is represented by the following two factor production function of general form;

$$Q = F(K, L; t)$$

where;

Q = output

K = Capital

L = Labour

and the variable "t" for time appears to allow for technological changes. "Technological change" is a shorthand expression for any kind of shift in the production function.

Solow's model is extended to include material inputs and takes the following general form;

$$Y = Y(K, L, MI; t)$$

where, Y represents gross output, K, L and MI represent capital, labour and material inputs respectively. Again "t" for time allows for technical change.

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[47] Solow, R. M. op. cit., pp. 312-320.

Data Used in Production Function

Gross Output

The value of gross output is the sum of animal products which includes cattle, dairy, eggs receipts and field products which include grain, and feed inventory change.* The data taken from records were not categorically detailed. Therefore, the values for gross output were deflated by the composite animal and crop price index for Western Canada.

Material Inputs

The value of material inputs includes the total value of inputs, such as seed, feed, fertilizer, chemicals, fuel, etc., used in production. The total value of these inputs was deflated by a composite price index of material inputs. This is the only available index from publications.

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*The analysis of production in the farms was done in aggregated crop and livestock form. This was done because, the unavailability of separate expences occurred in these two sectors. Total expenses could have been separated into these two sectors on the basis of the proportion of crop and livestock receipts. However, this would not be a good approximation because, there is no guarantee that the costs follow the same pattern that incomes do. The combined crop and livestock production analysis assumes that the marginal productivities of inputs are the same in both crop and livestock operations.

Machinery and Equipment

The value of machinery and equipment includes the cost of trucks, tractor, combines, and other equipment. The values of machinery and equipment were added together and then deflated by a composite price index of machinery and equipment for Western Canada.

Livestock

The value of livestock which was taken from records includes cattle, hogs, sheep and poultry. The total value of these was deflated by a livestock wholesale price index.

Land and Buildings

The assessed values of land and buildings which were taken from farm records reflect both qualitative and quantitative differences that exist between different parcels of land. The value of buildings includes main barn, poultry house, machine shed and garage, and fences, etc. It does not include the value of operator's house. However, the value of operator's house is included in total assets for the purpose of calculating total net-worth. The values of buildings were deflated by the price index for building materials.

Total Capital Input

The value of total capital input is derived by adding the deflated values of land and buildings, machinery and equipment and livestock.

Labour

Data regarding labour input were available in terms of the main-equivalent. A man-equivalent is defined as an adult male of average capacity, fully employed for a twelve month period. The deficiencies of this measure are that it does not measure the flow of labour input and does not take the quality of labour into account. This would not show the variation of labour used in the farms of different sizes.

Consumption Function

Two types of consumption functions are estimated. One is consumption functions for each year using cross sectional data. The other type is, consumption function to analyze the consumption behaviour of farms during the period, using panel data. The derivation of data for variables included are explained below.

Consumption Expenditure

Consumption expenditure includes the value of consumption goods and services purchased plus, the value of farm products consumed. The goods and services purchased include items such as food, clothing, furniture and appliances, fuel, education, medical services, transportation, housing and household repairs. The total expenditure on these items were taken from farm records and deflated by the consumer price index for Winnipeg.

Disposable Income

Disposable income is derived in the following manner. Net farm income is arrived at by deducting all the operational expenses including depreciation, from gross income. The off-farm income is added to the net farm income. Disposable income is arrived at by deducting income tax from this total income. The value of farm products consumed is included in the net farm income and not deducted in arriving at total disposable income, because this value is included in the total consumption expenditure. The disposable income was deflated by consumer price index for Winnipeg.

The depreciation allowance of machinery and buildings are deducted from gross farm income in arriving at disposable income. The farmers may not consider depreciation as an expenditure in arriving at their disposable income. However, in a study of farm growth, which is a long run phenomena, the depreciation has to be considered as an expenditure. Unless this is done, the systems management will make decisions on the basis of false evaluations and therefore, the system, in the long run may disappear. If the system is to grow, then the depreciated machinery and buildings have to be replaced, as well as the addition of new capital goods. Therefore, the depreciation allowance must be deducted before arriving at disposable income, which determines an outflow of cash (that will never come back to the system), in the form of consumption expenditure.

Family Size

This represents the number of individuals in the family. Family size was calculated in terms of equivalent adults by giving weights for age groups and their estimated consumption requirements. The weights used are as follows:[48]

	Weight	
Age Group	Male	Female
under 5 years	.28	.28
5 to 14 years	.675	.675
15 and over	1.000	.900

The available information does not provide data regarding number of dependents in farm families for each year. The number of dependents in the years of 1961 and 1965 can be found from records. However, their ages are not given, but the following approximation is used in estimating their ages. When there is only one dependent, that person is taken as farmer's wife. When there are two or more dependents the additional ones are counted as children. Since

[48]Stone, R. Measurement of Consumer Expenditure and Behaviour in the United Kingdom, 1920-1938. Vol. 1 (Cambridge University Press, 1954).

their ages are not given, it is assumed that the first child was born when the farmer is 25 years old and the rest were born in every other year. This method of approximating ages was used in estimating income tax for the purpose of deriving disposable income.

Net-Worth

The variable, previous year's net-worth is included in the consumption function for two reasons. Firstly, it takes the effect of wealth on consumption. The fact that net-worth is taken into consideration attempts to reply the criticism that the farmers have major objectives other than increasing net-worth. This is explained in the discussion of objective function, hence, not repeated here. The second reason is that the net-worth variable in the consumption function takes the effects of growth on consumer behaviour into account. This explains the link between growth and consumer behaviour in the system.

The difference between total assets and total liabilities (including both farm and personal) at the end of the previous year is taken at the market value. This is taken at the market value because people mostly think in terms of market value when they assess wealth.

The random term u in the consumption function gives the stochartic nature to the model. This term takes other factors such as religion, social status that influence the

consumer behaviour.

Investment Function

Two types of functions, one using cross sectional data and the other using panel data, are estimated for investment analysis as well. The data for variables included are taken in the following manner.

Investment

The value of investment is taken from the expenditure on investments in farm records. This includes the expenditure to purchase and improve land, buildings, additions to buildings and livestock in each year. Investment is taken in gross value including replacements of depleted assets. This is taken in terms of constant dollar value by deflating the investment value on separate items and then adding them together.

Savings

The difference between disposable income and consumer expenditure is defined as savings. In the present study in addition to this, the depreciation allowance also is counted as savings. Since the disposable income and consumer expenditure are already deflated, the savings are taken in terms of constant dollar value. Therefore, the depreciation allowance also deflated by the composite

machinery and equipment price index.

External Funds

The data regarding the funds borrowed in each year is not available. This was estimated by using the farm liabilities. The positive difference between the year end farm liabilities and the farm liabilities at the beginning of the year is taken as the amount borrowed during the year. If this is negative, it is considered as a repayment of debt and the amount borrowed is considered to be zero.

The random term u in the investment function takes the other factors, such as interest rate, rate of return on investment, which influence the investment decisions, into account.

The Measurement of Growth

The change in net-worth of farm is taken as the growth or performance measure of the system. The justification for using this measure to explain growth is discussed in the conceptual framework and theoretical consideration.

The growth is measured as a percentage change in net-worth in each time period. This involves two variables. One is the change in net-worth during the time period. The method of determining the value of change in net-worth is explained in the discussion of objective function. The method of deriving the other variable, the net-worth at the

beginning of the time period is discussed in this section.

Net-worth is the difference between the total assets of the farm-household and total liabilities. Total assets include the values of land and buildings, machinery and equipment, livestock, inventories of feed, grain, and material inputs, off farm investments and cash balances. Total liabilities include the money borrowed from outside institutions and persons. The data for these variables are taken from available farm records.

The difference between total assets and total liabilities is assumed to be invested on farm assets. For the purpose of taking the constant dollar value, this difference is deflated by a combined machinery and equipment, livestock, material inputs and crop price index. In arriving at this combined price index, the weights for each sector are given according to the value of assets, of each category, at the beginning of each time period. This deflated difference between total assets and total liabilities represents the net-worth of farm household.

The Flow-chart

The flow-chart in Figure 1 shows the relationships between various internal variables affecting the net-worth and, therefore, the growth of the system. The directions of flow of goods, service payments and receipts are indicated by arrows.

The service of capital goods, material inputs and labour used determined the level of gross farm income. Part of this generated gross income is paid as operating expenditure. Also, the depreciation allowance on depleting capital goods, deducted before arriving at net farm income.

Consumption behaviour of farm-household is affected by several factors. These are shown in the chart, by pointing arrows towards consumption. Disposable income is the major determinant of consumption behaviour. This is determined by adding off-farm income to the net farm income and by deducting total tax from total net income. Among other factors, which affect consumption, family size, previous year's consumption level, and net-worth are major ones. Previous year's consumption level indicates the consumption habits of family farms, while net-worth is indicating the wealth effect and the effect of farm growth on consumption.

The remaining portion of disposable income, after consumption, is the net savings of farm household. The depreciation allowance deducted from gross farm income is added to net savings. This portion of gross savings is utilized to replace the depreciated capital in production. The remaining portion of gross savings, i.e., net savings, increases the net-worth of family farm. This can be used in three ways. It can be used to repay the farm liabilities or can be invested on new capital goods or do any combination

of these two.

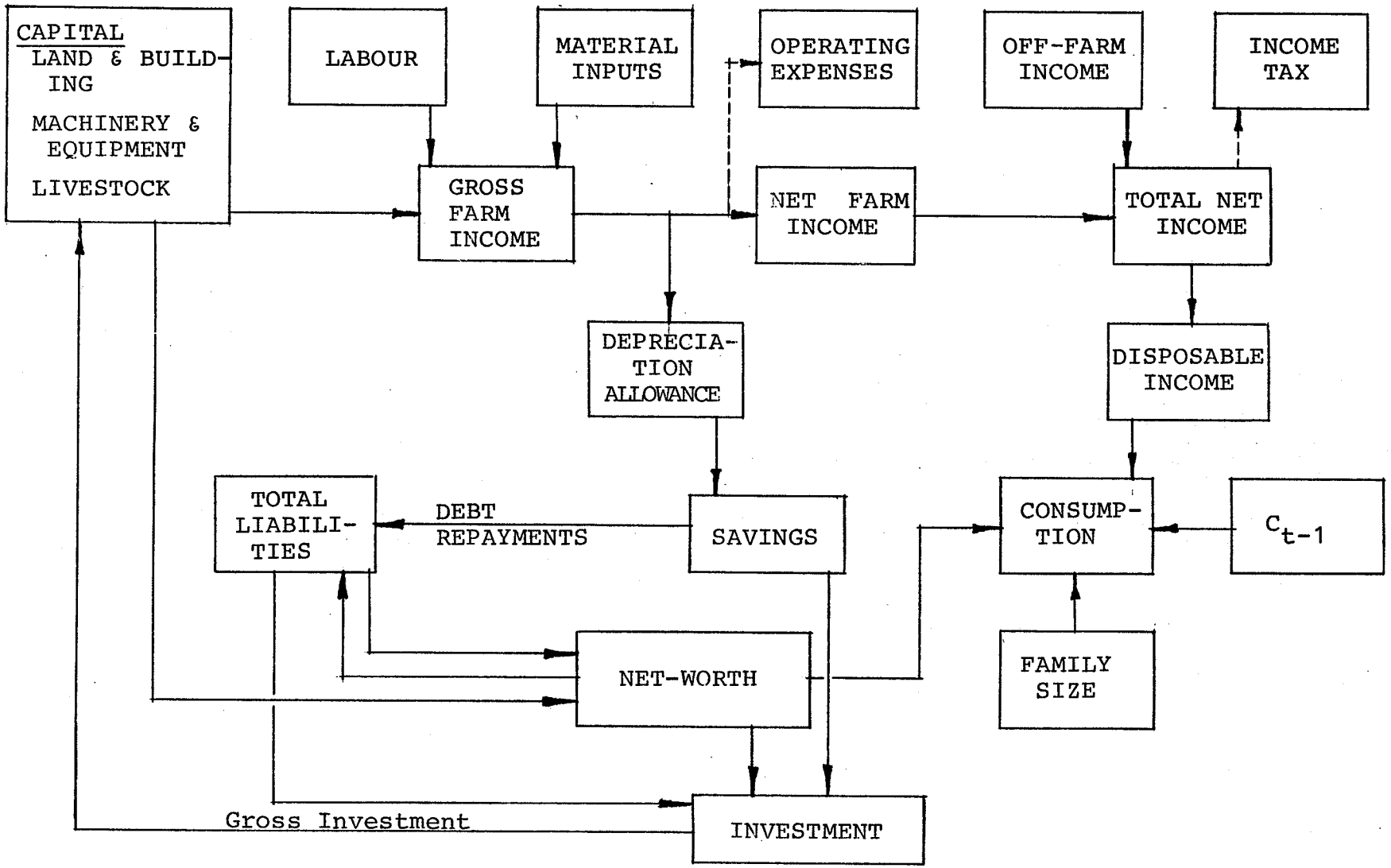
Repayment of debt increases the equity ratio or net-worth of family farm. On the other hand, credit is important to farmer in carrying out his future plans. The amount that can be borrowed is affected by the repayment capacity, and net-worth of the farm-household.

Investment, which is a major factor that determines the production capacity and, therefore, growth rate, is affected by savings, credit and previous year's net-worth. Gross investment determines the amount of capital input used in production.

Total investment on land and buildings, machinery and equipment, and livestock affects the production and therefore, farm income.

The net-worth, which is the indicator of growth, is determined by the total capital and total liabilities. The difference between total assets (capital) and total liabilities is represented by net-worth.

All the internal determinants explained in the flow-chart directly or indirectly affect the value of net-worth as well as the change in net-worth or growth rate. On the other hand, net-worth also influences other variables such as consumption, investments via ability to borrow. These interrelationships and interdependency among internal variables make the system very complicated to study by examining only one or two components.



THE FLOW CHART: INTER-RELATIONSHIP BETWEEN FACTORS AFFECTING THE GROWTH IN FAMILY FARM SYSTEM.

The analysis of econometric results, which were estimated on the basis of the model discussed in the present chapter is given in Chapter VI. In the following chapter, the general aspects of farms and the behaviour of economic variables during 1961-69 period in Western Manitoba farms are discussed before going into the analysis of econometric results in Chapter VI.

CHAPTER V

GENERAL ASPECTS OF THE FARMS STUDIED AND THE TRANSFORMATION TOOK PLACE DURING THE PERIOD

Area Studied

The area selected for the study is located in Western Manitoba approximately 50 miles north-west of Brandon. The study includes 23 Western Manitoba Farm Business Association member farms which have kept a set of continuous financial records from 1961 to 1969. The records provide the necessary information to study the growth process of the family farm firm during this period in Western Manitoba. The study is primarily concerned with the factors that influence long run economic growth. In looking at the over-all adjustment process, little emphasis is given to the factors such as product prices, factor prices, which influence the short run decisions.

Net-worth Situation of Farms

The transition that took place during the study period can be analyzed by looking at the change in farm net-worth situations among farmers during the period. The net-worth situations for the years 1961, 1965 and 1969 are given in Table I.

The average net-worth has increased during the period implying a growth in family farms in Western Manitoba. The average net-worth, which stood at $45,776 in 1961 rose to $75,577 and $121,500 in 1965 and 1969, respectively. This is

a 76.63 percent growth during the period 1961 to 1965 and 60.76 percent in the period 1965 to 1969. Classification of farms according to their net-worth situations should provide a good insight into the transition that took place during 1961-1969. This distribution is shown in Table II.

The number of farms with a net-worth of less than $50,000 has decreased from 15 in 1961 to 8 and 5 in 1965 and 1969 respectively. In 1965 there were 17 farms with a net-worth less than $75,000. By 1969, 10 out of these moved into a net-worth class of $75,000 or more. In 1961 there were only two farms with a net-worth more than $75,000; but by the end of the study period this number had risen to sixteen. This shift in the net-worth structure of farms is a result of the growth in farm output and income. Consideration of the growth of gross production, and other factors that influenced the growth in gross production, should give a clear understanding of the family farm growth in Western Manitoba.

TABLE I

AVERAGE NET-WORTH PER FARM AMONG WESTERN MANITOBA

23 FARMS IN 1961, 1965 AND 1969

	1961 $	1965 $	1969 $
Average net-worth including capital gains and losses	42,776	75,577	121,500
Percentage change during the periods		76.63	60.76

TABLE II

CLASSIFICATION OF FARMS ACCORDING TO THEIR NET-WORTH

Economic Class Dollars	1961		1965		1969	
	No.	%	No.	%	No.	%
Less than 24,999	4	17.4	4	17.4	0	0.0
25,000 to 49,999	11	47.8	4	17.4	5	21.7
50,000 to 74,999	6	26.0	9	39.1	2	8.7
75,000 to 99,999	1	4.4	4	17.4	8	34.8
100,000 and over	1	4.4	2	8.7	8	34.8
Total	23	100.0	23	100.0	23	100.0
Less than 75,000	21	91.2	17	73.9	7	30.4
75,000 and over	2	8.8	6	26.1	16	69.6

Farm Income - Gross

Table III provides the distribution of farms according to their gross profit. The number of farms of which the gross profit is less than $20,000 has decreased from 21 in 1961 to 16 and 13 in 1965 and 1969 respectively. In 1961 there was no farm with a gross profit of above $30,000, but in 1965 there were 4. By 1969 there were 7 farms in this economic class. The number of farms in the economic class of $20,000 and over gross profit has increased by 8 during the period from 2 in 1961 to 10 in 1969. Most farms have moved into larger producing units during this period. Average gross profit per farm has increased from $10,983 in 1961 to $18,574 and $24,510 in 1965 and 1969 respectively. This is an increase of 69.1 percent during 1961-65 and 32 percent during 1965-69 period. There has been a rapid growth in gross profit during 1961-65, but figures indicate a slower growth during 1965-69 period.

The major contributors for this growth are crop production and livestock operation. The growth in output and gross profit may have resulted from increased use of inputs as well as better use of inputs to increase efficiency and productivity. These factor inputs are land, building, machinery, labour and material inputs. The efficient use of external financial resources and rational allocation of income between consumption and re-investment may also have influenced the growth. An analysis of the changes that took place during the period may reveal the effects of these factors in augmenting produc-

TABLE III

CLASSIFICATION OF FARMS ACCORDING TO GROSS PROFIT

Economic Class Dollars	1961		1965		1969	
	No.	%	No.	%	No.	%
Less than 5,000	2	8.7	0	0.0	0	0.0
5,000 to 9,999	9	39.2	5	21.8	1	4.4
10,000 to 14,999	7	30.4	6	26.0	6	26.0
15,000 to 19,999	3	13.0	5	21.7	6	26.0
20,000 to 29,999	2	8.7	3	13.0	3	13.0
30,000 to 39,999	0	0.0	2	8.7	2	8.7
40,000 to 49,999	0	0.0	2	8.7	4	17.5
50,000 and over	0	0.0	0	0.0	1	4.4
Total	23	100.0	23	100.0	23	100.0
Less than 20,000	21	91.3	16	69.6	13	56.5
20,000 and over	2	8.7	7	30.4	10	43.6
Average gross profit per farm $	10,983		18,574		24,510	
Rate of growth during periods		69.1%		32%		

tion.

The two major economic activities of the farms in Western Manitoba are crop production and livestock operation. The distribution of farms according to the receipts from these two activities is given in Table IV.

Table IV shows the degree of involvement of farms in crop production and livestock operation during the study period. In 1961, the number of farms of which crop receipts were less than $7,500 was 18 while the number of farms which livestock receipts fell in this class was 15. In 1965 there was a little improvement with respect to crop receipts. The number of farms of which crop receipts were above $7,500 has increased by 3 to 8 while the number of farms in this class of livestock receipts has dropped by 1 to 7. During the period 1965-69 another 3 farms have moved up to $7,500 and above class in crop receipts, and 7 farms have moved to this class from less than $7,500 class in livestock receipts. A striking feature is that 5 farms have dropped livestock operation during 1965-69 period, in spite of the fact that the average livestock receipts per farm among 23 farms has increased.

Average crop receipts per farm increased from $4,880 in 1961 to $8,460 in 1965 and $9,987 in 1965. This is an increase of 73.3 percent and 18 percent during the periods 1961-65 and 1966-69 respectively. Average livestock receipts per farm among 23 farms has increased from $6,968 in 1961 to

TABLE IV

CLASSIFICATION OF FARMS ACCORDING TO CROP AND LIVESTOCK RECEIPTS

Economic Class Dollars	1961				1965				1969			
	Crop		Livestock		Crop		Livestock		Crop		Livestock	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
0*	0	0.0	1	4.4	0	0.0	1	4.4	0	0.0	6	26.1
0 - 2,500	6	26.1	5	21.7	2	8.7	0	0.0	1	4.4	1	4.4
2,500 - 5,000	10	43.4	5	21.7	3	13.0	8	4.8	4	17.4	0	0.0
5,000 - 7,500	2	8.7	4	17.4	10	43.5	7	30.4	7	30.4	2	8.7
7,500 - 10,000	1	4.4	3	13.0	4	17.4	2	8.7	3	13.0	4	17.4
10,000 - 15,000	3	13.0	1	4.4	1	4.4	0	0.0	4	17.4	3	13.0
15,000 and over	1	4.4	4	17.4	3	13.0	5	21.7	4	17.4	7	30.4
Total	23	100.0	23	100.0	23	100.0	23	100.0	23	100.0	23	100.0

* Economic class 0; Number of farms which were not in livestock operation is included in this class.

TABLE IV -- Continued

Economic Class Dollars	1961 Crop No.	1961 Crop %	1961 Livestock No.	1961 Livestock %	1965 Crop No.	1965 Crop %	1965 Livestock No.	1965 Livestock %	1969 Crop No.	1969 Crop %	1969 Livestock No.	1969 Livestock %
Less than 7,500	18	78.2	15	65.2	15	65.2	16	69.6	12	52.2	9	39.2
7,500 and over	5	21.8	8	34.8	8	34.8	7	30.4	11	47.8	14	60.8
Average per farm $	4,840		6,968		8,460		8,399		9,987		12,934	
Average per farm in operation $			7,285				8,780				16,567	
Change in average crop production				73.3%				18.0%				
Change in average livestock production				20.5%				54.0%				
Change in average livestock production per farm in operation				20.5%				88.7%				

$8,399 and $12,934 in 1965 and 1969 respectively. The increase is of 20.5 percent during 1961-65 and 54 percent during 1966-69. Average livestock receipts per farm in operation increased from $7,285 in 1961 to $8,780 in 1965 and $16,567 in 1969. This is an increase of 20.5 percent and 88.7 percent during 1961-65 and 1965-69 respectively.

During the period 1961-65 crop production has contributed the major share in the growth of gross receipts while during 1965-69 period livestock operation has become the leading contributor to gross receipts. The net contribution of these two components and their significance for the growth is not possible to determine because, the available data are not sufficient to determine the expenses that occurred in these two components separately. However, it can be hypothesized that towards the end of the study period, livestock operation was unprofitable, therefore, the farmers who were operating at the margin were forced to go out of business. Though it is not possible to determine the separate net contributions of crop and livestock components an investigation of total net income distribution and changes that occurred during the period may provide an insight of the growth process.

Farm Income - Net

The classification of farms according to their net income is shown in Table V. At the beginning of the study period majority of the farms were concentrated in the lower

TABLE V

CLASSIFICATION OF FARMS ACCORDING TO NET FARM INCOME

Economic Class Dollars	1961		1965		1969	
	No.	%	No.	%	No.	%
Less than 0	4	17.4	1	4.4	3	13.0
0 - 1,999	4	17.4	1	4.4	1	4.4
2,000 - 4,999	9	39.2	8	34.7	6	26.1
5,000 - 9,999	3	13.0	7	30.4	5	21.8
10,000 - 14,999	3	13.0	3	13.0	3	13.0
15,000 - 19,999	0	0.0	1	4.4	2	8.7
20,000 and over	0	0.0	2	8.7	3	13.0
Total	23	100.0	23	100.0	23	100.0
Less than 5,000	17	74.0	10	43.5	10	43.5
5,000 - 14,999	6	26.0	10	43.5	8	34.7
15,000 and over	0	0.0	3	13.0	5	21.8
Average net farm income $	3,750		7,313		8,049	
Percentage change in average net income		95%		10%		

group. In 1961 there were 4 farms operating at a net loss, which was reduced to 1 in 1965 and increased again to 3 in 1969. Altogether there were 17 farms in less than $5,000 net income group in 1961 this number declined to 10 in 1965. There was no improvement in this class during 1965-69. There were no farms which earned a net income of more than $15,000 in 1961; but at the end of 1969 there were 5 farms in this class.

Average net income per farm has increased from $3,750 in 1961 to $7,313 and $8,049 in 1965 and 1969 respectively. This gives another fact which supports the hypotheses that livestock operation was unprofitable during the latter period. During this period livestock operations have been the major contributor in the growth of total receipts. During the same period the growth of net income decreased to 10 percent from 95 percent in the previous period implying the leading sector in the gross income has eaten up most of the revenue as operating expenses. The analysis of the components in production and expenses may provide a basis to understand the reasons for slower growth in net income during the second half of the study period.

Land Use

Land is the major input in crop and livestock production. A classification of the structure of farms according to the area of land is shown in Table VI.

In 1961 there were 19 farms operating with a land base of less than 639 improved acres. During the period 1961-69.

TABLE VI

THE STRUCTURE OF FARMS ACCORDING TO IMPROVED LAND

Size group Acres	1961		1965		1969	
	No.	%	No.	%	No.	%
Less than 320	4	17.4	3	13.0	0	0.0
320 - 399	1	4.4	0	0.0	1	4.4
400 - 479	6	26.0	4	17.4	3	13.0
480 - 559	5	21.7	8	34.7	5	21.7
560 - 639	3	13.0	2	8.7	2	8.7
640 - 719	0	0.0	1	4.4	0	0.0
720 - 799	2	8.7	1	4.4	4	17.4
800 - 879	1	4.4	0	0.0	2	8.7
880 - 959	0	0.0	1	4.4	4	17.4
960 - 1,039	0	0.0	0	0.0	0	0.0
1,040 and over	1	4.4	3	13.0	2	8.7
Total	23	100.0	23	100.0	23	100.0
Less than 640	19	82.5	17	73.8	11	47.8
640 and over	4	17.5	6	26.2	12	52.2

TABLE VII

IMPROVED AND UNIMPROVED LAND PER FARM

(Acres)

	1961		1965		1969
Total land	775		666		976
Improved land	503		606		723
Percentage of improved total land	64.9		70.0		74.07
Percentage change in improved land		20.5%		19.3%	

additional land has been rented or bought and improved. By 1969 twelve farms had more than 640 acres of improved land. Average improved acreage per farm has increased from 503 acres in 1961 to 606 acres in 1965 and 723 acres in 1969. This is an increase of about 20 percent in each period. This increase in land base should have encouraged the introduction of new technology and enable farms to move downward on long run average cost curve. This would result in less cost per unit and additional and savings for re-investment.

Capital Investments

The proportion of improved land to total land has increased from 64.9 percent in 1961 to 74 percent in 1969. This improvement coupled with the additional land bought would have raised the use of other inputs such as machinery, material inputs, labour, and investments in livestock. The classifications of farms according to capital investment and components of capital are outlined in Tables VIII and IX.

In 1961 nineteen farms had a capital investment of less than 75,000. Fifteen out of this had moved up to the class of $75,000 and over by the end of the period 1961-69. In 1961 there were 13 farms with a capital investment of less than $50,000 but by 1969 all these have moved to upper classes. In 1961 there were no farms with a capital investment of $125,000 and over, but at the end of the period there were 9 farms in this group.

TABLE VIII

CLASSIFICATION OF FARMS ACCORDING TO CAPITAL INVESTMENT

Size group Dollars	1961		1965		1969	
	No.	%	No.	%	No.	%
Less than 25,000	3	13.0	0	0.0	0	0.0
25,000 - 49,999	10	43.5	3	13.0	0	0.0
50,000 - 74,999	6	26.1	7	30.4	4	17.5
75,000 - 99,999	2	8.7	4	17.5	7	30.4
100,000 - 124,999	2	8.7	4	17.5	3	13.0
125,000 - 149,999	0	0.0	3	13.0	3	13.0
150,000 and over	0	0.0	2	8.6	6	26.1
Total	23	100.0	23	100.0	23	100.0
Less than 75,000	19	82.6	10	43.4	4	17.5
75,000 - 149,999	4	17.4	11	45.0	13	56.4

TABLE IX

DISTRIBUTION OF AVERAGE CAPITAL INVESTMENT AMONG COMPONENTS

	1961		1965		1969	
	Value $	% of total	Value $	% of total	Value $	% of total
Land and Buildings	27,057	54.4	54,945	63.0	74,269	66.3
Livestock	9,950	20.0	11,352	13.0	13,010	11.6
Machinery and Equipment	12,725	25.6	20,907	24.0	24,755	22.1
Average investment per farm	49,732	100.0	87,204	100.0	112,034	100.0
Percentage Change			75.3		28.5	

This is a fast movement of farms from lower capital investment group to higher group. Total capital investment has increased by 75.3 percent between 1961 and 1965. This was 28.3 percent between 1965 and 1969 period. Though this is a growth augmenting factor, farmers can over invest in capital. This can be checked in the analysis of econometric results.

Land and building have been the major component of capital investment. Investments on land and buildings have increased almost three times. These values include the appreciation of land. Increasing land values do not increase output. However, as the additional land and buildings are a necessary component to increase the crop production, keep grain inventory, inputs and equipment, and livestock, the additions in lands and buildings can be considered as a growth augmenting factor.

The investment in livestock has increased throughout the period at a lower rate compared to the change in other components. The increase during the period has been about 50 percent. This might have been a result of the farmers dropping livestock operation due to less profitability. As was seen earlier, the average gross income from livestock has been always greater than the income from crop production. However, since the data regarding the distribution of cost is not available, it is not possible to say anything about the contribution of livestock investments for the growth.

The investments on machinery and equipment has nearly doubled during the period 1961-69. This change reflects the increase in both quantity and quality of the input. Additional

use of machinery and equipment could accelerate the growth and increase the labour productivity. Increase in investment on machinery and equipment would be useful only if the use of other inputs such as land and material inputs is increased accordingly.

Operating Expenditure

The use of material inputs in production during the period is shown in Table X. Data for material inputs used are not available, however, current operating expenses should provide a proxy for the expenditure on fertilizer, chemicals, fuel, seed, etc. This might have included the payments for hired labour, but since it is difficult to differentiate the expenditure on various types of inputs, current operating expenses have to be used to evaluate the influence of material inputs on growth.

Average current operating expenses per farm have increased by 55.7 percent during the period 1961 to 1965 from $5,000 in 1961 to $7,783 in 1965. This growth has reduced to 39 percent during 1965 to 1969, reflecting the slower growth in gross income during the same period as discussed above.

In 1961 there were 19 farms with less than $7,500 in current operating expenses and it has reduced to 14 and 11 in 1965 and 1969 respectively. Generally, the use of material inputs has increased during the study period. In 1961 there were 14 farms using less than $5,000 worth of material inputs, but in 1969 there was only 1 farm remaining in this group. The increased use of land inputs would have demanded an increase

TABLE X

CLASSIFICATION OF FARMS ACCORDING TO THE AMOUNT OF OPERATING EXPENDITURE

Expenditure Group - Dollars	1961		1965		1969	
	No.	%	No.	%	No.	%
Less than 2,500	4	17.4	0	0.0	0	0.0
2,500 - 4,999	10	43.4	11	48.0	1	4.4
5,000 - 7,499	5	21.7	3	13.0	10	43.5
7,500 - 9,999	2	8.7	3	13.0	3	13.0
10,000 - 12,499	1	4.4	3	13.0	4	17.4
12,500 - 14,999	1	4.4	0	0.0	2	8.7
Total	23	100.0	23	100.0	23	100.0
Less than 7,500	19	82.5	14	61.0	11	47.9
7,500 and over	4	17.5	9	39.0	12	52.1
Average per farm $	5,000		7,783		10,818	
Percentage change			55.7%		39.0%	

use of material inputs. The increased use of material inputs coupled with the increased use of capital inputs and land normally results in an increased gross profit. Realizing these relationships among production inputs, farmers have spent more money on current operating expenses.

Credit Utilization

Another factor that has to be considered in a growth study is the utilization of borrowed funds. Classification of farms according to the utilization of credit is given in Table XI. In 1961 all the farms were in the class of less than $30,000 groups of borrowed funds. This has changed during the study period towards increased use of credit. In 1965 there were 8 farms in the group of $30,000 and over in borrowed funds and this has increased up to 12 in 1969. There is a substantial increase in the use of borrowed funds during the 1961-1965 period. The increase has somewhat slowed down during the second half of the study period, again reflecting the slower growth in gross income. The proper use of credit is a powerful tool in accertaining a rapid growth. Increase in net-worth as a measurement of growth is related to the development of the size of farms that will require the use of modern technology. The available internal funds are very often not sufficient to finance the required land, machinery and other inputs that are needed for a rapid growth. In order to finance these needs the farmers must use borrowed funds.

TABLE XI

CLASSIFICATION OF FARMS ACCORDING TO THE UTILIZATION OF CREDIT

Value - Dollars	1961		1965		1969	
	No.	%	No.	%	No.	%
Less than 5,000	7	30.5	2	8.7	0	0.0
5,000 - 9,999	9	39.1	3	13.0	4	17.4
10,000 - 14,999	4	17.4	6	26.1	1	4.4
15,000 - 19,999	0	0.0	3	13.0	1	4.4
20,000 - 29,999	3	13.0	1	4.4	5	21.6
30,000 - 39,999	0	0.0	6	26.0	6	26.0
40,000 - 49,999	0	0.0	1	4.4	2	8.7
Total	23	100.0	23	100.0	23	100.0
Less than 30,000	23	100.0	23	67.2	11	47.8
30,000 and over	0	0.0	8	34.8	12	52.2
Average per farm $	8,376		22,259		34,311	
Percentage change		166%		54%		

Consumption Expenditure

So far we have discussed the income generating component and the factors affecting in the production of farm products, with the emphasis on changes that occurred in these factors during 1961 to 1969 in 23 farms of Western Manitoba. Another aspect of family farming, which affect the growth, is farm family consumption. This is an important factor which is very often overlooked in the studies of family farm growth. Consumption expenditure is a portion of income flowing out of the business for ever, and therefore, retard the growth to a certain extent. In Table XII it can be seen the average consumption expenditure per farm family has increased during the study period from $3,463 in 1961 to $4,527 and $6,231 in 1965 and 1969 respectively. This is an increase of 30.7 in the former period and 37.6 in the latter period. One interesting feature in consumption behaviour is that the increase in consumption expenditure has been rapid in the second period regardless the decline in the rate of growth in gross and net farm income. This increase in consumption expenditure might have indirectly affected the growth of income in the second period.

Table XII shows that 14 out of 23 farm families were in the less than $4,000 group of consumption expenditure in 1961. During the period 1961 to 1969 the situation has improved and by 1969 the number in that class has decreased to 4. There were no farm families in the class of $8,000 and

TABLE XII

CLASSIFICATION OF FARM FAMILIES ACCORDING TO THEIR CONSUMPTION EXPENDITURE

Value Class Dollars	1961		1965		1969	
	No.	%	No.	%	No.	%
Less than 2,000	3	13.0	1	4.4	0	0.0
2,000 - 3,999	11	47.8	6	26.0	4	17.4
4,000 - 5,999	8	34.8	9	39.2	9	39.2
6,000 - 7,999	1	4.4	5	21.7	5	21.7
8,000 - 9,999	0	0.0	2	8.7	2	8.7
10,000 and over	0	0.0	0	0.0	3	13.0
Total	23	100.0	23	100.0	23	100.0
Less than 4,000	14	60.8	7	30.4	4	17.4
4,000 - 9,999	9	39.2	16	69.6	16	69.6
Average per family	$ 3,463		4,527		6,231	
Percentage change			30.7%		37.6%	

over in their consumption expenditure. However, there were 5 families in this group in 1969, out of which 3 were in the $10,000 and above group, implying an increase in the standard of living among Western Manitoba farm families.

A noticeable feature among Western Manitoba farms in 1961-69 period is the expansion of the size of operation. The average improved acreage per farm has increased by 44 percent from 503 acres in 1961 to 723 acres in 1969. Along with this increase in size, the average investment on farm machinery also has increased by 95 percent from $12,725 in 1961 to $24,755 in 1969. The more than proportional increase in machinery compared to the increase in land indicates that there was a trend towards more mechanization of farming in this period. The expanded size of farms requires additional use of material inputs. The use of material inputs has increased from $5,000 in 1961 to $10,818 in 1969 by 116 percent.

The 123 percent increase in production from $10,983 in 1961 to $24,510 in 1969 shows that the expansion of the size of operation and increased use of machinery and material inputs has generated more than proportional income compared to the increase in inputs. This indicates an increase in productivity of resources used, as well as, that the strategy of expanding farm operations in order to increase income has been successful during 1961-69 period among Western

Manitoba farms. The increases in the values of production, machinery and material inputs include the price changes as well as the increases in physical units. However, drastic price changes did not occur during 1961-69 period, therefore, the increases in the values are mainly due to the increases in physical units.*

The net farm income among Western Manitoba farmers has increased by 116 percent from $3,750 in 1961 to $8,049 in 1969. This increase in net farm income has resulted in an increase in consumption expenditure. The consumption has increased from $3,463 in 1961 to $6,231 in 1969 by 80 percent. This less than proportional increase in consumption expenditure, compared to the increase in net farm income, indicates that the farmers were saving more and more for investing in farms.

The expanded size of farms and the increased use of machinery are the results of more and more investments on farms. The major factor that influenced the investments has been the borrowings. The average borrowings per farm has increased from $8,376 in 1961 to $34,311 in 1969. The other factor that influenced investments is the savings within the farm. The net savings has increased from $287 in 1961

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*The price indexes show the following increases in prices during 1961-69 period:

Agriculture Products	3.4 percent
Farm Machinery	21.2 "
Material Inputs	20.6 "

to $1,818 in 1969. The large amount of borrowings and small amount of savings indicate that the main factor influenced investment, and therefore, farm growth is borrowings. This show that the farmers have taken advantage of credit leverage in expanding their operation.

The expansion of farm operation and increased use of machinery and material inputs have resulted in more production income. The ultimate results of these activities are the improvements in the standard of living and the increase in net-worth or the growth of family farms. The average net-worth per farm has increased by 184 percent from $42,776 in 1961 to $121,500 in 1969. This increase in net-worth includes the change in prices of assets. The price indexes show an increase of 55 percent in the price of land and buildings and 21.2 percent in machinery in 1961-69 period. The extremely high growth rate of net-worth indicates that even after allowing for the increases in prices, there has been a substantial increase in net-worth during 1961-69 period. The main factors that have influenced this high rate of growth is the increased production and the extensive use of credit.

The inter-relationships among the variables discussed so far affect the growth of family farm firm. The magnitude of the effect of various variables will be discussed in the next chapter on analysis of econometric results.

Chapter VI

ECONOMETRIC RESULTS AND INTERPRETATIONS

The tables in this chapter present the parameter estimates for the production function, the consumption function and the investment function. The significant levels of the estimates are stated in the following manner. An asterisk (*) indicates that the estimates are significantly different from zero at one percent level, two asterisks (**) indicate five percent significant level, three and four asterisks indicate ten and twenty percent significant levels respectively. The standard errors of estimates are given in parenthesis. The significance of R^2 is determined by using F-ratio. An asterisk indicates that the R^2 value is significantly different from zero, at one percent level and two asterisks indicate the five percent significant level. Durbin-Watson statistic is used to determine autocorrelation. The number sign (#) indicates that there is no autocorrelation, while the values without any sign indicate inconclusive ones. The correlation matrices are given in Appendix 1.

The production function.

The production functions were estimated by using Cobb-Douglas specification. The constant terms of the equations are given in real values rather than in logirithmic

values. The estimated coefficients of the production function for the years from 1961 to 1969 are shown in Table XIII. These production functions explain the gross production as a function of capital, labour and material inputs. The estimated parameters of the functions - the regression coefficients - are the elasticities of production with respect to the factors of production. These elasticities of production indicate the percentage change in output resulting from one percent change in input used. The marginal value production of factor inputs are given in the tables under the heading MVP.[49]

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[49] The marginal value productivities are calculated at the geometric means. Since the output is measured in dollar terms. The M.V.P.'s are same as the marginal productivities $(\frac{dy}{dx})$ of resources. It is calculated by using the following formula.

B_i = beta coefficients equal to the elasticities of production.

i.e., $Bi = \frac{dy}{dx_i} \cdot \frac{X_i}{y}$,

Therefore, $\frac{dy}{dx_i} = B_i \frac{Y}{X_i}$

Table XIII

PRODUCTION PARAMETERS AND MARGINAL VALUE PRODUCTIVITIES USING AGGREGATED CAPITAL FOR EACH YEAR DURING THE PERIOD 1961-69.

Year	K	MVP $	L	MVP_L	MI	MVP_{MI}	Constant	Sum of the Coefficient	R^2	F-Ratio	D.W. Ratio
1961	-0.0258	-0.0073	0.6197	4554.87	0.4694***	1.08	212.22	1.0633	0.5615	10.37*	1.82#
	(0.329)		(0.485)		(0.209)						
1962	0.6085*	0.2396	0.1341	1363.55	0.1846****	0.55	4.79	0.9272	0.8478	41.83*	1.69#
	(0.111)		(0.177)		(0.121)						
1963	0.5133*	0.1801	0.4708***	4515.00	0.0709	0.18	27.64	1.055	0.8161	33.54*	1.75#
	(0.147)		(0.254)		(0.152)						
1964	0.4687**	0.1542	-0.5103***	-5748.18	0.6306*	1.82	0.53	0.589	0.8102	32.31*	1.70#
	(0.168)		(0.269)		(0.138)						
1965	0.4263***	0.1244	-0.2858	-3166.14	0.5976*	1.53	0.91	0.7381	0.7626	24.55*	1.81#
	(0.209)		(0.272)		(0.206)						
1966	0.5506**	0.1854	-0.0947	-1305.97	0.5131*	1.42	0.51	0.969	0.8387	39.14*	1.64#
	(0.204)		(0.190)		(0.155)						
1967	0.4698*	0.1581	0.0892	-1449.51	0.5267*	1.47	1.09	0.9075	0.8480	41.90*	1.99#
	(0.144)		(0.216)		(0.143)						
1968	0.2213	0.0713	0.0936	1717.46	0.5181*	1.32	16.60	0.833	0.7499	22.99*	1.35#
	(0.198)		(0.154)		(0.144)						
1969	0.0542	0.0178	0.1892	3203.78	0.7725*	2.08	10.92	1.0159	0.7214	19.99*	1.70#
	(0.245)		(0.319)		(0.219)						

The interpretation of coefficients of factor inputs are included in the following sections.

Capital

The estimated coefficients of capital are significant at one percent or above levels in the years 1962, 1963 and 1967. In the years 1964 and 1966 they are significant at five percent level. The coefficient is significant at ten percent level in 1965. In rest of the years, the coefficients are not significant at any of the above specified levels. This may be an indication that the capital is not closely related to the gross production during these years. The coefficient in 1961 is negative. This may be due to over employment of capital inputs in proportion to the other inputs. The drought weather conditions also might have affected the productivity of capital in this year resulting in a negative MVP for capital. The MVP's of capital in other years range from $0.0178 in 1969 to $0.2396 in 1962. The capital inputs are measured in terms of stock concept. Therefore, the MVP values represent the percentage return on the capital investment. During the period 1962 to 1967, the return on capital has been over 12.44 percent per annum. This was a return greater than the market interest rate.[50] The high returns on capital during this period indicate that the

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[50]Yeh, M.H. and Li, Lew-King. Technological Change in Canadian Agriculture. A six percent return on capital investments has been assumed in the estimation of technological changes in Canadian agriculture.

farmers were allocating their capital resources, by using good management techniques, to obtain gains from the marginal dollar invested.

The low insignificant values of capital coefficients in 1968 and 1969 may be attributed to a combination of several factors such as, increased use of capital inputs compared to other inputs, particularly material inputs, changes in the composition of capital input towards more land and buildings and the idle capacity of buildings due to the reduction in the level of livestock operation by some farmers and some farmers leaving livestock operation altogether.

The decreasing values of MVP indicate that the farmers were carefully expanding their capital investments until 1968. The low value of MVP in 1969 may be due to over employment of capital compared to other inputs.

Labour

The elasticity coefficients of labour are significant at ten percent level in the years 1963 and 1964, and they are significant at twenty percent level in the years 1961 and 1965. The coefficients are not significant at these levels in the rest of the period. This lack of significance may be due to the imprecise measure of labour. Labour is measured in terms of man equivalent, in which a unit of labour is equal to an adult male of average capacity employed for a period of twelve months. The man equivalent measure of labour is inefficient in takeing the small variations of labour employed into account. Therefore, in any given period small changes in labour employed is not precisely taken into account while the small changes in other inputs and outputs are counted for. It would be expected that

the true labour input would be closely related to the variation in other inputs such as land, machinery, livestock and material inputs.

The elasticity coefficients in the years from 1964 to 1967 are negative indicating that as the use of labour is increased the output decreases. This may be a result of over employment of labour in these years compared to other inputs.

The MVP's of labour range from $-5,748.18 in 1964 to $4,554.87 in 1961. The MVP of labour represents the productivity of marginal unit of labour employed. In four years out of nine, the MVP's were negative and in two out of the remaining five the MVP's are less than $2,000.00. These negative values of MVP indicate that the farmers were poor in management techniques to obtain a sufficient gain for labour. This may be due to poor management techniques used in allocation and combination of resources.

Material Inputs

The elasticity coefficients of material inputs in the years 1964 to 1969 are significant at one percent level. The coefficient in the years 1961 and 1962 are significant at ten and twenty percent levels respectively. The coefficient in 1963 is not significant at the above specified levels indicating that there was no close relationship between output and material inputs used in that year. The MVP's of material inputs during the period range from $0.18 in 1963 to $2.08 in 1969. The MVP explains the gross return on marginal dollar spent on material inputs. The figures indicate that

in 1961 and during the period 1964 to 1969 the net return on marginal dollar spent range from $0.08 in 1961 to $1.08 in 1969. This implies that the farmers were using material inputs at a profit during these years. Theoretically the farmers can increase the use of material inputs up to a level where the MVP equals to price.[51] However, the risky nature of agricultural operations makes the farmers alert and they use less inputs than if no risk is involved. The net returns in the years except in 1961 are substantially high indicating the farmers were not using the input sufficiently. The gross profit could have been increased by expanding the use of material inputs during these years. The net gains from the use of material inputs in the years 1962 and 1963 are $-0.45 and $-.082 respectively. That means the farmers have lost these amounts for every marginal dollar spent on material inputs. This may be a result of over employment of material inputs and unfavourable weather conditions.

The MVP's calculated on the basis of the elasticity coefficients with 95 percent confidence intervals show that there is a 95 percent probability of using material inputs with a $0.29 profit at the margin in 1962. The same procedure shows that the loss in 1963 could be as low as $0.02 at the margin, on material inputs.

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[51] The market price would be an expenditure of $1.00 plus the current interest rate.

In general the elasticity coefficients of all the variables in each year are less than unity indicating that all the resources had diminishing marginal returns.[52] The positive coefficients represent the second phase of production while negative coefficients representing third phase of production indicating losses occurred due to the use of inputs at the levels used.

The overall performance of the production component of the system in management's point of view can be analyzed using the marginal value productivity/price ratios of the inputs. The combination of inputs which gives maximum net farm income is attainable when,

$$\frac{MVP_C}{P_C} = \frac{MVP_L}{P_L} = \frac{MVP_{MI}}{P_{MI}}, \text{ under competitive systems.}$$

Otherwise, the prices should be replaced with marginal costs.

The ratios shown in Table XIV show that the farmers have not attained this efficient combinations in any of the years in 1961-69 period. The ratio for capital in 1961 is negative and lower than the ratios for labour and material inputs indicating that the farmers could have increased the net income by reducing the use of capital in that year. The higher ratio for labour indicates that the net income could have been increased by increasing the use of labour input. The ratio for capital in the period 1962-67 is greater than the ratio for labour and material inputs in the same period.

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[52] Haver, Cecil B. "Economic Interpretation of Production Function Estimates". In Resource Productivity Returns to Scale and Farm Size. Edited by Earl O. Heady, et. al. (The Iowa State College Press, Ames, Iowa, 1956), p. 147.

TABLE XIV

MARGINAL VALUE PRODUCTIVITY/PRICE RATIOS

Year	Capital*	Labour**	MI***
1961	-0.146	2.100	1.029
1962	4.356	0.625	0.521
1963	3.602	2.010	0.171
1964	2.869	-1.446	1.727
1965	2.212	-1.258	1.449
1966	3.156	-0.486	1.341
1967	2.300	-0.508	1.375
1968	1.056	0.590	1.237
1969	0.230	1.034	1.930

*The interest rates for the calculation of the MVP_C/P_C ratio is taken from 1969-70 Annual Report of the Farm Credit Corporation.

** The hourly rate of wages paid in Manitoba for workers without board is taken in calculating the MVP_L/P_L ratio.

***The ratio of MVP_{MI}/P_{MI} is calculated taking $1.00 plus the interest rate of the year as the cost of material inputs.

This again indicates the inefficient combination of resources The net income in that period could have been increased by expanding the use of capital input. The negative ratios for labour in 1964-67 period indicate the over employment of labour input. The use of this input should have been reduced to a point where MVP equals marginal cost. The MVP/Price ratios for material inputs is higher than the ratio for capital and labour in 1968 and 1969. The net income in these two years could have been increased by expanding the use of material inputs.

In general the MVP/Price ratios of inputs for the same year are different from each other indicating that the farmers were not able to use proper management techniques in coordination of resources to obtain maximum net income. The resources were not efficiently used. The ratios, which are less than one imply that the marginal return of that input is less than the marginal cost, or under competitive situations the price of the input. This indicates that the farmers were using the input at a loss. The farmers could have increased their net income by reducing the use of these inputs.

The coefficients of multiple determination, R^2's for the estimated functions range from 0.5615 in 1961 to 0.8478 in 1962. This coefficient explain the percentage of variations in the dependent variable, which on the average, is associated with the explanatory variables. The R^2 values in all the years are statistically significant at one percent

level or above. Except in 1961, the R^2 values are greater than 0.7214 in the period, indicating more than 72.14 percent of the variations in output is explained by capital, labour and material inputs. In five out of nine years, this ratio was greater than 80 percent.

The coefficient of production functions estimated by using panel data for the periods 1962-69, 1962-65 and 1966-69 are presented in Table XV. The elasticity coefficients of capital and material inputs are significant at one percent or above levels in these periods. The coefficients of labour input are not significant in any of these periods. This may be due to the imprecise measurement of labour as explained above.

The elasticity coefficient of capital has decreased from 0.453 in 1962-65 period to 0.3094 in 1966-69 period. This may be due to the increased use of capital inputs in the latter period. The MVP of capital has also decreased from \$0.1534 in 1962-65 period to \$0.1027 in 1966-69 period. This decrease in MVP verifies the above statement of increased use of capital inputs. This is related to the law of diminishing returns which explains that as the use of one input is increased, given the level of other inputs the marginal productivity of that input decreases.

The elasticity coefficient of material inputs has increased from 0.3822 in the period 1962-65 to 0.5626 in the period 1966-69. This indicates that any increase in use of

Table XV

PRODUCTION PARAMETERS AND MARGINAL VALUE PRODUCTIVITIES USING AGGREGATED CAPITAL AND PANEL DATA FOR THE PERIODS 1962-69, 1962-65 AND 1966-69.

Independent Variable	1962-69	1962-65	1966-69
Capital	0.4068*	0.4530*	0.3094*
	(0.058)	0.075)	(0.097)
MVP - $	0.1364	0.1534	0.1027
Labour	0.0054	0.0009	0.1086
	(0.064)	(0.121)	(0.092)
MVP - $	80.83	9.43	1762.95
Material inputs	0.4750*	0.3822*	0.5626*
	(0.052)	(0.080)	(0.077)
MVP - $	1.29	1.04	1.52
Constant	3.26	4.37	4.32
Sum of Coefficients	0.8872	0.8361	0.8946
R^2	0.8015	0.7782	0.7900
F-Ratio	247.24*	107.45*	115.13*
D-W Ratio	1.82#	1.79#	1.83#

material inputs would have increased output in the latter period more than that of former period. The MVP also has increased from $1.04 in the first period to $1.52 in the second period. Higher MVP in the second period indicates that the material inputs have not been used sufficiently to increase output. The farmers could have used capital and labour productively in this period by expanding the quantity of material inputs used.

The MVP of labour has increased from $9.43 in the period 1962-65 to $1762.96 in the period 1966-69. This increase in marginal value product may be a result of the increased use of capital inputs in the second period. The MVP of labour in both periods were less than sufficient indicating that the labour input was not used productively in any of the periods. The productivity of labour could have been increased by increasing the use of other inputs particularly capital in the first period and material inputs in the second period. Else, the unproductive excess labour could have been taken away from farm operations.

The MVP's of capital, labour and material inputs during the period 1962-69 were $0.1364, $70.83 and 1.29 respectively. This indicates that the capital and material inputs were used productively gaining an average of 13.64

percent annual return on marginal dollar invested in capital and net return of $0.29 on the marginal dollar spent on material inputs.

The R^2 value in the period 1962-69 was 0.8015 indicating that 80.15 percent of variations in output during this period was explained by capital labour and material inputs. The R^2 values from the periods 1962-65 and 1966-69 were 0.7782 and 0.7900 respectively. These R^2 values were significant at one percent or above levels.

The sums of elasticities represent the return to scale in each period. During the period 1962-69 this was 0.8872 indicating diminishing return to scale. During the periods 1962-65 and 1966-69 these values were 0.8361 and 0.9806 respectively, also indicating diminishing returns to scale.

The estimated elasticity coefficients of production function on the basis of disaggregated capital in per labour terms for each year during the period 1961-69 are given in Table XVI. This disaggregated form of capital would show the contribution of components of capital to marginal returns.

Real estate per labour

The estimated coefficients are significant at one percent level in 1964 and 1966. The coefficients are significant at five percent level in 1965 and 1967. In 1962 and 1963 they are significant at twenty percent level. In

Table XVI

PRODUCTION PARAMETERS AND MARGINAL VALUE PRODUCTIVITIES USING DISAGGREGATED CAPITAL IN PER LABOUR TERMS FOR EACH YEAR DURING THE PERIOD 1961-69.

Year	Real Estate per Labour	MVP $	Machinery and Equipment per Labour	MVP $	Livestock per Labour	MVP $	Material Inputs per Labour	MVP $	Constant	R^2	F-Ratio	D.W. Ratio
1961	0.0699	0.0457	0.0222	0.0203	0.0032	0.0082	0.4404****	1.01	87.37	0.1080	1.67	1.82#
	(0.205)		(0.221)		(0.031)		(0.266)					
1962	0.1565***	0.1468	0.3900*	0.4642	0.0283****	0.0828	0.1188	0.35	20.99	0.6689	12.11*	1.73#
	(0.092)		0.079		(0.020)		(0.132)					
1963	0.1746****	0.1461	0.2890*	0.3024	0.0232	0.0593	0.1194	0.30	41.04	0.3862	4.46**	1.90#
	(0.118)		(0.090)		(0.021)		(0.138)					
1964	0.5710*	0.3731	0.0499	0.0541	-0.0392	-0.0945	0.2948***	0.89	3.33	0.6935	13.44*	2.22#
	(0.148)		(0.116)		(0.030)		(0.160)					
1965	0.3440**	0.2027	0.1573	0.1474	0.0210	0.0794	0.4971**	1.27	1.13	0.6193	9.95*	2.27#
	(0.136)		(0.176)		(0.025)		(0.228)					
1966	0.3759*	0.2425	-0.0043	-0.0045	0.0104	0.0807	0.6354*	1.76	1.40	0.7778	20.26*	1.71#
	(0.107)		(0.183)		(0.016)		(0.170)					
1967	0.1771	0.1620	0.1741	0.1843	0.0336*	0.7431	0.5817*	1.62	0.92	0.7739	19.82*	2.25#
	(0.112)		(0.136)		(0.011)		(0.149)					
1968	0.0652	0.0353	0.0771	0.0851	0.0228***	0.8056	0.5789*	1.46	22.17	0.7952	22.36*	1.34#
	(0.144)		(0.157)		(0.011)		(0.155)					
1969	0.0771	0.0438	-0.1081	-0.1210	0.0209	0.5532	0.8368*	2.26	12.56	0.5626	8.07*	2.04
	(0.158)		(0.187)		(0.016)		(0.183)					

rest of the years they are not significant at any of the above specified levels. This would indicate that the available land and buildings were not used to their full capacity during these years. Any of the coefficients of real estate, machinery or livestock in 1961 is not significant. This indicates that these inputs were not closely related to the output in that year. Poor yields resulted from unfavourable weather conditions might have affected the productivity of resources in this year. This is reflected by the very low MVP's of resources in 1961.

The MVP of real estate input during the period ranges from $0.0353 in 1968 to $0.3731 in 1964. During the years from 1962 to 1967 this input has been used productively. The returns on marginal dollar invested in real estate had been greater than 14.61 percent during this period. The higher values of MVP in the years of 1964, 1965 and 1966 implies that the use of this input could have been expanded to yield a greater output. The low MVP in the years 1968 and 1969 indicates that the real estate input has been over employed.

Machinery per labour

During the period the coefficient of machinery and equipment were significant at one percent level only in 1962 and 1963. The coefficients in the years 1965 and 1967 are significant at forty and thirty percent levels respectively.

The general insignificant situation might be a result of over-employment of resources in machinery and equipment. This can be verified from two factors. One is the low MVP's in these years and the other is the negative coefficients in the years 1966 and 1969.

The MVP's of machinery and equipment range from $-0.121 in 1969 to $0.3024 in 1963. Machinery and equipment have been productively used only in four years during the period. This implies that the farmers were poor in management techniques in order to obtain a greater return for their resources. In five years within this period the resources invested in this input have been used at a loss.

Livestock per labour

The estimated elasticity coefficients of this input in the years 1962, 1967 and 1968 are significant at twenty, one and ten percent levels respectively. The coefficients in all the other years are not significant at these levels. This general insignificant situation indicate that there was no close relationship between output and investments on livestock. The negative coefficient in 1964 indicates the over employment of resources in livestock compared to other inputs.

The MVP's of livestock during the period range from $-0.0945 in 1964 to $0.8056 in 1968. The higher MVP's in the years from 1967 to 1969 indicate that towards the end of the period the farmers have not made use of livestock

enterprise to increase their gross profit. Had the investments on livestock been expanded during these three years the farmers could have yielded a greater return for their investments on land.

Material inputs per labour

The coefficients of material inputs per labour are significant at one percent level in the years from 1966 to 1969. They are significant at five percent, ten percent and twenty percent levels in 1965, 1964 and 1961 respectively. The MVP of this factor range from $0.30 in 1963 to $2.26 in 1969. The low MVP's in the years from 1962 to 1964 indicate that this factor has been over employed. From 1965 to 1969 material inputs have been used productively. As stated earlier had the use of material inputs in these years been increased, the farmers could have gained a higher output together with a productive use of other resources.

The MVP/Price ratios for disaggregated capital shown in Table XVII again indicate that the resources were not efficiently used. The ratios for the inputs in the same period are different from each other. The high ratio for machinery in 1962-63 indicates that the farmers should have incresed the use of that input. The higher ratios for land in 1964-66 period again indicate that the net income could have been increased by expanding the land base. The higher rates for livestock in 1967-69 period indicate that the farmers could have increased their net income by expanding the livestock

TABLE XVII

MARGINAL VALUE PRODUCTIVITY/PRICE RATIOS

OF DISAGGREGATED CAPITAL

Year	RE	ME	LVK	MI
1961	0.914	0.406	0.164	0.962
1962	2.669	8.44	1.505	0.332
1963	2.992	6.048	1.186	0.286
1964	6.941	1.007	-1.758	0.845
1865	3.604	2.620	1.412	1.202
1966	4.128	0.077	1.374	1.660
1967	2.356	2.681	10.809	1.516
1968	0.523	1.261	11.935	1.368
1969	0.565	-1.561	7.138	2.097

The prices of inputs are taken as explained in Table XIV.

operations. The higher ratios for material inputs in 1968-69 compared to the ratios for land and machinery indicate that the net increase could have been increased by expanding the use of material inputs.

The R^2 values range from 0.1080 in 1961 to 0.7952 in 1968. All the R^2 values but the ones in years 1961 and 1963 are significant at one percent level. R^2 value in 1963 is significant at five percent level. The low and insignificant R^2 value in 1961 indicate that variations in output in that year are not explained sufficiently by the independent variables. This may be due to the effects of unfavourable weather conditions on productivity of resources.

The coefficients of production function with disaggregated capital in per labour terms for the periods 1962-69, 1962-65 and 1966-69 are given in Table XVIII. These coefficients were estimated using panal data. All the coefficients, except for the coefficient of machinery and equipment in the period 1966-69 and coefficient of livestock in the period 1962-65 are significant at one percent level. During the period 1962-69 all the inputs have been used productively. The real estate, machinery and livestock show MVP's ranging from \$0.1514 to \$0.1911. The MVP of material input was \$1.28. This higher values indicate that in the long run farmers were using their resources productively. The long run productive use of resources implies that the farmers were employing good long run management techniques, though they were not good short run managers.

Table XVIII

PRODUCTION PARAMETERS AND MARGINAL VALUE PRODUCTIVITIES USING DISAGGREGATED CAPITAL AND PANEL DATA IN PER LABOUR TERMS FOR THE PERIODS 1962-69, 1962-65 AND 1966-69

Independent Variable	1962-69	1962-65	1966-69
Land and Buildings per labour	0.2310*	0.2122*	0.1945*
	(0.038)	(0.055)	(0.062
MVP - $	0.1525	0.1583	0.1137
Machinery and equipment per labour	0.1780*	0.2632*	0.0250
	(0.047)	(0.058)	(0.080)
MVP - $	0.1911	0.2807	0.0270
Livestock per labour	0.0200*	0.0102	0.0215*
	(0.006)	(0.012)	(0.006)
MVP - $	0.1514	0.0292	0.4310
Material inputs per labour	0.4731*	0.2783*	0.6413*
	(0.053)	(0.084)	(0.077)
MVP - $	1.28	2.72	1.73
Constant	3.88	11.35	5.70
R^2	0.7478	0.5680	0.7412
F-Ratio	136.67*	30.91*	66.15*
D-W Ratio	1.89#	1.83#	1.99#

The results of the two sub periods show that the coefficients of real estate and machinery have decreased in the period 1966-69 compared to that of in the period 1962-65, while the coefficients for livestock and material inputs have increased in the period 1966-69. The MVP's of inputs have changed in opposite direction except of material inputs. The MVP of real estate has decreased from $0.1583 in 1962-65 period to $0.1137 in 1966-69 period. The MVP of machinery and equipment has dropped drastically from $0.2807 in the first period to $0.0270 in the second period. The MVP of material inputs has decreased from $2.72 in the former period to $1.73 in the latter period. These drops in MVP's imply that in the second period the use of those inputs have been expanded. The only input which shows an increase in MVP in the second period is livestock. This may be due to the contractions in investments on livestock enterprise.

The R^2 values in these periods range from 0.5680 in 1962-65 period to 0.7478 in 1962-69 period. All the R^2 values are significant at one percent or above levels. The sums of coefficients range from 0.7639 in 1962-65 period to 0.9021 in 1962-69 period.

Technological change

Technological change in Western Manitoba farms is measured using the Slow model and results are presented in Table XIX. This table also presents the total values of gross output, material inputs, net output, capital stock and

TABLE XIX

MEASUREMENT OF GROSS AND NET GEOMETRIC GROWTH RATES OF TECHNOLOGICAL CHANGE IN WESTERN MANITOBA 1961-69

Year	1 Gross Output 1961 Prices $	2 Material Inputs 1961 Prices $	3 Net Output 1961 Prices $	4 Capital Stock 1961 Prices $	5 Labour Man Equivalents	6 Share of Capital in Gross Output	7 Share of Capital in Net Output	8 Share of Material Inputs in Outputs	9 Share of Labour in Gross Output	10 Share of Labour in Net Output	11 Year to Year Rates of Change in Technology Gross Measure	12 Year to Year Rates of Change in Technology Net Measure	13 Cumulated Technology Change Gross Measure	14 Cumulated Technology Change Net Measure
1961	253,210	125,008	138,202	869,657	31.40	0.2061	0.3776	0.4542	0.3397	0.6224	-	-	1.0000	1.0000
1962	354,984	126,949	228,035	919,784	33.94	0.1555	0.2420	0.3576	0.4869	0.7580	0.3164	0.6086	1.3164	1.6086
1963	348,425	145,297	203,128	997,744	35.20	0.1718	0.2947	0.4170	0.4112	0.7053	0.1087	-0.1523	1.2077	1.4563
1964	408,810	154,429	255,381	1,240,483	34.30	0.1821	0.2914	0.3753	0.4426	0.7086	0.1193	0.1968	1.3270	1.6531
1965	411,178	167,632	243,546	1,366,558	34.35	0.1994	0.3367	0.4077	0.3929	0.6633	-0.0528	0.0811	1.2742	1.5720
1966	506,760	187,488	319,272	1,436,599	33.76	0.1701	0.2700	0.3700	0.4599	0.7300	0.1879	0.2904	1.4621	1.8624
1967	540,811	200,457	340,354	1,580,639	30.88	0.1754	0.2787	0.3707	0.4540	0.7214	0.0627	0.0773	1.5248	1.9397
1968	521,526	221,637	299,889	1,609,224	27.32	0.1851	0.3220	0.4250	0.3899	0.6784	-0.0390	-0.1770	1.4858	1.7627
1969	545,198	206,619	338,579	1,558,244	28.94	0.1715	0.2761	0.3790	0.4495	0.7239	0.0370	0.1146	1.5228	1.8773
1961-69 Avg.	432,322	169,391	262,932	1,268,548	32.23	0.1797	0.2988	0.3952	0.4251	0.7012				

Notes: Columns (6) and (7) are calculated as $0.06 * \frac{(4)}{(1)}$ and $0.06 * \frac{(4)}{(3)}$ respectively assuming 6 percent interest rate return on all capital.

Column (8) = (2)/(1)

Column (9) = 1 - (6) - (8)

Column (10) = 1 - (7)

Column (11) = $\Delta(1)/(1) - (6)\frac{\Delta(4)}{(4)} - (8)\frac{\Delta(2)}{(2)} - (9)\frac{\Delta(5)}{(5)}$

Column (12) = $\Delta(3)/(3) - (7)\frac{\Delta(4)}{(4)} - (10)\frac{\Delta(5)}{(5)}$

Column (13) and (14) are calculated from (11) and (12) respectively, with 1961 = 1.

physical labour inputs during the period 1961-69. The values are deflated by price indexes based on 1961. The average values of relative shares of capital, material inputs and labour in gross output in this period are 0.1797, 0.3952 and 0.4251 respectively. The relative shares of capital and labour in net output are 0.2988 and 0.7012 respectively, based on the 1961-69 average. In both cases relative share of labour is quite high. This is because the residuals are taken as the share of labour and indicate that the management was able to extract more output from the available resources.

The technological index has risen from 1 in 1961 to 1.8773 in 1969 in net measure and to 1.5228 in gross measure. This rapid increase in index indicate that the Western Manitoba farmers were going through a technological revolution during this period.

From Table XIX it is possible to devide the total increase in net labour productivity (net output per man-equivalent) and gross labour productivity (gross output per man-equivalent) into two parts. One part can be measured by the shift of the aggregate production function which results from technological change, and the other by the movements along the production function attributable to the increased use of capital per man-equivalent. The calculated shares of factors are given in Table XX.

This table shows that the increased net labour productivity was 165.81 percent of which technological change accounted for 58.41 percent and capital intensity 41.59

Table XX

PERCENTAGE SHARE OF CAPITAL INTENSITY, MATERIAL INPUTS AND TECHNOLOGICAL CHANGE IN INCREASED NET AND GROSS LABOUR PRODUCTIVITY IN WESTERN MANITOBA 1961-69*

Classification	Labour Productivity		Capital Intensity	Material Inputs	% of Share Technological Change
	Total Increase	Annual Increase			
	---------- Percent ----------				
Net	165.81	18.42	41.59	-.-	58.41
Gross	133.62	14.85	16.69	36.72	46.59

*The method of calculation is given in Appendix II.

percent. The increase in gross labour productivity is 133.62 of which capital intensity accounting for 16.69 percent, material inputs for 36.77 percent, and technological change for 46.59 percent.

Such a division of increased labour productivity into those due to technological change and those attributable to capital intensity and material inputs is based on the assumption of constant return to scale. A test of the hypothesis of constant return to scale accepted at one percent level indicating that there was constant return to scale in 1961-69 period.**

The results show that the share of technological change in gross labour productivity was lower than that in net labour productivity. It was relatively low because a part of increased gross labour productivity has been attributed to the increased use of material inputs.

The consumption function

The elasticity coefficients estimated for consumption function, from cross sectional data, by using Cobb-Douglas formulation, for the years from 1962 to 1969 are shown in

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** The method of testing the constant return to scale hypothesis is explained in Appendix III.

Table XXI. The calculated values of APC and MPC are shown under these headings.[53]

Disposable income

The coefficients of disposable income are not significantly different from zero except for the years 1966 and 1967 which are significant at twenty and ten percent levels respectively. This imply that the consumption among farmers in Western Manitoba was not closely related to the income. The consumption among these farmers has influenced, to a greater extent, by consumption habits. This can be seen by an examination of coefficients of consumption lagged by one year. The APC during this period range from 0.4827 in 1966 to 1.1356 in 1969. The APC 1.1356 in 1969 is contradictory to the basic hypothesis in consumer theory.

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[53] The average propensity to consume and marginal propensity to consume are abreviated as APC and MPC respectively. The APC and MPC are calculated at geometric mean. The MPC is calculated by using the following formula:

B_{yd} = elasticity coefficient of disposable income

i.e. $$B_{yd} = \frac{\frac{dc}{c}}{\frac{d_{Yd}}{Yd}} = \frac{dc}{dYd} \cdot \frac{Yd}{C}$$

Therefore; $$\frac{dc}{d_{Yd}} = B_{Yd} \cdot \frac{c}{Yd}$$

i.e., MPC equals APC times elasticity coefficient at disposable income.

Table XXI

THE CONSUMPTION PARAMETERS, AVERAGE PROPENSITY TO CONSUME AND MARGINAL PROPENSITY TO CONSUME FOR EACH YEAR DURING THE PERIOD 1962-69.

Year	Y_{dt}	C_{t-1}	Family Size	NW_{t-1}	Constant	APC	MPC	R^2	F-Ratio	D-W Ratio
1962	0.1833	0.6287*	0.0093	-0.0650	8.33	0.4919	0.0902	0.6219	10.06*	2.16#
	(0.167)	(0.185)	(0.152)	(0.130)						
1963	0.0299	0.7614*	0.0424	-0.0339	7.58	0.8294	0.0248	0.6576	11.56*	1.66#
	(0.032)	(0.166)	(0.120)	(0.122)						
1964	0.0981	0.6134*	0.2414*	0.0816	3.66	0.6138	0.0602	0.8291	27.69*	0.845
	(0.088)	(0.126)	(0.084)	(0.077)						
1965	0.0253	0.5671*	0.1343	0.2101**	2.72	0.7563	0.0191	0.8187	25.84*	1.16
	(0.054)	(0.152)	(0.119)	(0.089)						
1966	0.2691****	0.8177*	0.1425	-0.0515	0.63	0.4827	0.1299	0.7833	20.88*	2.24#
	(0.162)	(0.242)	(0.146)	(0.152)						
1967	0.1535***	0.6822*	0.1926****	0.0899	1.21	0.6690	0.1027	0.8411	30.11*	1.81#
	(0.077)	(0.146)	(0.117)	(0.118)						
1968	0.0087	0.5289*	0.2801**	0.2244***	2.99	0.8277	0.0072	0.8135	25.00*	1.40
	(0.060)	(0.166)	(0.130)	(0.137)						
1969	0.0.232	0.7107**	0.2333	0.0337	4.76	1.1356	0.0263	0.6291	10.33*	1.52
	(0.308)	(0.225)	(0.218)							

This greater than unity APC indicate that the farmers have consumed more than what they have earned in that year. The APC is low in high income years and high in low income years indicating that the farmers were maintaining their consumption at a somewhat constant level. The higher MPC in 1969 is a result of the low income in that year. The farmers have been reluctant to change their consumption habits, therefore some of the savings from the previous periods have been spent on consumption. This is indicated by a negative growth in 1969 as shown in Table XXV. The MPC in this period range from 0.0072 in 1968 to 0.1299 in 1966. The low values of MPC reflect the behaviour of farmers, to a certain extent. That is, the farmers were maintaining their lifestyle at a certain level and therefore, most of the additional income is directed towards re-investment in farms.

Consumption habits

The consumption habits among farmers are represented by the consumption expenditure lagged by one year period. All the elasticity coefficients except for the one in 1969 are significantly different from zero at one percent level. In 1969 it is significant at five percent level. The coefficients range from 0.5289 in 1968 to 0.8177 in 1966 and they have relatively high values. This implies that the consumption behaviour among farmers was mostly influenced

by habits. This situation explains the insignificant coefficients of disposable income. The higher coefficient of lagged consumption in 1969 explains, to a certain extent, the greater than unity APC in that year.

Family size

The elasticity coefficients of family size in the years 1964, 1967 and 1968 are significantly different from zero at one, twenty and five percent levels respectively. The coefficients in other years are not significant at the levels specified above. This may be due to the inclusion of one period lagged consumption in the function. Lagged consumption represents consumption habits which, to a certain extent, is dependent upon the family size. The coefficient of family size range from 0.0093 in 1962 to 0.2801 in 1968. The highest coefficient is one of the significant ones indicating that there is a relationship between consumption level and family size among farmers.

Net-worth lagged by one year

The elasticity coefficients of net-worth are significant in the years 1965 and 1968 at five and ten percent levels respectively. The coefficients of other years are not significant at these levels. The hypothesized relationship between consumption and net-worth is positive. However, in 1962, 1963 and 1965 they have turned out to be negative.

This indicates that as the net-worth increases the farmers reduces their consumption. This might be a result of reduction in consumption in order to invest more in the farms. Except for those three years, the coefficients in other years indicate that the farmers increase their consumption as the net-worth increases. The coefficients range from -0.0650 to 0.2244. As in the case of family size the largest coefficient is one of the significant ones indicating that there is a positive relationship between consumption level and net-worth of family farm.

The R^2 values range from 0.6919 in 1962 to 0.8411 in 1966 indicating that a greater part of variations in consumption expenditures is explained by disposable income, consumption lagged by one year period, family size and net-worth of family farm. These R^2 values are significant at one percent level in all the years.

The elasticity coefficients of consumption function estimated with panel data for the periods 1962-69, 1962-65 and 1966-69 are shown in Table XXII.

The coefficients of disposable income, lagged consumption and family size are significantly different from zero at one percent level during 1962-69 period indicating that there is a definite relationship between long run consumption and these variables. The coefficient of lagged net-worth is significant only at thirty percent level. In the long run, as in short run, the consumption level among farmers is

Table XXII

THE CONSUMPTION PARAMETERS, AVERAGE PROPENSITY TO CONSUME AND MARGINAL PROPENSITY TO CONSUME FOR THE PERIODS 1962-69, 1962-65 AND 1966-69.

Independent Variable	1962-69	1962-65	1966-69
Disposable income	0.0412*	0.0325****	0.0466**
	(0.016)	(0.023)	(0.023)
Lagged consumption	0.6819*	0.6332*	0.7003*
	(0.060)	(0.077)	(0.101)
Family size	0.1507*	0.1106***	0.2141*
	(0.045)	(0.058)	(0.077)
Lagged net-worth	0.0445	0.0739****	0.0544
	(0.035)	(0.048)	(0.069)
Constant	5.34	6.58	3.58
R^2	0.7614	0.7354	0.7533
F-Ratio	146.97*	64.24*	70.47*
D-W Ratio	1.71#	1.64#	1.68#

mainly determined by habits. This is indicated by the high value of lagged consumption. The APC and MPC during this period are 0.6819 and 0.0412 respectively. The relatively high APC indicate that in the long run the farmers spend a substantial portion of their income on consumption goods. The very low value of MPC shows that even in the long run the farmers spent most of their additional income on investments.

The coefficients in the periods 1962-65 and 1966-69 are significant at one, five, ten and twenty percent levels except for the coefficient of lagged net-worth in the second period, indicating that there was no close relationship between consumption and wealth of farmers during this period. All the coefficients except for that of lagged net-worth have increased in value in the second period indicating that the farmers have tended to increase their consumption expenditure. This may be due to relatively less requirements of further investments, since as the time passes the investment requirements are fullfilled, or it may be due to the increase in family size as the children grow with the passage of time. The second fact, i.e., increase in family size, is more likely to happen and it can be seen from the almost doubled coefficient of family size from 0.1106 in the first period to 0.2141 in the second period.

Both APC and MPC have increased in value from 0.6597 and 0.0214 in the former period to 0.7422 and 0.0346 in the latter period respectively. This may be an indication that the farmers increase their consumption as their wealth or

net-worth increases.

The R^2 values of these periods are significant at one percent level, and indicate that 76.14 percent of variations in consumption during the period 1962-69 is explained by income, family size, habits and net-worth. The R^2 values in the periods 1962-65 and 1966-69 are 0.7354 and 0.7533 respectively. They indicate that a substantial portion of variation in consumption is explained by the independent variables in both periods.

Investment function

The estimated coefficients of linear investment function are given in Table XXIII. The values of coefficient indicate the change in investment result in a unit change in the particular variable other variables held constant. The investment function explain the investments in farm capital such as land and buildings, machinery and equipment and livestock as a function of savins lagged by one year period, farm credit and net-worth lagged by one year period.

Savings lagged by one year period

The coefficients of savings are significant at one, five, ten and twenty percent levels except for that of 1969. They range from -0.0456 in 1969 to 1.7226 in 1965. The coefficients have increased from 1.1201 in 1962 to 1.7226 in 1965 except for the drop in 1964. Since 1965 the coefficients have dropped steadily. This is consistent with the increase

TABLE XXIII

THE INVESTMENT PARAMETERS FOR EACH YEAR DURING THE PERIOD 1962-69.

Year	S_{t-1}	CR_t	NW_{t-1}	Constant	R^2	F-Ratio	D-W Ratio
1962	1.1201**	0.3556**	0.0328	542.62	0.2354	3.26**	1.68#
	(0.426)	(0.159)	(0.051)				
1963	1.5204*	0.8342	-0.0411	-708.43	0.4932	8.14*	1.41#
	(0.526)	(0.261)	(0.064)				
1964	0.6478***	-0.0988	0.0611	2106.43	0.1152	1.95	1.70#
	(0.551)	(0.180)	(0.059)				
1965	1.7226*	0.7542*	-0.0203	888.23	0.6996	18.07*	2.2#
	(0.419)	(0.153)	(0.042)				
1966	1.1173***	0.7043**	0.0317	453.65	0.1941	2.77	2.28#
	(0.594)	(0.271)	(0.062)				
1967	0.9090***	-0.0124	0.0599	-3478.50	0.3536	5.01*	1.65#
	(0.475)	(0.216)	(0.048)				
1968	0.5767****	0.7907*	0.0178	-1024.60	0.7076	18.75*	1.86#
	(0.345)	(0.114)	(0.025)				
1969	-0.0456	1.5482*	-0.0021	4790.39	0.7329	21.12	1.28
	(0.412)	(0.212)	(0.027)				

in the coefficient of income in consumption function in 1966-69 period. During this period, the farmers have not only increased their consumption but they have not invested all their savings in farm capital. The negative coefficient in 1969 may be a result of negative savings in 1969 as we have seen from greater than unity APC in consumption function. However, the coefficients in other years indicate that the savings is a major determinant of investment behaviour among farmers.

Farm credit

The coefficients of farm credit in 1963, 1965, 1968 and 1969 are significantly different from zero at one percent level. The coefficients are significant at five percent level in 1962 and 1966. These significant coefficients indicate that there was a definite relationship between investment and farm credit. The coefficients in 1964 and 1967 are negative and not significant at the above specified levels indicating that the investment and farm credit were not closely related in these years. This may be understood by going back to the coefficients of savings in these years. They indicate that only a part of a dollar saved was invested in farm capital. The other part might have been used to retire debt. Therefore, on the average the farmers have taken negative credit in these years. The negative coefficients therefore, might have resulted from this situation.

Net-worth lagged by one year period

The coefficients of net-worth are not significant except in 1967, which is significant at thirty percent level. This indicate that there was no close relationship between net-worth and investment on farm capital. The available farm records show that most of the farmers had substantial amount of off farm investments. The purpose of including the net-worth variable in the investment function was to take the effects of these off farm investments on farm investments into account. The insignificant coefficients indicate that there was no such an effect. However, the effects of these off farm investments might have been indirectly included in the coefficient of farm credit. This is because the net-worth of farms is one of the factors affecting the amount that can be borrowed. The R^2 values range from 0.1152 in 1964 to 0.7329 in 1969. They are significant at one percent level except in the years 1962, 1964 and 1966. The R^2 value in 1962 is significant at five percent level, but others are not significant at these levels indicating the variation in investment in these years are not explained by independent variables. The R^2 values are relatively low except in 1965, 1968 and 1969. These low R^2 values indicate that the variations in investments are not sufficiently explained by independent variables.

The estimated coefficients of investment function in the periods 1962-69, 1962-65 and 1966-69 are given in Table XXIV.

TABLE XXIV

THE INVESTMENT PARAMETERS FOR THE PERIODS

1962-69, 1962-65 AND 1966-69.

Independent Variable	1962-69	1962-65	1966-69
Lagged savings	0.8666*	1.2020*	0.6783*
	(0.159)	(0.231)	(0.222)
Farm Credit	0.5851*	0.4501*	0.6819*
	(0.072)	(0.093)	(0.106)
Lagged Net-worth	0.0194****	0.0253	0.0304****
	(0.013)	(0.027)	(0.019)
Constant	816.07	367.58	-323.11
R^2	0.3822	0.4302	0.3758
F-Ratio	38.74*	23.91*	19.26*
D-W Ratio	1.70#	2.05#	1.69#

The coefficients of savings and farm credit are significant at one percent level and the coefficient of net-worth significant at twenty percent level in 1962-69 period. This indicates that all three variables are closely related with investment. Particularly, the significant net-worth coefficient indicates that in the long run off farm investments or net-worth influences the investment decisions even though it is not the case in the short run.

The coefficients of farm credit and savings are significant at one percent level in both 1962-65 and 1966-69 periods. However the coefficient of net-worth is not significant in the first period but significant at twenty percent in the second period. The coefficient of savings has decreased from 1.202 in the first period to 0.6783 in the second period. The coefficient of farm credit has increased from 0.4501 in the first period to 0.6819 in the second period. Going back to consumption behaviour in the second period, the changes in investment function indicate that the farmers have consumed more of their income and have depended on external capital for investment in this period.

The R^2 values range from 0.3758 in 1966-69 period to 0.4302 in 1962-65 period. The R^2 value in 1962-69 period is 0.3802. They all are significant at one percent level. The low R^2 values in investment functions indicate that the variations in investments are not sufficiently explained by the independent variables.

The growth process

The growth of net-worth in family farms is taken as the criterion for growth. The growth of net-worth of family farms depends upon the production, in turn which depends upon investment on capital, consumption expenditure and other expenses such as operational expenses and taxes. The estimated coefficients of production function, consumption function and investment function of the system are combined for the periods 1962-69, 1962-65 and 1966-69 and presented in this section. The growth rates of net-worth are calculated in these periods as well as the annual rates of growth and presented in Table XXV.

The functional form of the change in net-worth is;

$$NW = Y(K, L, MI) - OE + OFI - T - C(Y_{dt}, C_{t-1}, F, NW_{t-1}) \quad \text{---(1)}$$

and $K = K(I(S_{t-1}, CR_t, NW_{t-1})$ ------- (2)

Substituting (1) into (2)

$$NW = Y[K(I(S_{t-1}, CR_t, NW_{t-1}), L, MI] -$$

$$C(Y_{dt}, C_{t-1}, F, NW_{t-1}) - OE + OFI - T \quad \text{-------(3)}$$

The period from 1962 to 1969

The estimated production function is;

$$\hat{Y} = 3.26\ K^{0.4068}\ L^{0.0054}\ MI^{0.4750} \quad \text{-------(4)}$$

The consumption function;

$$\hat{C} = 5.34\ Y_{dt}^{0.0412}\ C_{t-1}^{0.6819}\ FS^{0.1507}\ NW_{t-1}^{0.0445} \quad \text{---(5)}$$

The investment function;

$$\hat{I} = 816.07 + 0.8666\ SAV_{t-1} - 0.5851\ CR_t + 0.0194\ NW_{t-1} \quad -- (6)$$

Substituting (4), (5) and (6) into (3);

$$\hat{NW} = [3.26 * (816.07 + 0.866\ SAV_{t-1} + 0.5851\ CR_t + 0.0194\ NW_{t-1} + \bar{K})^{0.4068}\ L^{0.0054}\ MI^{0.4750}] - [5,34\ Y_{dt}^{0.9412}\ C_{t-1}^{0.6819}\ FS^{0.1507}\ NW_{t-1}^{0.0445}] + OFI - OE - T. \quad ----(7)$$

where $\bar{K}$ = investment in capital at the beginning of the period.

Equation (7) explain the change in net-worth as an increasing function of savings and net-worth lagged by one period, farm credit, amount of labour and material inputs used and off-farm income and as a decreasing function of disposable income, consumption and net-worth lagged by one period, family size, operational expenses and income tax. Previous period's net-worth has both positive and negative effects on change in net-worth. The negative effects of this is greater than the positive effect in this period. One percent increase in previous periods net-worth increases net-worth in current period by 0.0257 percent while it decreases present net-worth by 0.0445 percent.

The average increase in net-worth per farm per year during 1962-69 period was calculated using the average values of

economic variables.* This shows an increase of net-worth by $4,872 per year on the average in 1962-69 period.

The combined equations of the system for the periods 1962-65 and 1966-69 are as follows:

1962-65 period

$$\hat{NW} = [4.37 * (367.58 + 1.202\ SAV_{t-1} + 0.4501\ CR_t + 0.0253\ NW_{t-1} + \bar{K})^{0.453}\ L^{0.0009}\ MI^{0.3822}] - [6.58\ Y_{dt}^{0.0325}\ C_{t-1}^{0.6332}\ FS^{0.1106}\ NW_{t-1}^{0.0739}] + OFI - OE - T.$$

1966-69 period

$$\hat{NW} = [4.32 * (-323.11 + 0.6783\ SAV_{t-1} + 0.6819\ CR_t + 0.0304\ NW_{t-1} + \bar{K})^{0.3094}\ L^{0.1086}\ MI^{0.5626}] - [3.58 Y_{dt}^{0.0466}\ C_{t-1}^{0.7003}\ FS^{0.2141}\ NW_{t-1}^{0.0544}] + OFI - OE - T.$$

During the first period the growth is mostly influenced by investment in farm capital while in the second period it is influenced by labour and material inputs used. Also, in the first period savings within the system has been a major factor while in the second period farm credit has taken

*The average values of the economic variables and calculations of net-worth are given in Appendix IV.

the place of savings as a major factor that influenced the growth.

The average increases of net-worth during the 1962-65 and 1966-69 periods were also calculated using average values of economic variables in the respective periods. There have been average increases of net-worth by $3,399 and $7,030 in 1962-65 and 1966-69 periods respectively. The large increase in 1966-69 period compared to 1962-65 period indicate that the influences of labour and material inputs in the second period have been more powerful than the influence of capital in 1962-65 period in increasing net-worth. Also, The large increase in net-worth in the 1966-69 period indicate the effectiveness of the use of credit in increasing net-worth. There has been an extensive use of credit in 1966-69 period compared to 1962-65 period when the investments were mostly funded by internal savings.

The growth rates presented in Table XXV were calculated from the data obtained from farm records. The values are taken in terms of 1961 dollars.

The table shows that during the period 1962-69 the growth rate was 118.12 percent. The growth rates for the period 1962-65 and 1966-69 were 53.51 percent and 42.08 percent respectively. The annual growth rates range from -0.0011 percent in 1969 to 26.16 percent in 1964. The negative growth rate in

TABLE XXV

THE GROWTH RATES OF FAMILY FARMS IN WESTERN MANITOBA

IN THE PERIOD 1962-69.

Time Period or Year	Net-worth at the beginning average per farm	Net-worth at the end average per farm	Change of net-worth during the period	Percentage change	Ave. Annual Percentage change
	$	$	$		
1962-69	42,776	93,298	50,522	118.2	14.78
1962-65	42,776	65,665	22,889	53.51	13.38
1966-69	65,665	93,298	27,623	42.08	10.52
1962	42,776	47,214	4,438	10.37	
1963	47,214	48,953	1,739	3.68	
1964	48,953	61,758	12,805	26.16	
1965	61,758	65,665	3,907	6.33	
1966	65,665	75,388	9,723	14.81	
1967	75,388	88,019	12,631	16.75	
1968	88,019	94,647	6,628	=0.0011	
1969	94,647	93,298	=1,349		

1969 is a result of the consumption, which is greater than the income as indicated by the greater than unity APC. The various factors that influenced the different growth rates in different years and periods are related to the behaviour of production, consumption and investment in those years and periods. These have already been discussed under those sections, hence not repeated here.

The analysis of econometric results in the present chapter has shown the contribution of production, consumption and investment components to the growth of the system. In the following chapter, the forecasting results of 1974 variables and the economic situation of Western Manitoba farms are discussed as a continuation of the analysis in the present chapter.

CHAPTER VII

EVALUATION OF THE FORECASTING RESULTS

The purpose of a research study on past behaviour of economic variables is to understand the relationship between economic variables and to use the knowledge gained, in making policy guidelines. Since the policies are made for the future, the usefulness of a model in a study depends upon the reliability and accuracy in forecasting the future.

In the present chapter, the forecasting power of the model in the present study is tested using the information and data obtained from the Canfarm reports of Manitoba Department of Agriculture. Most of the data in these reports are not directly applicable in the present model, therefore, some adjustments were made. These adjustments are explained below under the heading of the particular variable. The size of the farm families among South-Western Manitoba* farmers is not given in these reports, therefore, it was estimated using the information obtained from Western Manitoba Farm Business Association (WMFBA) records. This is also explained below under the heading family size. The values of these independent variables as well as the 1974 observed values of dependent variables are given in Table XXVI.

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*The area refers to the Manitoba Department of Agriculture Administrative Region of South-Western Manitoba.

Predictions were done in two forms. One is point prediction, which gives a single value of dependent variable, the other is interval prediction, which gives a range within which the value of dependent variable most probably lie.

Production

The value of farm production in 1974 among South-Western Manitoba farms was estimated using the production function estimated from the data for the period 1962-69, which is given in Table XIV. The adjustments made to the independent variables are as follows:

Capital

The value of capital used in 1974 production is obtained from the Third Canfarm Report of the Manitoba Department of Agriculture.[54] The report provides the year end value of land and buildings, farm machinery and livestock. The depreciation value in 1974 was added to the total of these three items in arriving at the value of capital goods used in 1974 production.

Labour

The amount of labour used in 1974 production was obtained from the Third Canfarm Report. The model in the present study has included labour in terms of man-equivalents. The Canfarm Report does not provide the units of labour in

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[54] Manitoba Department of Agriculture, 1974 Manitoba Farm Business Summary. (Third Canfarm Report, Economic Report No. 25, July 1975, Economic Branch, MDA, prepared by T.J. Yudai).

TABLE XXVI

THE VALUES OF VARIABLES USED IN FORECASTING - 1974

Variable	Values obtained from Canfarm Reports	Value obtained from WMFBA Records
Production Function		
Capital	$122,216	
Labour	3.89 M.E.	
Material Inputs	16,043	
Consumption Function		
Disposable Income	11,848	
Lagged Consumption	7,291	
Family Size	N.A.	3.025 Adults
Lagged Net-worth	131,464	
Investment Function		
Savings	5,946	
Farm Credit	3,594	
Growth Equation		
Capital Investment at the beginning of 1974	111,177	
Operating Expenditure	18,283	
Income Tax - 1974	3,985	

terms of man-equivalents. Instead they are given in dollar values. These include two types of labour values, hired labour and family labour. These were converted into labour hours deviding by $2.52 and $2.12 respectively.[55] The number of hours then converted to man-equivalents.

Material Inputs

The value of supply and service purchases given in Canfarm Report was taken in estimating the value of material inputs. Adjustments for inventory changes and for supply and services used by home were made in arriving at the value of material inputs used in 1974 production. The value of "other fixed purchases" given in the income and expenditure statement of the report was added to the adjusted supply and service purchases.

Comparison of predicted production with 1974 observed value.

Point prediction, interval prediction and test of significance were done using the values in terms of natural logs and then converted into real values. This is because the model has been estimated in Cobb-Douglas form.

The point prediction of 1974 production is $38,196. The observed value of production in 1974 was $39,684. This is an under-estimation of $1,488 or 3.9 percent. This difference may be due to the weather factor which is not

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[55]Manitoba Department of Agriculture, 1974 Yearbook, Manitoba Agriculture. (Queen's Printer for the Province of Manitoba), p. 41. $2.12 is the average rate per hour with board and $2.52 is the average rate per hour without board, paid in Manitoba in 1974. In this forecasting, hired labour is assumed to be paid $2.52.

TABLE XXVII

COMPARISON OF FORECASTED AND OBSERVED VALUES

IN 1974

Variable	Predicted Values	Observed Values	Difference	Percentage Difference
Production	$38,196	$39,684	$1,488	3.9
Consumption	6,735	4,781	1,954	29.0
Investment	10,622	11,039	417	3.93
Growth Rate	10.03	10.00		0.03

INTERVAL PREDICTION*

Variable	Minimum Values	Maximum Values	Confidence Level
Production	24,763	58,918	95%
Consumption	4,322	10,497	95%
Investment	2,918	18,326	70%

TEST OF SIGNIFICANCE**

Variable	Critical 't' value with 95% probability	Calculated 't' value	Results
Production	1.96	0.1728	No significant difference between observed and predicted values.
Consumption	1.96	1.5137	
Investment	1.96	0.0561	

*Interval prediction is done by estimating confidence intervals for point predictions, using the following formula

$$\hat{V}_F \pm (t_{\text{probability level}})\ \hat{\sigma}_{V_F}$$

Table XXVII Continued.

where,

$\hat{V}_F$ = point prediction of the variable

$\hat{\sigma}_{V_F}$ = Standard error of the forecast of the variable.

**The test of significance is done to find out whether there is a significant difference between observed and predicted values. The method is as follows:

Test the Null Hypothesis

$$H_o: V_A = \hat{V}_F$$

against the Alternative Hypothesis

$$H_a: V_A \quad \hat{V}_F$$

V_A = Actual observed value of the variable

$\hat{V}_F$ = Predicted value of the variable.

The formula

$$t^* = \frac{V_A - \hat{V}_F}{\hat{\sigma}_{V_F}}$$

If t* is less than the value obtained from t Table with a given probability level and relevant degress of freedom we accept Null Hypothesis. Otherwise reject the Null Hypothesis and accept alternative hypothesis.

included in the model. In the present model weather is not counted as an explanatory variable. Therefore, the effects of climatic condition on production are not explained. They are included in the error of u term of the model. The difference between observed and predicted production, therefore, can be counted as a result of weather factor which is not included in the model.

The interval prediction was done by estimating confidence interval for the point prediction. The interval prediction for 1974 production shows that the production in that year is expected, with 95 percent probability, to be between $24,763 and $58,918.

The test of significance of the difference between 1974 actual production and predicted production shows that there is no significant difference between actual and predicted values. "The observation is compatible with the estimated relationship. In this case we accept that the predictive power of our model is good." [56]

The Consumption

The consumption expenditure among the South-Western Manitoba farmers was estimated using the consumption function given in Table XXI, which was estimated for the period 1962-1969. The adjustments made to the variables

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[56] Koutsoyiannis, A., op.cit., p. 479.

in consumption function are explained below:

Disposable Income

The amount of disposable income in 1974 was estimated using information in the Third Canfarm Report and WMFBA records. Disposable income was estimated by deducting 1974 income tax from net farm income given in Canfarm report. The tax was estimated using 1974 tax guide. The number of dependents in farm families are not given in Canfarm report. This was estimated taking the average number of dependents from WMFBA records.

Lagged Consumption

The consumption expenditure in 1973, among farmers in South-Western Manitoba region was estimated using 1973 Second Canfarm Report.[57] The consumption expenditure is not given in the report. It was estimated by conducting a cash flow analysis.**

Family Size

An estimation of family size was done using the WMFBA records. This is because Canfarm Report does not provide information regarding family size. The average family size

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[57]Manitoba Department of Agriculture. Manitoba Farm Business Summary. (Second Canfarm Report. No. 24, July 1974, Economics Branch, M.D.A., prepared by T. J. Yudai).

**The cash flow analysis is given in Appendix V.

in Western Manitoba during the period 1961-69 was taken as the family size in 1974. This was converted into adult units using the table on page 69 .

Lagged Net-worth

The value of lagged net-worth was directly taken from 1973 Second Canfarm Report.

Comparison of predicted consumption with 1974 observed value

The point prediction of 1974 consumption is $6,735. The observed value of consumption in 1974 is $4,781. The difference is $1,954 or a 29 percent over estimation. This large difference is mainly due to the omission of the value of the service of house, from the observed value. This value is not availabe even in initial records of farms. Since the prediction has taken this value into account the actual consumption might not have been very much different from predicted value. Apart from this, the difference may be due to the factors such as religion, social status, which are not included in our model. These factors, particularly social status, affect the consumption habits. Since these factors are not included in the model the effects of them are shown by the error term, or the difference between actual and predicted values.

The interval prediction of 1974 consumption shows that the consumption in that year is expected to lie between

$4,322 and $10,497 with 95 percent probability.

The test of significance of the difference between 1974 observed consumption and predicted consumption shows that there is no significant difference between actual and predicted values, indicating that the predictive power of the model is good.

Investment

The investment function, which was estimated from 1962-69 data and given in Table XXIV was used in estimating 1974 investments in South-Western Manitoba farms. The values of explanatory variables were obtained in the following manner:

Savings

The savings in 1973 were estimated using the information available in Canfarm Report. The difference between disposable income and consumption expenditure was taken as savings. The disposable income and consumption expenditure were estimated using information available in Canfarm Report.***

Farm Liabilities

The amount of credit obtained during 1974 was estimated using information given in the Third Canfarm Report. The available information gives the year end farm liabilities

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***The method of estimation of consumption expenditure is given in Appendix IV.

and percentage change in farm liabilities during 1974. This information was used in estimating credit obtained during 1974.

Comparison of predicted investment with 1974 observed value

The predicted value of investment, using linear investment function, in 1974 is $10,622. The observed value of investment in the same year was $11,039. This is an underestimation of $417 or 3.93 percent. This difference in point prediction may be due to the omission of factors such as rate of interest, rate of return on investment, which influence the investment decisions. The effects of these factors on investment are accounted for by error term, and therefore,represented in the difference between actual and predicted value.

The interval prediction on investment was estimated at 70 percent probability. This is because the large standard error makes the minimum limit negative, if estimated at 95 percent probability. The interval prediction shows that the investment in 1974 was expected to be between $2,918 and $18,326, with 70 percent probability.

The test of significance of the difference between 1974 actual and predicted investment shows that there is no significant difference between observed and predicted values, indicating that the model has good predicting power.

Farm Growth

The rate of growth of net-worth in South-Western Manitoba region farms in 1974 was estimated using the growth equation presented in page 143. The equation was formulated by combining the estimated production, consumption and investment functions.

The growth rate of net-worth was estimated before and after tax deductions. The predicted growth rate, after tax deductions, shows a 7.0 percent growth in net-worth in 1974. This is a more realistic situation than before tax rate of growth, because the farmers have to pay tax on their income. However, the Third Canfarm Report has not considered the income tax in calculating the rate of growth in net-worth. The rate of growth given in the report is 10.0 percent. The predicted rate of growth, before tax deduction, is 10.03 percent. There is a 0.03 percent over-estimation of growth rate. This is mainly due to the over-estimation of production, and under-estimation of consumption due to omission of some variables in those functions.

In general, the statistical tests have shown that the predicting power of the model is good. The predicted values of production, investment and the rate of growth has come very close to the actual values. The only exception is consumption model. It also might have been very close to the actual values, if the rented value of the house is counted.

Economic aspect of farms in 1974

The values of variables of production which are obtained from 1974 CANFARM report and, given in Table XXVI show that in 1974 South-Western Manitoba farmers have produced $39,684 worth of farm products using $122,216 worth of capital, manpower of 3.89 man-equivalents and $16,043 worth of material inputs. The use of more and more inputs, compared to 1969 values, has generated more farm income. This indicate that the increase in size of operation and the use of material inputs have been worthwhile in generating more income. A portion of this increased value of production may be due to price hikes experienced in 1973-74 period. However, the farmers have acted rationally by increasing the use of inputs to take the advantage of price hikes of products.

The productivity analysis of these inputs shows that the MVP's of capital, labour and material inputs in 1974 were $0.1321, $55.08 and $1.17 respectively. The MVP/Price ratio for capital labour and material inputs in that year were 1.6, 0.01 and 1.08 respectively. The less than unity ratio for labour indicate that this input was not productively used. The use of labour should have been reduced to a level where MVP equals its marginal cots.

The disposable income in 1974 was $11,848. This low disposable income compared to high gross production in 1974 indicate that the operational expenses and tax have shared a large portion of gross income. However, a monthly average

net income of $1,000 indicates that the farmers were earning a high income from farming. The consumption in 1974 was $4,781. This shows that the APC was 0.4, indicating that on the average the farmers have spent less than half of their income on consumption.

The savings among these farmers in 1974 amounted to $5,946. In addition to these savings they have obtained $3,594 worth of credit, on the average. The borrowing among these farmers has decreased during 1969-74 period from $34,311 in 1969 to $3,594 in 1974 on the average. The large amount of savings resulted from high income has been the major factor that influenced the investments in 1974. The investment in farm capital in 1974 was $11,049. The low amount of borrowings and high savings indicate that a large portion of this investment expenditure has come from the savings within the farm. These investments on farm capital will be more useful in increasing farm output and income in the future, as shown in the analysis of WMFBA farms.

The net-worth has increased from $131,464 in 1973 to $140,661 in 1974. This is an increase of $9,197 or 7.0 percent. The percentage increase indicates that the growth rate is low compared to the 14.78 percent average annual growth rate of net-worth during the period 1962-69. However, an increase of $9,197 in net-worth within a one year period is not a small increase. The major factors that influenced this increase in net-worth are the high income and low

consumption. The already higher net-worth position among farmers at the end of 1973 was the reason for the low percentage rate of growth shown in 1974.

The values of production, capital investment and material inputs used in 1974 show an increase in output and inputs compared to 1969. However, these values include the drastic price hikes experienced in the farming industry during 1973-74 period. The increase in the value of output and inputs may be due to the increases in both price and quantity. The increased use of capital inputs and material inputs might have resulted in increased output. The farmers have acted rationally, consuming a small portion and saving a large part of their income. The savings have been invested in the farm for future production. This has resulted in a substantial increase in average net-worth in South-Western Manitoba farms.

So far, we have considered the behaviour of economic variables during 1961-74 period in Western Manitoba. The following chapter presents a brief summary of this analysis together with the implications and conclusions.

CHAPTER VIII

SUMMARY AND CONCLUSION

The objective of the present study is to identify and analyze the effects of the internal determinants of the family farm growth in Western Manitoba. The determinants are easily separated into two groups on the basis of type of decisions that have to be taken by farmers. Family farms have to consider both farm and family in their day to day decision making as well as long run planning. These decisions are related to production in the farm and consumption in the family. The available resources limit the activities in both of these areas. Therefore, the growth rate of family farms mainly determined by the decisions made by farmers regarding the allocation of resources among these two components.

Among the farms included in the study, the net-worth has increased from $42,336 in 1961 to $93,298 in 1969. This is a growth of 120.4 percent during the nine year period, averaging 13.4 percent per year. The growth rates of individual years range from a minimum of -0.011 percent in 1969 to a maximum of 26.16 percent in 1964. The 1974 predictions indicate that the net-worth in that year was $140,661. This is an increase of $47,363 or a 50.76 percent during the 1969-74 period.

Gross production, as the major contributor to the growth, has increased from $10,083 in 1961 to $24,510 in 1969 on the average per farm. This is an increase of 123 percent in this period. Gross production in 1974 was $39,684. The increase in production compared to 1969 is $15,174 or 61.9 percent. A rapid increase in gross production as experienced by Western Manitoba farmers would augment growth in family farms depending on the consumption behavior. Among the factors that influenced this rapid increase in production are capital, labour, material inputs and management. They are considered as the internal determinants.

Capital consists of land and buildings, machinery and equipment and livestock. The farmers have increased their total capital investments in order to increase the production. The average capital investment per farm has increased from $49,732 in 1961 to $112,034 in 1969. The investment on land and buildings has increased from 54.4 percent of total investment in 1961 to 66.5 percent in 1969. The average improved acreage has increased from 503 acres in 1961 to 723 acres in 1969. Total capital investment has increased to $122,216 in 1974. This shows an increase of $10,182 or 9.09 percent.

This indicates that the farmers were expanding the size of their operations in order to increase production. Although land is a basic factor of production that is needed for production, the econometric results indicate that this input has not influenced the production in 1968 and 1969.

The MVP of land in these years was as low as $0.0353 for the marginal dollar invested. Probably the farmers were not able to improve their newly purchased land within the two years of 1968-69. However the large increase of $15,174 or 61.9 percent in production and the low increase of $10,182 or 9.09 percent in capital investment during the 1969-74 period indicate that the farmers have improved their previously owned unproductive land. The production in this period has been increased by improving the available land rather than expanding the size of operation.

Production can be increased by expanding capital investment on land and machinery. However, the farmers should be careful when deciding to invest additional money on machinery. They should consider whether the available machinery are fully utilized or not. If they are not fully utilized, the farmers should increase their land base. On the other hand, if the available machinery are not sufficient for efficient use of available land, additional investments should be made on machinery instead of on land.

The coefficients of capital are not significant in the years of 1968 and 1969. This may be a result of the large investments on land and machinery which were not able to coordinate to get their maximum use within the two years of 1968-69. However, the large increase in production and small increase in investment on land and machinery during 1969-74 period, as explained earlier, again indicate that

the farmers were able to coordinate the available land and machinery in order to increase production. The investments on land and machinery require an increased use of material inputs. The large values of the material inputs coefficients in 1968-69 indicate that there was a substantial increase in output for the additional units of material inputs used.

The farmers have used more material inputs with the increase in land base. The use of material inputs has increased from $5,000 in 1961 to $10,818 in 1969, on the average per farm. This 116 percent increase in material inputs compared with 44 percent increase in land use suggests that the farmers were attempting to improve the productivity of land by applying more fertilizer and chemicals per acre. Material inputs have been closely related to the output almost throughout the period. In fact, in 1966-69 period this input has generated very high returns. The MVP of material inputs has been as high as $2.08 in this period. This high MVP's indicate that the farmers could have increased the output by increasing the use of material inputs. The farmers have spent $16,043 on material inputs in 1974. This is an increase of $5,225 or 48.3 percent. This large increase in the use of material inputs indicates that the farmers have used more and more material inputs in order to increase output rather than increasing the investments on land and machinery during 1969-74 period.

The production in these farms consists of crops and livestock products. Crop production, which increased by

farmers. The close contacts with the Farm Business Association might have improved the managerial ability of farmers, allowing them to make adjustments with the technological changes.

The other component of the family farm system which affects the growth rate is consumption. The average consumption expenditure during the period 1961-69 has rapidly increased from $3,463 in 1961 to $6,231 in 1969. This is an increase of 80 percent. It is, however, lower than the average increase in net farm income which has increased by 115 percent from $3,750 in 1961 to $8,049 in 1969. This indicates that the farmers were allocating their income rationally in both consumption and re-investment directions. By doing so, they have improved their current as well as future standards of living. The predicted value of consumption shows an increase of $504 or 8.09 percent during the 1969-74 period. This is a very small increase compared to the 92 percent increase in net farm income from $8,049 in 1969 to $15,642 in 1974. This indicates that the farmers are used to a certain level of consumption expenditure, and therefore, in above average income years they save the additional income.

Econometric results indicate that the major determinant of consumption among this group of farmers was consumption habits. This is shown by the larger values of the coefficients for lagged consumption. The average propensity to consume which is lower in high income years and higher in

73.3 percent during 1961-65 period has been the leading component of the increase in gross production in that period. In the 1966-69 period livestock has become the leading component. The value of livestock operations has increased by 54 percent during this period. Even though the income earned from livestock has increased rapidly in this period some farmers have dropped out of livestock operation. Those farmers might have decided that the best return for their land can be obtained from crops.

The amount of labour used in production was not changed very much during the 1961-69 period. However, the gross profit has substantially increased during the same period. This indicates that there was an increase in labour productivity. The Solow model was used in measuring labour productivity. The results show that there was 165.81 percent and 133.62 percent increase in net and gross labour productivity respectively. The share of capital and material in gross labour productivity was 16.69 percent and 36.72 percent respectively. The share of technological change in net and gross labour productivity were 58.41 and 46.59 respectively.

The growth in Western Manitoba farms was definitely influenced by technology. Technological changes give opportunities for farmers to increase the productivity of their land by means of substituting inputs to each other. This is closely related to the managerial ability of the

low income years indicates that the farmers were not adjusting their consumption pattern with the changes in income. Regardless of income level they have maintained a certain level of consumption expenditure, and by doing so, they have invested additional income earned in high income years. This behaviour confirms that the farmers were very much considering their current level of living as well as future. Although the consumption expenditure is only one of the many variables that can be controlled by farmers in order to accelerate growth, the behaviour among this group of farmers, in this aspect, can be considered as rational.

The standard of living among farmers depends upon the farm income. Farm income on the other hand depend upon the level of production which in turn mostly determined by the size of operation. The results of the current analysis have shown that the income increases as the size of operation expands. The size of a farm operation is expanded by further investments on land and machinery and livestock. The analysis shows that there have been heavy investments on land and machinery in these farms during the 1961-69 period. Also, these investments have generated a greater income, although towards the end of the period some of the capital was not productive due to insufficient time for proper coordination.

Econometric results indicate that savings within the farm has been the major determinant of investment during the 1962-67 period. During the last two years, 1968-69, the major determinant has been credits obtained from outside.

During these two years a substantial amount has been invested on land and machinery. The farmers have used credit leverage in expanding their operations.

Implications

Increased labour productivity and high rates of growth during the period 1962-68 indicate that the farmers were successful in adopting new techniques and increasing the production. However, the MVP/Price ratios, shown in Tables XIV and XVII indicate that the farmers were not allocating and combining the resources efficiently. This is a problem related to management. Management is one of the important internal determinants of the growth of the family farm system. Therefore, any attempt to improve farmers' managerial ability will result in high rates of growth. The results of the analysis show that towards the end of the study period, the farmers were not able to obtain maximum productivity from resources due to improper coordination of inputs. They have expanded the resource base in order to increase production without giving much attention to proper coordination of inputs. This is again shown by MVP/Price ratios. They should be advised of techniques of obtaining maximum productivity from available resources before expanding resource base in order to increase production.

The utilization of credit has been an influential factor in the growth process. The average use of credit per farm has increased from $8,376 in 1961 to $34,111 in

1969. This is an increase of 310 percent. This indicates that the farmers were using credit extensively, in order to expand their operations. Credit is a growth augmenting factor in any type of business. However, improper management of credit makes more troubles than benefits. Therefore, the farmers should be given proper advice in credit management.

Farming is a risky means of producing income. It depends on many uncontrolable factors such as weather. There are methods of reducing the risk of earning an income. The farmers should be advised of these methods. One of them is farm diversification. The farmers should be advised to carry livestock operations along with crop production rather than having either crop or livestock alone. However, the study shows that some farmers disregarded the advantages of diversification and dropped their livestock operations. These can be corrected by giving individual advice to those farmers who are planning to have only one type of operation.

Crop insurance is another method of reducing the risk involved in farming. The farmer pays a premium each year to the insurance company. In return the company guarantees a minimum income from the insured crop. In case of a crop failure the company pays the guaranteed income to the farmer. This is a method which transfers the risk to another person or sharing the risk with other successful farmers. This method involves a small cost to the farmer. However, this is

one of the best and mostly used methods in order to avoid the risk involved in farming.

Another method of reducing the risk of getting an income is investing some money outside of the farm. These investments can be made on bonds and shares of corporations. The study shows that some farmers were having this type of investments. Farmers can invest some of their income outside of farm in prosperous years. These investments will serve several purposes. Firstly, they reduce the risk of going without any income in bad years. These investments can be sold to get money when farming did not bring enough income for the family. In addition they generate additional income in the form of interest.

Secondly, these external investments are considered as good collaterals in case of borrowing to expand the operation. Thirdly, these investments provide a retirement fund. When the farmer decides to retire, he can use these investments as the retirement fund. By doing so he can transfer his farm to his son without affecting the productivity of resources. Usually the farmers have to sell their farm assets to provide a retirement fund for himself. They may be sold to one person or several persons. In the latter case the new owners have to organize from the beginning. This type of arrangements severely affect the productivity of resources. However, if the farmer has created a retirement fund outside the farm, the farm can be transferred to his descendants without affecting the productivity of resources.

Another method of transfering the farms without affecting the productivity of resources is the corporation system. The farm family can form a corporation and transfer the assets. Under this method the farm family does not own the farm directly. The corporation owns the farm, and the family owns the shares of the corporation. When retiring, the farmer can sell his shares of the corporation without having to sell the assets of the farm thereby not affecting the productivity of resources.

The major economic problem among farmers, as indicated in the report of the Federal Task Force Agriculture, is the problem of low income. The present study shows that this problem is mainly related to the size of operation. Among the 23 farmers studied, the gross and net incomes have increased with the expansion of the size of farm and increased use of machinery and material inputs. The future of family farm as a mean as well as a way of life depends upon the competitiveness of the farms. The competitiveness can only be maintained by adopting new techniques and using new machinery. The use of new techniques and machinery is not economical in small scale farms. Only the large scale farms can use these new techniques economically, and can be competitive in the industry. These two factors, the increase in income with the expansion of operation and the competitiveness of the large scale farms imply that the viability of farming depends upon the size of operation. Therefore, the

farmers should increase the size of their farms and expand the use of machinery and material input in order to be competitive in the industry and to generate a sufficient income.

Suggestions for further research

The econometric model used in the present study considers the efficient combination of resources in a given enterprise such as crop and livestock. It does not consider optimal allocation of resources between enterprises. This can be done using the linear programming technique. A linear programming model would show the most efficient enterprise in terms of accelerating the growth, and would indicate the efficient allocation of resources between alternative enterprises. Therefore, there is a room for future studies, in the area of farm growth using optimization models.

Another area which can be considered for future studies is the variables included in the model. The present study considered the internal determinants of family farm growth. This includes the resources of the system, i.e., the factors which can be changed or influenced by the individual decision of farmer. The factors which cannot be influenced by farmer are considered as external factors, i.e. the environment of the system. These include government policies on tax, development programmes and policies

of lending institutions. Although these factors are environment to the farmer, they can be changed by government and other institutions. Also there are some factors which cannot be changed by government but depend upon the market behaviour. This includes the prices of inputs and outputs.

The effects of these factors are not considered in the present study. There is a room for studies in this area which include the factors that are considred as the environment of the system in this study.

BIBLIOGRAPHY

Boulding, K. E. "Toward a General Theory of Growth". General Systems. Edts. L. von Bertalanffy and Anatol Rapoport. Vol. I, 1956, pp. 66-75.

Churchman, C. W. The Systems Approach. Dell Publishing Co., Inc., New York, 1968.

Dent, J. B. and J. R. Anderson. Systems Analysis in Agricultural Management. John Wiley & Sons, Australia Pty. Ltd., Sydney, 1971.

E. C. C. Poverty and Social Policy in Canada. Edt. W. E. Mann. Copp Clark Publishing Co., 1970.

Federal Task Force on Agriculture. Canadian Agriculture in the Seventies. Queen's Printer for Canada Ottawa, 1970.

Gillis, R. J. Growth of the Family Farm Business in the Carman Area of Manitoba with Particular Reference to Farm Household Interrelationships and Efficiency within the Farm; 1957-67. Unpublished M.Sc. Thesis, University of Manitoba, 1972.

Halter, A. N. "Models of Farm Growth." J.F.E. Vol. 48, No. 5. December 1966.

Heady, Earl O. Economics of Agricultural Production and Resource Use. Prentice Hall, New York, 1952.

_____, L. Johnson, Lowell S. Hardin, Resource Productivity, Returns to Scale, and Farm Size. The Iowa State College Press, Ames, Iowa, 1956.

Hutton, R. F. "Discussion: Models of Farm Growth." J.F.E. Vol. 46, No. 5, December 1966.

Keynes, J. M. The General Theory of Employment Interest and Money. Macmillan and Co. Ltd., London, 1970.

Koutsoyiannis, A. Theory of Econometrics. Macmillan Press Ltd., London, 1973.

Padoluk, J. R. "Low Income and Poverty." Poverty in Canada. Edts. J. Hamp and J. R. Hofley. Prentice Hall (Canada), Ltd. 1971.

Patrick, G. F. and L. M. Eisgruber. "The Impact of Managerial Ability and Capital Structure on Growth of the Farm Firm. J.F.E., Vol. 50, 1968.

Penrose, E. T. The Theory of the Growth of the Firm. John Wiley and Sons Inc., New York, 1959.

Solow, R. M. "Technical Change and the Aggregate Production Function." Review of Economics and Statistics. Vol. 39, 1957.

Statistics Canada. Prices and Price Indexes - September 1971. Vol. 49, No. 9.

Stone, R. Measurement of Consumer Expenditure and Behaviour in the United Kingdom, 1920-1938. Vol. 1, Cambridge University Press, 1954.

von Bertalanffy, Ludwig. General Systems Theory. George Braziller Inc., New York, 1968.

_____. "Principles and Theories of Growth." Fundamental Aspects of Malignant Growth. Ed. W. W. Nowinski. Amsterdam, 1960.

Yeh, M. H. A Systems Approach to Agricultural Development in Latin America. Unpublished Discussion Paper, Department of Agricultural Economics, University of Manitoba, October 1974.

_____, Lew-King Li, Technological Change in Canadian Agriculture. Research Report No. 15, Department of Agricultural Economics, University of Manitoba, 1968.

APPENDIX I

THE INTERCORRELATION COEFFICIENTS

TABLE XXVIII

THE INTERCORRELATION COEFFICIENTS BETWEEN THE VARIABLES IN THE PRODUCTION FUNCTION USING AGGREGATED CAPITAL FOR THE PERIOD 1962-69

	YG	K	MI	L
YG	1.00			
K	0.83	1.00		
MI	0.86	0.82	1.00	
L	0.49	0.47	0.58	1.00

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TABLE XXIX

THE INTERCORRELATION COEFFICIENTS BETWEEN THE VARIABLES IN THE PRODUCTION FUNCTION USING AGGREGATED CAPITAL FOR THE PERIODS 1962-65 AND 1966-69

	1962-65				1966-69			
	YG	K	MI	L	YG	K	MI	L
YG	1.00				1.00			
K	0.83	1.00			0.80	1.00		
MI	0.83	0.77	1.00		0.88	0.81	1.00	
L	0.70	0.68	0.81	1.00	0.50	0.44	0.51	1.00

TABLE XXX

THE INTERCORRELATION COEFFICIENTS BETWEEN THE VARIABLES IN THE PRODUCTION FUNCTION USING AGGREGATED CAPITAL FOR EACH YEAR DURING THE PERIOD 1961-69

	1961				1962			
	YG	K	MI	L	YG	K	MI	L
YG	1.00				1.00			
K	0.68	1.00			0.91	1.00		
MI	0.77	0.85	1.00		0.80	0.72	1.00	
L	0.73	0.77	0.81	1.00	0.73	0.66	0.79	1.00
	1963				1964			
YG	1.00				1.00			
K	0.88	1.00			0.81	1.00		
MI	0.81	0.77	1.00		0.87	0.78	1.00	
L	0.85	0.77	0.86	1.00	0.68	0.79	0.82	1.00
	1965				1966			
YG	1.00				1.00			
K	0.83	1.00			0.88	1.00		
MI	0.86	0.83	1.00		0.90	0.85	1.00	
L	0.64	0.68	0.82	1.00	0.59	0.64	0.65	1.00
	1967				1968			
YG	1.00				1.00			
K	0.87	1.00			0.79	1.00		
MI	0.89	0.78	1.00		0.87	0.83	1.00	
L	0.63	0.57	0.73	1.00	0.26	0.23	0.21	1.00
	1969							
YG	1.00							
K	0.69	1.00						
MI	0.87	0.79	1.00					
L	0.65	0.51	0.70	1.00				

TABLE XXXI

THE INTERCORRELATION COEFFICIENTS BETWEEN THE VARIABLES IN THE PRODUCTION FUNCTION USING DISAGGREGATED CAPITAL FOR THE PERIOD 1962-69. THE VARIABLES ARE IN TERMS OF PER MAN-EQUIVALENT.

YG	1.00				
RE	0.71	1.00			
ME	0.72	0.60	1.00		
LVK	-0.15	-0.26	-0.21	1.00	
MI	0.80	0.63	0.70	-0.32	1.00

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TABLE XXXII

THE INTERCORRELATION COEFFICIENTS BETWEEN THE VARIABLES IN THE PRODUCTION FUNCTION USING DISAGGREGATED CAPITAL FOR THE PERIODS 1962-65 AND 1966-69. THE VARIABLES ARE IN TERMS OF PER MAN-EQUIVALENT.

1962-65

	YG	RE	ME	LVK	MI
YG	1.00				
RE	0.55	1.00			
ME	0.66	0.41	1.00		
LVK	-0.17	-0.10	-0.18	1.00	
MI	0.58	0.34	0.54	-0.45	1.00

TABLE Continued.

1966-69

	YG	RE	ME	LVK	MI
YG	1.00				
RE	0.64	1.00			
ME	0.65	0.55	1.00		
LVK	0.03	-0.17	-0.10	1.00	
MI	0.83	0.62	0.74	-0.16	1.00

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TABLE XXXIII

THE INTERCORRELATION COEFFICIENTS BETWEEN THE VARIABLES IN THE PRODUCTION FUNCTION USING DISAGGREGATED CAPITAL FOR EACH YEAR DURING THE PERIOD 1961-69. THE VARIABLES ARE IN TERMS OF PER MAN-EQUIVALENT.

1961

	YG	RE	ME	LVK	MI
YG	1.00				
RE	0.20	1.00			
ME	0.34	-0.01	1.00		
LVK	0.08	-0.13	0.20	1.00	
MI	0.52	0.27	0.65	0.12	1.00

1962

	YG	RE	ME	LVK	MI
YG	1.00				
RE	0.36	1.00			
ME	0.81	0.22	1.00		
LVK	0.01	-0.22	-0.11	1.00	
MI	0.48	0.20	0.51	-0.32	1.00

1963

	YG	RE	ME	LVK	MI
YG	1.00				
RE	0.26	1.00			
ME	0.62	0.001	1.00		
LVK	0.15	-0.001	-0.02	1.00	
MI	0.32	0.05	0.33	-0.21	1.00

1964

	YG	RE	ME	LVK	MI
YG	1.00				
RE	0.71	1.00			
ME	0.57	0.54	1.00		
LVK	-0.42	0.01	-0.20	1.00	
MI	0.68	0.33	0.47	-0.63	1.00

TABLE Continued.

	1965					1966				
	YG	RE	ME	LVK	MI	YG	RE	ME	LVK	MI
YG	1.00					1.00				
RE	0.68	1.00				0.73	1.00			
ME	0.69	0.56	1.00			0.67	0.47	1.00		
LVK	-0.26	-0.16	-0.32	1.00		-0.35	-0.30	-0.40	1.00	
MI	0.70	0.42	0.70	-0.58	1.00	0.83	0.52	0.79	-0.46	1.00

	1967					1968				
YG	1.00					1.00				
RE	0.57	1.00				0.73	1.00			
ME	0.73	0.48	1.00			0.78	0.68	1.00		
LVK	0.08	-0.20	-0.16	1.00		0.31	0.16	-0.21	1.00	
MI	0.80	0.42	0.74	-0.23	1.00	0.88	0.77	0.82	0.09	1.00

	1969				
YG	1.00				
RE	0.38	1.00			
ME	0.32	0.45	1.00		
LVK	0.10	-0.29	-0.18	1.00	
MI	0.77	0.49	0.52	0.11	1.00

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TABLE XXXIV

THE INTERCORRELATION COEFFICIENTS BETWEEN THE VARIABLES IN THE CONSUMPTION FUNCTION FOR THE PERIOD 1962-69.

C_t	1.00				
Y_{dt}	0.28	1.00			
NW_{t-1}	0.64	0.23	1.00		
C_{t-1}	0.86	0.22	0.71	1.00	
F	0.62	0.09	0.37	0.61	1.00

TABLE XXXV

THE INTERCORRELATION COEFFICIENTS BETWEEN VARIABLES IN THE CONSUMPTION FUNCTIONS FOR THE PERIODS 1962-65 AND 1966-69

	1962-65					1966-69				
	C_t	Y_{dt}	NW_{t-1}	C_{t-1}	F	C_t	Y_{dt}	NW_{t-1}	C_{t-1}	F
C_t	1.00					1.00				
Y_{dt}	0.28	1.00				0.27	1.00			
NW_{t-1}	0.63	0.36	1.00			0.60	0.09	1.00		
C_{t-1}	0.85	0.21	0.65	1.00		0.86	0.21	0.71	1.00	
F	0.61	0.11	0.41	0.62	1.00	0.63	0.05	0.27	0.61	1.00

****

TABLE XXXVI

THE INTERCORRELATION COEFFICIENTS BETWEEN VARIABLES IN THE CONSUMPTION FUNCTIONS FOR EACH YEAR IN THE PERIOD 1962-69

	1962					1963				
	C_t	Y_{dt}	NW_{t-1}	C_{t-1}	F	C_t	Y_{dt}	NW_{t-1}	C_{t-1}	F
C_t	1.00					1.00				
Y_{dt}	0.57	1.00				0.22	1.00			
NW_{t-1}	0.59	0.68	1.00			0.54	0.46	1.00		
C_{t-1}	0.82	0.56	0.71	1.00		0.84	0.14	0.61	1.00	
F	0.59	0.47	0.49	0.70	1.00	0.52	-0.01	0.44	0.60	1.00

TABLE Continued.

1964

	C_t	Y_{dt}	NW_{t-1}	C_{t-1}	F
C_t	1.00				
Y_{dt}	0.09	1.00			
NW_{t-1}	0.71	-0.09	1.00		
C_{t-1}	0.89	0.14	0.71	1.00	
F	0.68	0.16	0.28	0.63	1.00

1965

	C_t	Y_{dt}	NW_{t-1}	C_{t-1}	F
C_t	1.00				
Y_{dt}	0.28	1.00			
NW_{t-1}	0.58	0.27	1.00		
C_{t-1}	0.82	0.30	0.73	1.00	
F	0.63	-0.01	0.28	0.66	1.00

1966

	C_t	Y_{dt}	NW_{t-1}	C_{t-1}	F
C_t	1.00				
Y_{dt}	0.69	1.00			
NW_{t-1}	0.89	0.67	1.00		
C_{t-1}	0.89	0.65	0.78	1.00	
F	0.60	0.30	0.27	0.60	1.00

1967

	C_t	Y_{dt}	NW_{t-1}	C_{t-1}	F
C_t	1.00				
Y_{dt}	0.44	1.00			
NW_{t-1}	0.69	0.36	1.00		
C_{t-1}	0.90	0.30	0.70	1.00	
F	0.62	0.11	0.27	0.58	1.00

1968

	C_t	Y_{dt}	NW_{t-1}	C_{t-1}	F
C_t	1.00				
Y_{dt}	0.09	1.00			
NW_{t-1}	0.71	-0.09	1.00		
C_{t-1}	0.89	0.14	0.71	1.00	
F	0.68	0.16	0.28	0.63	1.00

1969

	C_t	Y_{dt}	NW_{t-1}	C_{t-1}	F
C_t	1.00				
Y_{dt}	0.28	1.00			
NW_{t-1}	0.58	0.27	1.00		
C_{t-1}	0.82	0.30	0.73	1.00	
F	0.63	-0.01	0.28	0.66	1.00

TABLE XXXVII

THE INTERCORRELATION COEFFICIENTS BETWEEN THE VARIABLES IN THE INVESTMENT FUNCTION FOR THE PERIOD 1962-69.

	INV.	SAV_{t-1}	CRT	NW_{t-1}
INV.	1.00			
SAV_{t-1}	0.39	1.00		
CRT	0.48	-0.01	1.00	
NW_{t-1}	0.28	0.44	0.07	1.00

****

TABLE XXXVIII

THE INTERCORRELATION COEFFICIENTS BETWEEN THE VARIABLES IN THE INVESTMENT FUNCTION FOR THE PERIODS 1962-65 AND 1966-69

	1962-65				1966-69			
	INV.	SAV_{t-1}	CRT	NW_{t-1}	INV.	SAV_{t-1}	CRT	NW_{t-1}
INV.	1.00							
SAV_{t-1}	0.54	1.00						
CRT	0.41	0.05	1.00					
NW_{t-1}	0.36	0.51	0.09	1.00	0.26	0.33	0.06	1.00

TABLE XXXIX

THE INTERCORRELATION COEFFICIENTS BETWEEN THE VARIABLES IN THE INVESTMENT FUNCTION FOR EACH YEAR IN THE PERIOD 1962-69.

	1962				1963			
	INV.	SAV_{t-1}	CRT	NW_{t-1}	INV.	SAV_{t-1}	CRT	NW_{t-1}
INV.	1.00				1.00			
SAV_{t-1}	0.41	1.00			0.56	1.00		
CRT	0.26	-0.30	1.00		0.59	0.19	1.00	
NW_{t-1}	0.10	0.19	-0.28	1.00	0.17	0.52	0.06	1.00
	1964				1965			
INV.	1.00				1.00			
SAV_{t-1}	0.42	1.00			0.64	1.00		
CRT	0.002	0.26	1.00		0.67	0.16	1.00	
NW_{t-1}	0.42	0.59	0.15	1.00	0.39	0.56	0.23	1.00
	1966				1967			
INV.	1.00				1.00			
SAV_{t-1}	0.22	1.00			0.63	1.00		
CRT	0.33	-0.48	1.00		0.04	0.08	1.00	
NW_{t-1}	0.17	0.45	-0.25	1.00	0.58	0.66	0.03	1.00
	1968				1969			
INV.	1.00				1.00			
SAV_{t-1}	0.26	1.00			0.22	1.00		
CRT	0.82	-0.01	1.00		0.88	0.27	1.00	
NW_{t-1}	0.30	0.48	0.12	1.00	0.27	0.04	0.32	1.00

APPENDIX II**

THE METHOD OF ESTIMATING SHARES OF CAPITAL, MATERIAL INPUTS AND TECHNOLOGY IN LABOUR PRODUCTIVITY

The increases in net and gross labour productivities over the period 1961-69 are calculated as

$$\Delta Y_N = Y_{N(1969)} - Y_{N(1961)} \text{ and}$$

$$\Delta Y_G = Y_{G(1969)} - Y_{G(1961)}, \text{ respectively,}$$

Net and gross outputs per man-equivalent are deflated by their respective technological change indices, GM(1969) and NM(1969) respectively to obtain gross labour productivity after removing technological change. The excess of this over net output per man-equivalent in 1961 is the increase imputed to capital (K) intensity. The excess of this over gross output per man-equivalent in 1961 is the increase imputed to capital intensity and material inputs (MI), i.e.,

$$\Delta Y_{N,K} = Y_{N(1969)}/NM_{(1969)} - Y_{N(1961)} \text{ and}$$

$$\Delta Y_{G,K,MI} = Y_{G(1969)}/GM_{(1969)} - Y_{G(1961)}$$

The shares imputed to each of K and MI are calculated using the 1961-69 average shares of these inputs in gross output in Table XIX.

** The method is obtained from Yeh, M.H., et.al., op. cit., p. 28.

The remainder of the increase is imputed to technological change (T), i.e.

$$\Delta Y_{N,T} = \Delta Y_N - \Delta Y_{N,K} \text{ and}$$

$$\Delta Y_{G,T} = \Delta Y_G - \Delta Y_{G,K,MI}$$

This division, as explained earlier, is subjected to the assumption of constant return to scale.

APPENDIX III

TEST OF CONSTANT RETURNS TO SCALE

The estimated Cobb-Douglas production function for the period 1961-69 is

$$Y_G = 3.2\ K^{0.4190}\ \ L^{-0.0181}\ \ MI^{0.4937}$$

If the sum of the coefficients is unity constant returns to scale prevails. However, this sum in the above equation is 0.8946, indicating decreasing returns to scale. The statistical reliability of this result should be tested. Test the hypothesis

$$H_1 : (b_1 + b_2 + b_3) = 1$$

against the alternative hypothesis

$$H_2 : (b_1 + b_2 + b_3)$$

The F statistic is used to conduct this test.

Step 1.

Perform a regression with the restriction $(b_1 + b_2 + b_3) = 1$. From this restriction, $b_1 = 1 - (b_2 + b_3)$ is obtained. The production function will be in the form,

$$Y_G = b_o\ L^{b_2}\ MI^{b_3}\ K^{(1 - b_2 - b_3)}$$

The estimated restricted production function for the period in this form is

$$Y_G = 2.01\ K^{0.4567}\ \ L^{0.0801}\ \ MI^{0.4632}$$

From these two equations Σe_1^2 and Σe_2^2, where,

Σe_1^2 = Sum of the squared residuals from the unrestricted function and,

Σe_2^2 = Sum of the squared residuals from the restricted function, were calculated.

$$F^* = \frac{\Sigma e_2^2 - \Sigma e_1^2}{\Sigma e_1^2} (N - K)$$

From the estimated production functions,

$\Sigma e_1^2 = \ell n\ 12.3520$

$\Sigma e_2^2 = \ell n\ 12.5437$

$F^* = 3.1506$

The theoretical $F_{0.01} = 6.63$ with $V_1 = 1$ and $V_2 = 203$ degrees of freedom. Hence $F^* < F_{0.01}$ and we conclude that $(b_1 + b_2 + b_3) = 1$. Accept the hypothesis that there was constant returns to scale during 1961-69 period.

APPENDIX IV

ESTIMATION OF THE AVERAGE INCREASES IN NET-WORTH PER YEAR DURING 1962-69, 1962-65 AND 1966-69 PERIODS.

TABLE XL

THE AVERAGE VALUES OF ECONOMIC VARIABLES PER FARM PER YEAR IN THE PERIODS 1962-69, 1962-65 AND 1966-69

	1962-69	1962-65	1962-69
Savings	5,299	4,417	6,181
Credit - $	4,445	4,288	4,602
NW_{t-1} - $	76,593	53,978	99,207
Capital - $	52,036	43,945	67,225
Labour - M.E. - $	1.33	1.42	1.3141
Material inputs - $	6,434	5,477	8,872
Disposable Income - $	6,124	5,771	6,499
Lagged Consumption - $	4,095	3,875	5,252
Family Size - Adult Units	3.01	3.1687	3.424
Off-farm Income - $	2,151	1,396	2,908
Operational Expenditure - $	10,344	8,594	12,093
Income Tax - $	2,036	1,489	2,583

1962-69.

$$\hat{NW} = [3.26 * (816 + 0.866\ SAV_{t-1} + 0.5851\ CR_t + 0.0194\ NW_{t-1} + \bar{K})^{0.4068}\ L^{0.0054}\ MI^{0.4750}] - [5.34\ Y_{dt}^{0.0412}\ C_{t-1}^{0.6819}\ FS^{0.1507}\ NW_{t-1}^{0.0445}] + OFI - OE - T.$$

Estimation of net-worth with average values of the variables in 1962-69 period.

$$\hat{NW} = [3.26 * (816 + 0.866 * 5299 + 0.5851 * 4,445 + 0.0194 * 76593 + 52036)^{0.4068} * 1.33^{0.1507} * 6434^{0.475}] - [5.34 * 6124^{0.0412} * 4095^{0.6819} * 3.01^{0.1507} * 76593^{0.0445}] + 2151 - 10344 - 2036$$

$$= 19,423 - 4,322 + 2,151 - 10,344 - 2,036$$

$$= \$4872$$

1962-65.

$$\hat{NW} = [4.37 * (367.58 + 1.202\ SAV_{t-1} + 0.4501\ CR_t + 0.0253\ NW_{t-1} + \bar{K})^{0.453}\ L^{0.0009}\ MI^{0.3822}] - [6.58\ Y_{dt}^{0.0325}\ C_{t-1}^{0.6332}\ FS^{0.1106}\ NW_{t-1}^{0.0739}] + OFI - OE - T.$$

Estimation of net-worth with average values of the variables in 1962-69 period.

$$\hat{NW} = [4.37 * (367.58 + 1.202 * 4,417 + 0.4501 * 4,288 + 0.0253 * 53,978 + 43,945]^{0.453} * 1.42^{0.0009} * 5,477^{0.3822}] - [6.58 * 5,771^{0.0325} * 3,875^{0.6332} * 3.1687^{0.1106} * 53,978^{0.0739}] + 1,396 - 8,539 - 1,489$$

$$= 16,180 - 4,149 + 1,396 - 8,539 - 1,489$$

$$= \$3,399$$

1966-69.

Estimation of net-worth with average values of the variables in 1966-69 period.

$$\hat{NW} = [4.32 * (-323.11 + 0.6783\ SAV_{t-1} + 0.6819\ CR_t + 0.0304\ NW_{t-1} + \bar{K})^{0.3094}\ L^{0.1086}\ MI^{0.5626}] - [3.58\ Y_{dt}^{0.0466}\ C_{t-1}^{0.7003}\ FS^{0.2141}\ NW_{t-1}^{0.0544}] + OFI - OE - T.$$

$$\hat{NW} = [4.32 * (-323.11 + 0.6783 * 6,181 + 0.6819 * 4,602 + 0.0304 * 99,207 + 67,225)^{0.3094} * 1.3141^{0.1086} * 8,872^{0.5626}] - [3.58 * 6499^{0.0466} *$$

$$5{,}252^{0.7003} * 3.424^{0.2141} * 99{,}207^{0.0544}] +$$

$$2{,}908 - 12{,}093 - 2{,}583.$$

$$= 24{,}071 - 5{,}273 + 2{,}908 - 12{,}093 - 2{,}583$$

$$= \$7{,}030.$$

APPENDIX V

THE ESTIMATED CONSUMPTION EXPENDITURES FOR THE YEARS 1973 AND 1974*

	1973			1974		
	$	$	$	$	$	$
Beginning cash balance		1,600			2,938	
Current farm sales	45,155			49,095		
less credit sales	24			5		
Cash sales		45,131			49,090	
Borrowing		2,234			3,594	
			48,965			55,622
less						
Purchases						
Crops	1,557			2,894		
Livestock	10,154			6,591		
Supplies	13,227			15,763		
Labour	1,060			1,756		
Other fixed	1,194			1,749		
Interest paid	2,391			2,240		
		29,583			30,993	
Fixed purchases						
Year end fixed assets	90,698			96,259		
Beginning fixed assets	83,897			86,018		
	6,807			10,241		
Depreciation	4,290			4,398		
		11,097			14,639	
Income tax 1972		-			-	
Income tax 1973		-			2,565	
Year end cash balance		1,600			3,055	
			42,280			51,252
Consumption expenditure			6,685			4,410
Farm produce and supplies			606			371
Total Consumption			7,291			4,781

*The values in Canfarm report were estimated with the sample sizes of 112 and 61 in 1973 and 1974. Therefore, the values in two years are not directly comparable.