

AN ANALYSIS OF THE EFFECTIVENESS OF DIVERSIFICATION AS A  
MEANS OF OVERCOMING THE INSTABILITY CHARACTERISTIC OF  
FARM INCOME IN MANITOBA

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An Abstract  
Submitted to  
The Faculty of Post Graduate Studies  
The University of Manitoba

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In Partial Fulfillment  
of the Requirements for the Degree  
of Master of Science in Agriculture

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by  
Vernon E. Nelson

May, 1959

This study or analysis consisted of a measurement of the effectiveness of the diversification practice in overcoming instability in farm income in Manitoba. A correlation analysis was made of the yields, prices and cash incomes of the major farm products produced in the Province. Correlation of course, is a measurement of the extent to which prices, yields, or cash incomes of one product tend to vary in a pattern similar to that of the prices, yields, or cash incomes of another product. If products are closely correlated, that is they tend to be affected by the same factors, their value as substitutes for diversification purposes is limited. This is because when the price, for example, of one product is low, the other or others will command a low price as well.

It was found that prices of all farm products tended to be highly correlated. Cash incomes received from these same products were also fairly highly correlated. Yields or marketings showed somewhat less correlation, and in some cases none at all. The lower correlation in yields was largely offset by the higher values for prices and cash incomes. It was therefore concluded that because correlation was relatively high, the value of substitution between products was relatively low, hence there was little to be gained by "intensive" diversification to overcome instability in farm income. There were also two factors, year to year variability, and sporadic instability that were found to modify this conclusion to some extent.

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#### ACKNOWLEDGEMENT

I would like to acknowledge the guidance given to me in this project by Dr. G. C. Gilson, Associate Professor, Department of Agricultural Economics, University of Manitoba. The time so generously given in reviewing the manuscript, and the suggestions and advice are in no small way responsible for the successful conclusion of this study.

## TABLE OF CONTENTS

CHAPTER		PAGE
I	INTRODUCTION	1
II	INSTABILITY: THE NATURE OF THE FARM INDUSTRY	3
	Causes of Instability in Farm Income	5
III	RISK AS A FACTOR AFFECTING FARM INCOME	10
IV	UNCERTAINTY AS A FACTOR AFFECTING FARM INCOME	14
	Types of Uncertainty	16
	The Effects of Uncertainty	20
	Methods of Limiting or Overcoming	
	Uncertainty	26
V	DIVERSIFICATION	31
	Types of Diversification	31
	Motives for Diversification	36
	Diversification and Specialization	38
VI	ANALYSIS OF CORRELATION AND DIVERSIFICATION	41
VII	INSTABILITY CHARACTERISTICS OF MANITOBA	
	AGRICULTURE	44
	Factors Used	44
	Measurement of Uncertainty	48
VIII	CORRELATION OF PRICE YIELD AND CASH INCOME	
	INSTABILITY	56
	Statistical Analysis	56
	Observations	57
IX	LIMITATIONAL FACTORS OF IMPORTANCE	75

X	IMPLICATIONS FOR FARM MANAGEMENT PRACTICES	
	IN MANITOBA	80
XI	CONCLUSIONS	82
	BIBLIOGRAPHY	85

## LIST OF FIGURES

FIGURE		PAGE
1.	Illustration of the Effect of a Change in Supply on Price With an Inelastic Demand Curve	8
2.	Illustration of Enterprise Relationships	33
3.	Correlation Coefficients for Yields	62
4.	Correlation Coefficients for Prices	63
5.	Correlation Coefficients for Cash Incomes	64

## CHAPTER I

### INTRODUCTION

The many factors impinging upon the agricultural sector of our economy combine to produce extreme variability in farm income from year to year. Fluctuations in farm income arise out of highly variable farm commodity prices and the uncertainties of weather conditions, diseases and insects, which have their effect on yield. Many different practices have been tried by farm managers in an effort to overcome this instability in farm income. One of the most common methods has been the adoption of some degree of diversification. The word "diversification" may have several meanings dependent upon the degree to which the practice is followed. These different meanings or levels of diversification will be discussed in detail later. It should be noted, however, that the word will be used in this analysis in reference to a very high level of diversification. This level will be referred to as "intensive diversification" in the following discussion.

The problem then, is one of a highly variable annual agricultural income in Manitoba. The objective is to make an examination of the practice of "intensive diversification" as a means of overcoming or ameliorating the effects of fluctuating farm incomes.

In the succeeding analysis an examination of the farm industry will be made and the reasons for, or the causes of instability in farm



income will be discussed. This will be followed by an explanation of risk and uncertainty which arise out of the factors causing instability. The practice of "diversification" will then be described in detail. This will prepare the way for a statistical analysis of the usefulness or effectiveness of the practice in overcoming uncertainty, which will be found in Chapter VIII of the thesis. The succeeding chapters will then be devoted to an examination of the observations recorded together with the conclusions reached. Lastly an interpretation will be made of some of the implications toward farm management policy indicated in the analysis.

It should be noted that in the title and in the following discussion the word "farm income" is meant to include both the variables of yield and price which are the factors determining the level of income. Intra-year variations in income and price are not analyzed because the year is commonly accepted as the unit of time for calculating income in agriculture. Variations in annual income are also much more significant for the purpose of this thesis.

## CHAPTER II

### INSTABILITY: THE NATURE OF THE FARM INDUSTRY

A brief description of the nature of the farm industry in Manitoba is absolutely essential before beginning a discussion of the value and effectiveness of diversification, in overcoming the extreme fluctuations in income to which the individual farm entrepreneur is subjected. The entrepreneur is faced with all or most of the variables affecting other primary industries as well as a number common only to the farm industry. It is these variables or uncertainties that are at the root of the many problems that have plagued the farm industry. They are much more a cause of concern to the modern farmer, however, who must turn to the market to obtain most of the factors of production which he must have. This is quite different from the period 50 to 60 years ago and less when a farm entrepreneur was comparatively self-sufficient.

Agriculture is particularly vulnerable to business fluctuations in the rest of economy. It is one of the major problems of a primary industry, that the income accruing to it is subject to violent fluctuations in the course of changes in the general level of business activity and national income. Farm income falls substantially during depression periods as the prices of farm commodities drop to very low levels. Even when the rest of the economy is enjoying prosperity, farm income may be quite low. The period from 1951 to 1957 is a good

example. National income was at an all time high, yet farm income and prices tended to decline and remained relatively low throughout much of this period.

Farm prices are subject to wide variation throughout the course of the business cycle and tend to fluctuate much more than the general level of prices in the economy. While the prices of farm produced commodities are very flexible, the prices of farm machinery, equipment and supplies are not nearly so variable. Thus when farm prices are declining, the prices of the factors of production required by farmers do not decline as quickly, if at all, thus squeezing the entrepreneur between falling income on the one hand and steady or rising costs on the other hand. This situation is aggravated by the large proportion of relatively fixed to total costs of agricultural production. Fluctuations in gross income accruing to agriculture are therefore reflected almost entirely in net income.

Control of resource administration in agriculture is vested in the hands of thousands of individual farm managers. This large group makes all the ultimate decisions on how farm resources will be allocated between alternative uses, both at a given point in time, and also over time. In terms of numbers, or as a percent of total labor requirements, management is nowhere nearly so important in non-agricultural industries. Management makes up the bulk of the labor force in agriculture, while in industry, management accounts for only a small fraction of the total labor requirements. All consumer

preferences and choices, national programs, and economic influences must thread through the management of the individual farm firm, in order to make any impact on farm production, income and resource use. This is undoubtedly one of the reasons why farmers are notoriously slow in adapting production patterns to changes in price relationships between different farm products.

The time involved in agricultural production in most cases precludes perfect knowledge of the future. Decision making thus takes place in an environment of uncertainty. The need for farm management, co-ordination and supervision grows out of these constantly changing conditions and the incomplete knowledge and information available to predict the future within acceptable limits, let alone certainty.

The preceding discussion serves to point out the dominant characteristic of farm income, that of instability. This again, is the problem that forms the basis for this thesis. The main causes of instability will now be discussed, followed by a more detailed review of the way in which it affects farm income.

#### 1. CAUSES OF INSTABILITY IN FARM INCOME

The main causes of instability of farm income may be classified into two general groups: (1) those originating in the demand for agricultural products through changes in business conditions, and (2) those arising out of the supply of agricultural products. These two cases of instability will now be discussed.

Instability of Business Conditions. The rise and fall of the demand for farm products is directly associated with fluctuations in business conditions of the economy outside agriculture. As agriculture has grown more dependent upon the exchange system for the necessary factors of production, it has become increasingly vulnerable to these business fluctuations. The prices received by farmers move in close sympathy with those in business, rising when industrial production and employment expand, and falling when they contract. However, the amplitude of farm price fluctuations is considerably greater than those of prices generally. This is because of the inability of the farm industry to equate the supply with the demand for individual farm commodities. When demand exceeds supply for a commodity such as flax, the price will be bid up as buyers compete for the limited supply. Conversely, when supply exceeds demand, the price of flax will decline to the level at which buyers will be willing to purchase all the production, (this is assuming ordinary free market conditions.)

The effect on price of even small changes in supply (production) in agriculture may be seen in Figure I, page 8. In the diagram, the curve D D represents the relatively inelastic demand curve for all farm products taken together. The inelastic nature of this demand curve indicates that the total requirements of all farm products is relatively stable or fixed for any particular period. In other words, demand changes very little in spite of changes in quantity marketed and prices. Assume in the diagram that the normal quantity of production is  $Q_1$ ,

with the level of farm prices at  $P_1$ . A small increase in supply to  $Q_2$ , causes prices to fall substantially to  $P_2$ . This happens because the demand changes very little with any change in price. Therefore, a substantial decline in prices was necessary before demand was sufficient to consume the small additional production. Similarly, a small decrease in supply ( $Q_3$ ) is reflected in a large increase in prices ( $P_3$ ). This comes about because demand is relatively fixed or inelastic, so that a decrease in production causes prices to rise as consumers compete or bid against each other for the smaller supply. Prices rise much more than in proportion to the decrease in production because the demand curve is relatively inelastic. That is, consumers' wants in terms of total farm products changes very little with changes in prices. It should be noted that although the total demand for farm products is relatively inelastic, the demand for individual farm products may not be nearly so inelastic. For example, the demand for meat may be relatively stable or inelastic, but consumer choices between beef, pork, poultry, mutton etc. may change substantially in relation to the relative prices of these products at any time.

Because of the very nature of the farm industry it is virtually impossible to regulate the supply of any product coming on the market in any one year. This is the opposite to industry, especially large monopoly or semi-monopoly industries where production can be, and is regulated fairly closely to the existing level of demand. These are the most important reasons why farm prices tend to fluctuate much more than prices generally.

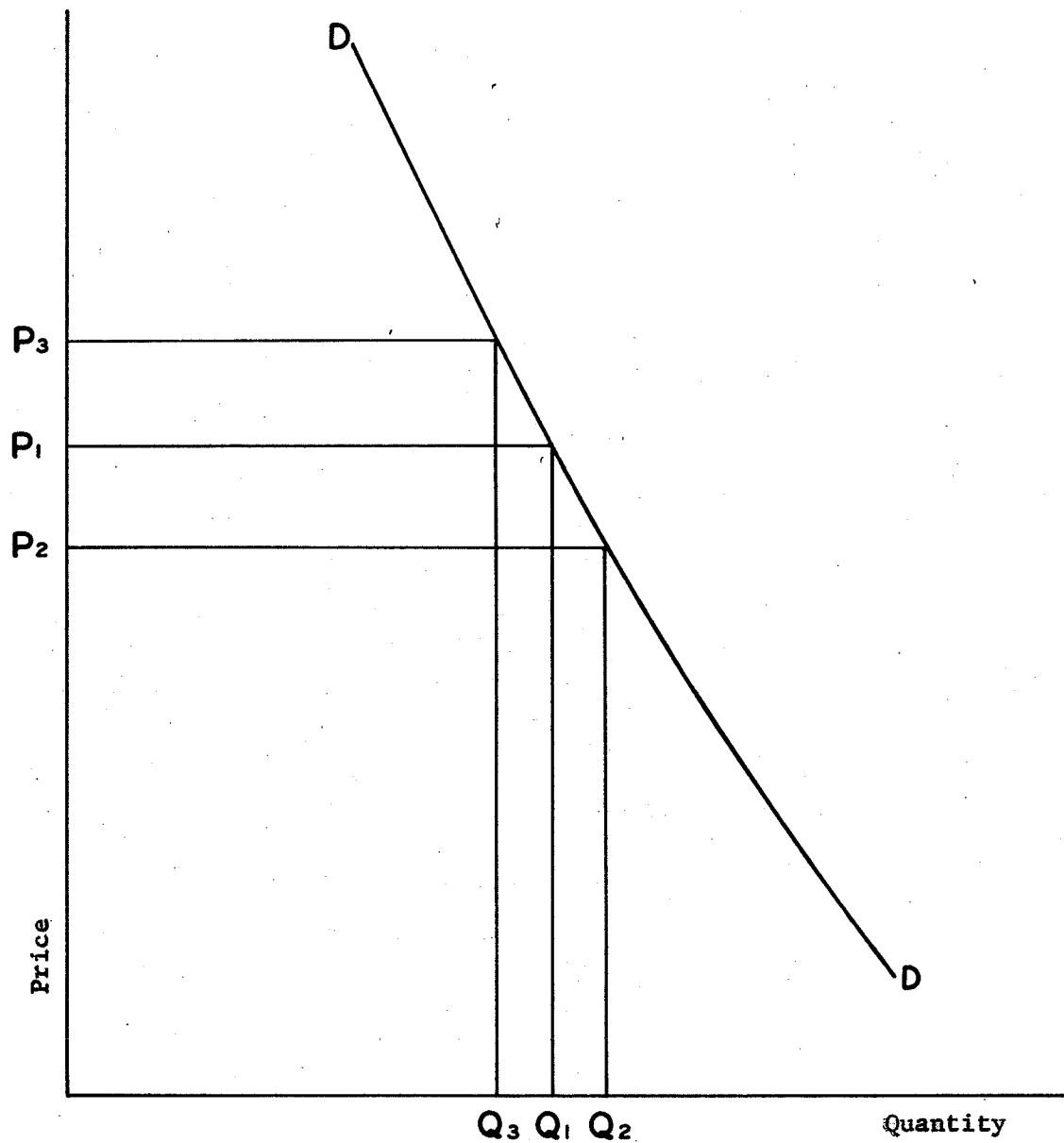


FIGURE I

ILLUSTRATION OF THE EFFECT OF A CHANGE IN SUPPLY ON  
PRICE WITH AN INELASTIC DEMAND CURVE

Instability of Agricultural Production. Agricultural production is subject to many risks and uncertainties that are a major factor in the income instability of the individual entrepreneur. Rain, drought, frost, flood, hail, wind storms, insects and rodents, plus a wide variety of animal and plant diseases, all affect the level of production from an individual farm. These factors determine in no small degree whether yields are large or small, and whether flocks and herds thrive or fail to respond to feeding practices. The individual farmer has relatively little control over these vagaries of nature, so that even in the better situated and more suitable farming areas, the fortunes and failures of farm entrepreneurs are determined to a considerable degree by these production uncertainties.<sup>1</sup>

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<sup>1</sup>For further discussion, see T. W. Schultz, Agriculture in an Unstable Economy (New York and London: McGraw-Hill Book Company, 1945), pp. 211 to 216.



## CHAPTER III

### RISK AS A FACTOR AFFECTING FARM INCOME

At this stage in the discussion, it is necessary to point out a distinction which exists between two different forms or conditions of uncertainty. In his quest to overcome or protect himself against instability of income, the farm entrepreneur is forced to make estimates of future conditions (comparative prices and yields of different commodities as well as general market levels) of which he has limited information. These future conditions may take either of two forms, which will be designated as "risks" on the one hand or "uncertainties" on the other. Risk will be explained and defined in the following discussion, while Chapter IV will be devoted to a discussion of Uncertainty.

### RISK

Estimates about any future event which is not regarded as certain, may involve either uncertainty or risk.<sup>1</sup> The future event viewed as it exists on an individual basis is always uncertain. Viewed as a member of a group of events so related that their joint outcome is more certain than the individual events in the group, it may be called risk. Both to a fire insurance company and to the owner, the

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<sup>1</sup>See E. O. Heady, Economics of Agricultural Production and Resource Use (New York: Prentice-Hall Inc., 1952), pp. 439-441.

future of a particular building is uncertain, but to the company which insures it, assuming that it also insures many comparable buildings, the burning of the building is a risk. There is therefore an actuarial basis for risk taking which is not the case for uncertainty.

The practical difference between risk and uncertainty is that in the former the distribution of the outcome over a group of instances is known, either through "a priori" calculation or from statistics of past experience.<sup>2</sup> For example, it is known that in throwing a perfect dice the chance of turning up a six will be once in every six throws, if the dice is thrown often enough. Uncertainty cannot be measured in this way because it is impossible to form a group of closely related instances or outcomes, as the situation is highly unique. The price of hogs is uncertain because there are no two years in which the combination of factors affecting the demand and supply of pork and the level of business conditions and prices generally in the economy are the same. It is therefore impossible to measure with any degree of accuracy what the price of pork at any particular time in the future will be, because neither the range of possibilities or the relative effects of each of the factors mentioned previously can be measured accurately. This discussion may be sum-

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<sup>2</sup>F. H. Knight, Risk, Uncertainty and Profit (Boston and New York: Houghton Mifflin Company, 1921), p. 233.

marized by saying that risk is characterized by a known or measurable probability distribution, while uncertainty has no known or measurable probability distribution, or has a myriad of probability distributions too numerous to be of any value.

Risk does not or need not have any impact of a nature to affect decision making and resource use in agriculture.<sup>3</sup> Since risk involves knowledge of the mean, as well as the range and dispersion of outcome, all of which can be estimated statistically, losses and gains which grow out of risk phenomena may be incorporated into the entrepreneur's cost schedule. This may be done even where the number of cases is not great enough to allow prediction of loss on the individual farm. Agencies have arisen which specialize in risk taking in such familiar forms as fire and hail insurance.

This overall distinction between risk and uncertainty was set out by Frank H Knight before 1921.<sup>4</sup> He stated that a risk is "an uncertainty which can by any method be reduced to an objective, quantitatively determinate probability" and thereby "can be reduced to complete certainty by grouping cases". "Pure" uncertainty was referred to as "not susceptible to measurement", and hence cannot be eliminated by inclusion in the firms cost schedule.

Risk then relates to variability phenomena which can be incor-

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<sup>3</sup>Heady, op. cit., p. 442.

<sup>4</sup>Knight, op. cit., p. 197.

porated into costs. It is uncertainty which gives rise to the need for an entirely different framework for decision making and resource administration. It is also the presence of uncertainty which has given rise to the concept of "intensive diversification" mentioned previously, which developed as a means of lessening the effects on the farm entrepreneur. Uncertainty is therefore a much more significant factor of decision making in agricultural production.

## CHAPTER IV

### UNCERTAINTY AS A FACTOR AFFECTING FARM INCOME

The term "uncertainty" is used throughout this analysis in reference to all circumstances in which decisions must be made without complete knowledge of significant future events. (Significant future events are all occurrences, which if foreseen correctly, would have influenced the particular decision). Uncertainty will exist if expectations of future prices, yields, or capital allowances are indeterminate, and if it is not even possible to calculate with any accuracy a predictable range of results.

Uncertainty then, involves the making of decisions without perfect knowledge. It is always present when knowledge of the future is less than perfect in the sense that the parameters of the probability distribution (the mean yield or price, the variance, range or dispersion and the skewness or shape of the distribution) cannot be predetermined.<sup>1</sup> Uncertainty refers simply to anticipations of the future which are peculiar to the mind of each individual producer. It arises because the entrepreneur must formulate an image of the future in his mind but has no quantitative means by which these predictions may be verified. Anticipations of the future may be made, but not enough observations under similar conditions can be made to predict the

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<sup>1</sup>E. O. Heady, Economics of Agricultural Production and Resource Use (New York: Prentice-Hall Inc., 1952), p.443.

relevant probability distribution.

The existence of uncertainty not only influences the process of decision making, but also has an effect upon the objectives or goals of the entrepreneur<sup>2</sup>. If expectations are uncertain, it no longer seems realistic to assume that the entrepreneur is interested solely in maximizing net income over some period of time. It may also be important or even a definite necessity to maintain a certain minimum level of income throughout the life of the firm in order to protect the capital invested against uncertainties which may force liquidation of assets in the short run. For example, an entrepreneur must receive a minimum annual income sufficient to maintain the existence of his family and himself, and also to retain the existence of his farm as an economic unit. It will be of little value if his average yearly income is more than sufficient to meet his requirements if he is faced with periods when his income is so small that he is forced to liquidate his assets and go out of operation.

A firm is thus confronted not only with the necessity of considering the expected value of the income stream but also with the desirability or necessity of maintaining within limits the capital value of the firm as a going concern. If the future is uncertain, the entrepreneur is influenced not only by the mean or most probable value

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<sup>2</sup>D. G. Johnson, Forward Prices for Agriculture (Chicago: University of Chicago Press, 1947), Chap. IV.

of future income but also by the distribution of income over time. The time involved in the production process is significant because the greater the period over which the production cycle extends, the more likely that uncertainty will affect the outcome.

# I. TYPES OF UNCERTAINTY

Uncertainty may be broken down into four main types or classes:<sup>3</sup>

- (1) price uncertainty for products or factors,
- (2) technical or yield uncertainty,
- (3) technological uncertainty,
- (4) the sociological and legal framework in which the firm operates.

Each of these four will be discussed briefly.

Price Uncertainty. Prices to be realized vary in accordance with a number of factors, the following four of which are among the most important.

(a) The actions of other producers. If many entrepreneurs produce a product with only a limited demand, an oversupply may develop which will suppress the price. Similarly, the action of many producers bidding for a factor of production which is limited in quantity, such as a new variety of seed wheat, will tend to bid up the price of that factor thus increasing its cost to each individual producer.

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<sup>3</sup>Heady, op. cit., pp. 453 - 454.

(b) The degree of national prosperity. Agricultural prices when allowed to fluctuate without government interference tend to follow a pattern similar to other prices and the general prosperity of the economy. Characteristically, however, they show much greater extremes of fluctuation than the general level of prices over the length of the business cycle.

(c) Changes in consumer tastes. A change in consumer taste between say beef and pork, or between beef and veal, to the extent that the change is reflected in the relative demand schedules for these products will also result in a change in their price relationships.

(d) The vagaries of the weather. Favorable weather conditions resulting in a bumper crop in any one year may flood the market for a particular commodity such as wheat, and its price will tend to be suppressed. On the other hand the opposite condition may result in low production but in higher prices because of the short supply. As an "exogenous" or outside variable, price instability or unpredictability is never quite as great in other industries as it is in agriculture because most other industries are not so greatly affected by weather-generated price variations.

The outstanding characteristic of these four sources of price uncertainty is the unpredictable nature of each one. Certainly no one can predict the weather over the length of a crop production period. It is also difficult to predict the actions of other producers and the effect of these actions on the production of different products and



their prices. The same applies to the gradual changes that take place in consumer tastes as well as the fluctuations that occur in national prosperity.

Technical or Yield Uncertainty. Technical uncertainty refers to variation in the production coefficients (yields) for a given technique or practice. It is absent in most non-agricultural industries to the extent that output is usually the result of exact quantities of productive factors in constant proportions, and manufactured under fixed predetermined conditions. For example, if ten pounds of copper plus two pounds of nickel-steel alloy are necessary to produce 100 feet of a certain grade of wire, then this is a fixed and definite production function (with constant production coefficients for each factor) which can be repeated at will to produce the same output. However, in farming there is considerable variation in the year to year output of a fixed quantity of resources. This of course is largely because of the vagaries of nature to which the farm production processes are so closely dependent. In other words, the environment of the production processes can be controlled in the manufacturing industries, which is not usually the situation in the agricultural industry. An entrepreneur may follow a fixed rotation, apply constant cultivation practices, fertilizer etc., but due to the effects of weather the resulting yields will show considerable variation. The extent of this yield variation is shown in Table III page 52. It will be noted in this table that the average year-to-year yield variation between 1926 and 1955 has

ranged from 16 percent for rye to 33 percent for oats. Wheat and barley have both varied over twenty-five percent each year on the average. Compare this with an ordinary manufacturing process where the average variation in product is usually quite small.

Even in the non-farm industries where technological uncertainty is present, its magnitude is not nearly as large as for particular agricultural crops or for the agricultural industry as a whole. The farm manager is thus faced with a complex task in formulating plans for the use of resources as he must reckon in terms of uncertain yields as well as uncertain prices. On the other hand, the non-farm producer since he is not so pressed on the side of technical uncertainty, often can devote a greater portion of his entrepreneurial efforts to formulating price expectations and planning.

Technological Uncertainty. Technological uncertainty arises from advances in scientific knowledge, and improvement in the methods of application of technical processes which increase the productivity of given resources. It is particularly important in industry where trade names and processes can be patented. Farm and non-farm firms alike are faced with uncertainties from technological change, when investment questions call for the consideration of whether the form of resources or the technique adopted will give costs as low as a new technique which may come on the market in the near future.

The fourth source of uncertainty is the sociological and legal framework in which the firm exists. This category includes problems

of tenure, purchasing contracts and related types of uncertainty. The character of individuals is also a phenomena which must be predicted and which could lead to errors of decision in employer-employee relationships and in successful loan transactions. Uncertainty and lack of predictability which attach to government programs might also be placed in this category.<sup>4</sup>

## II. THE EFFECTS OF UNCERTAINTY

One of the chief functions of market prices is that of guiding resources into lines of production which conform with the choices of consumers. The great variability of farm commodity prices and the lack of any simple and effective system which farmers can use in forming price expectations, causes market prices to serve inefficiently in this respect. The expectations are subject to such great errors that production may be guided into the wrong alternatives and resources organized inefficiently as a precaution against uncertainty. For example, a farmer may be so uncertain of the outcome of his seasonal crop pattern, that rather than take a chance on specializing in the enterprise or enterprises in which his efficiency is greatest, he may introduce several other crops on the assumption that at least one of them will be successful. Under highly uncertain and hazardous conditions this practice could result in a lower average income, but a more

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<sup>4</sup>For further discussion of the types of uncertainty, see Heady, op. cit., p.453.

stable income than under a more specialized system. This practice is inefficient to the extent that farm resources are not always used in those enterprises in which they are most productive.

Precautions to meet uncertainty almost always necessitate a sacrifice, which either results in less than maximum production from given resources or conversely, does not allow for a minimum cost for a given output. Both the farmer and the consuming society suffer when production is geared to inaccurate expectations. It is in these ways that price and technological uncertainty have important undesirable effects upon allocative efficiency and income distribution in agriculture.

Short-run effects of uncertainty. The farm entrepreneur is faced with two types of judgments which must be made in the short run.<sup>5</sup>

(1) What will be the prices of factors and products in alternative lines of output when decisions made now materialize in marketable products?

(2) What will be the physical products forthcoming from the combination of inputs used?

The defects in resource allocation with uncertain expectations are of two types. First, if the mean or most probable expected price proves to be correct, the allocation of resources will not be the same as with single-valued expectations. Second, the mean or most probable

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<sup>5</sup>Johnson, op. cit., p. 43 - 44.

price may not materialize and will have resulted in a misallocation of resources.

In the first case, if price expectations were fulfilled as far as mean prices were concerned, but the producer had made plans in terms of anticipations that were not certain, the allocation of resources would not be in terms of the optimum or most productive use. The producer would likely have a desire to limit the anticipated ranges of his receipts or profits, in other words provide more stability or at least reduce the possible variation in income that might result. This desire would enter into his calculations as a separate variable affecting the allocation of resources. The evaluation of uncertainty leads the producer to allocate resources, not with maximization of profit as the sole guide, but with some consideration of maintaining a certain degree of safety.

If the expected price is wrong as in the second case, a much more significant error is involved. Under such circumstances, the producer obviously cannot equate marginal costs and prices, or equalize the marginal profit possibilities in alternative lines of production. The output at the same time would not have been such as to have maximized consumer satisfaction from the resources available.

Long-run Effects. During the short-run the size and structure of the firm are largely fixed.<sup>6</sup> It is the longer run influences which shape the nature of the firm itself. The long-run consequences are in

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<sup>6</sup>Ibid, p. 44 - 46.

addition to the short-run effects, since the short-run misallocations are to a considerable degree independent of the specific asset structure of the firm. The additional costs of uncertainty over time can be largely attributed to the particular effects of uncertainty upon the size and structure of the firm. Most of the long-run effects of uncertainty grow out of two sets of reactions; that of farmers and that of the capital market to the fact that all price and yield anticipations are subject to wide error. Because of the frequency of inaccurate expectations, there has grown up a number of rules of thumb, or procedures and attitudes that have an important and persuasive effect upon the allocation of resources in agriculture. These factors affect in mixed, but never-the-less important ways the size of the farm, the selection of enterprises, the combination of resources and the nature of the assets held by farmers. The types of loans available to farmers and the stringent conditions required for obtaining funds have largely been the outgrowth of the reactions of loaning agencies to uncertainty in agriculture. Also an outgrowth of uncertainty is the cautious attitude of most farmers toward making a loan. The effects of uncertainty upon the availability of capital thus presents itself not only through the decisions of the entrepreneur but also influences the decisions of anyone making available outside sources of capital for use in the agricultural industry.

Effect Upon Farm Size. The addition of more resources and a greater volume of output contribute to the effects of uncertainty along

with the variables of change and the imperfect knowledge of future prices and yields.<sup>7</sup> An increase in size raises the number of decisions which must be made by management, and the greater the number of decisions the less perfect they tend to become, because the supporting knowledge upon which each is based becomes less perfect. Thus "diminishing returns" to management come about as size increases because of imperfect decisions and the corresponding misdirection of resources relative to price and production outcomes. The greater the amount of change and uncertainty, the greater are the possible errors in prediction and choice which tend to limit the size of the farm.

Because of the "increasing risk" feature of size and borrowed capital, the farm entrepreneur will tend to limit the scale of enterprise for commodities characterized by a high degree of uncertainty. This tendency toward internal capital rationing is commonly referred to as "risk aversion". D. G. Johnson describes it as the entrepreneurs' attitude of "distaste or dislike for an activity in which large losses are frequent even if large gains are possible."<sup>8</sup> It may also be referred to as the psychological discount of returns due to the presence of uncertainty. Limited capital and the risks which are attached to borrowing thus place a premium on short-lived assets in order to reduce uncertainty in the sense of shortening the planning period and

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<sup>7</sup>Heady, op. cit., p. 535 - 536.

<sup>8</sup>Johnson, op. cit., p. 38.

allowing a given capital outlay to support a larger scale of operations. In this way fewer funds are tied up in resources which may be transformed only in remote production periods.

Capital Rationing. Capital rationing is largely the response of outsiders to uncertainty in agriculture. It affects the efficiency of resource allocation in two ways: (1) by affecting the combination of factors employed, (2) by affecting the scale of operations.<sup>9</sup> Insecurity of tenure, which is a form of uncertainty, and social factors which lead to a desire for farm ownership, have induced many farmers to undertake ownership under conditions which limit the size of the total enterprise. Capital rationing leads to too many small scale farms; farms too small to utilize the labor capacities of the families living upon them. Also of importance is the distortion in the relative employment of factors due to the different impacts of capital rationing. In general, the existence of uncertainty, and with it capital rationing, has tended to put greater emphasis upon the use of labor, and upon short-term investments rather than long-term investments. Labor has been substituted for capital because it either has no fixed contractual relationship to the firm other than "subsistence" in the case of family labor, or a contractual arrangement that can be easily broken in the case of hired labor. This is in contrast to the situation in which a loan is made to purchase capital items, which must be backed by

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<sup>9</sup>Ibid, p. 24.



all or most of the farm assets. The resulting commitment may bring about the loss of all or part of the farm assets if returns are low over a period of time. Capital rationing may then be summed up as being significant on individual farms as it affects production decisions and resource applications, and between farms as it influences the relative sizes of farms.

### III. METHODS OF LIMITING OR OVERCOMING UNCERTAINTY

When expectations are uncertain, the farm entrepreneur may be said to be influenced in his decisions on the distribution of assets, by four major types of adjustments which he may make.<sup>10</sup> These adjustments include: (1) diversification, (2) flexibility, (3) liquidity and (4) safety preference in factor choice. Each of these related factors will be discussed in turn, with "diversification" being left to the last because the importance and value of this practice is the central point of the discussion.

Flexibility. The chief motivation for flexibility is in terms of increasing profit expectations.<sup>11</sup> This is in comparison to diversification in which the major motive is to lower the dispersion or variance of income. In other words, while diversification is mainly to prevent large losses, flexibility is more nearly a method of preventing the

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<sup>10</sup>Ibid., p. 47.

<sup>11</sup>Heady, op. cit., p. 524.

sacrifice of large gains. Flexibility may be used both to lessen income variability from one year to the next and to increase the expected value of income. It provides turning points in time for redecision, for a redistribution of resources, and allows for quicker changes at a lower cost sacrifice than a rigid plan, since flexible plans are adaptable to a wider range of alternatives. Flexibility is the keynote of resource administration when uncertainty is great.

There are three different types of flexibility, including that of time, cost and product. Time flexibility involves the adoption of enterprises that exist or reach maturity over a short period. For example, a hog enterprise can be terminated or begun within a few months at the most, whereas operating an orchard does not offer much in the way of flexibility because of the length of time required for fruit trees to reach maturity. Cost flexibility is emphasized through the use of cheap short-lived production factors which thereby allow for changes in the production scheme without involving high costs. An example is the construction of shelter for beef cattle out of poles or old lumber rather than the building of large expensive housing facilities. Product flexibility is exemplified by the use of dual purpose cattle. The enterprise emphasis here may be easily and fairly quickly changed between milk or beef production, depending of course on the comparative markets for these products. All of these considerations emphasize the fact that if uncertainty has an effect on decisions it is that of emphasizing short-run plans.

Flexibility tends to increase average unit costs, although it should also increase profit expectations under conditions of uncertainty. Suppose for example, that a dual purpose herd of cattle are kept for the sake of flexibility, so that production may be changed quickly and inexpensively between beef and milk. Certainly the average unit costs would be higher because milk ordinarily could be produced more cheaply with dairy than with dual purpose breeds of cattle. Similarly, beef could ordinarily be produced cheaper with specialized breeds of beef cattle. Because of flexibility, however, profit expectations could still be higher assuming highly uncertain conditions, as long as the price of either beef or milk was at a satisfactory level. The entrepreneur would be able to switch production to whichever of the two products indicated the highest profit margin in any particular season. The main assumption here is that if the price of either beef or milk is low, that of the other product will be higher. In other words, the prices of the two products do not tend to rise and fall together (are not highly correlated). This assumption will be tested in Chapter VIII.

The "cost" of flexibility to society rests upon two considerations: (1) would a reduction in uncertainty eliminate the necessity for some flexibility? (2) are the types of flexibility now provided, the most appropriate?<sup>12</sup> Concerning these points, there is a reasonable

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<sup>12</sup>Johnson, op. cit., p. 54.

presumption that the types of flexibility required for short-run shifts in the relative outputs of agricultural products, or of crops are largely unnecessary and are an outgrowth of mistaken price expectations. The relative demand for agricultural products does not change appreciably from year to year so that a reasonable stability of relative outputs seems to be most consistent with the interests of both producers and consumers.

Liquidity. Liquidity may be defined as the maintenance of cash balances or unused credits in excess of needs for transactions under conditions of certainty.<sup>13</sup> Its function is to permit the firm to take advantage of favorable opportunities which require readjustments of plans involving purchases, or to reduce the possibilities of unfavorable circumstances resulting in loss of assets. The necessity for some degree of liquidity is strengthened by the presence of capital rationing, which may make it difficult to borrow in order to take advantage of a favorable circumstance, or may force liquidation when the turn of events is unfavorable. It is doubtful, however, if the desire for liquidity has much influence on resource allocation in agriculture. This is because the desire to hold more cash can be satisfied by increasing the total supply of money in excess of the needs for ordinary transactions, without having much influence on the total real value of productive assets. This is because the total cash balances held in agriculture represent only a small proportion of the total assets used in production.

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<sup>13</sup>Ibid., p. 56.

The Safety Preference in Factor Choice. One of the most important relationships between uncertainty and the firm in agriculture has been the effect upon the combination of the factors of production employed in agriculture.<sup>14</sup> The existence of uncertainty has, in general tended to place greater emphasis upon the use of labor, upon short-term investments, and has limited the size of farm. The first and last points have undoubtedly resulted in lower labor incomes and a larger labor force in agriculture than would exist with less uncertainty.

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<sup>14</sup>Ibid, p. 57.

## CHAPTER V

### DIVERSIFICATION

Diversification in agriculture may be loosely defined as the simultaneous production of several different crops and types of livestock. It is the distribution of farm resources over the production of a variety of farm products or enterprises in comparison to specialization in one or two. There are several types of diversification distinguished by the extent to which the practice is carried, and explained by the motives behind this "spreading of resources" over the production of multiple products. Included is diversification to take advantage of: (1) complementary enterprise relationships, (2) supplementary enterprise relationships, (3) equating substitution and price ratios in the competitive range of enterprise relationships, and (4) as an uncertainty precaution where the immediate objective is not so much one of profit maximization as one of income stability.

#### I. TYPES OF DIVERSIFICATION

The diagram, Figure II page 33 will be used to show the four types of diversification. It should be noted that only two enterprises, referred to as A and B are used for the sake of simplicity, but the same principles apply to any number of enterprises. Complementarity and supplementarity are of course not necessarily apparent between the same enterprises as shown in the diagram. The curve PQ may be denoted

as the physical production possibility curve for the fixed amount of given resources assumed in this example. Complete specialization will result in either OP of A or OQ of B being produced.

Complementary enterprise relationships. Enterprise A and B are complementary if an increase in output of one, with resources held constant also results in an increase in output of the other. In the diagram suppose the farm entrepreneur is currently producing OP of enterprise A and none of enterprise B. Now if he produces OW of B, output of A will increase from OP to OL. An example of this could be the introduction of a legume and grass crop enterprise into a specialized wheat farm. Although the resources being applied to wheat (A) would be reduced by the amount being used for legumes and grasses (B), total wheat production could be increased because these crops add nitrogen and improve soil structure, help prevent soil erosion and are of assistance in controlling insects, thus resulting in higher yields of wheat.

Supplementary Enterprise Relationships. Two enterprises bear a supplementary relationship, when with resources held constant, output of one product may be increased with neither a gain nor a sacrifice in the other product. Increasing production of B from OW to OX results in no change in the production of enterprise A. A tractor or truck used in a crop enterprise may be employed in a livestock enterprise in the off-season. In this example total farm output is increased without affecting the output or the resources allocated to the major crop enterprise.

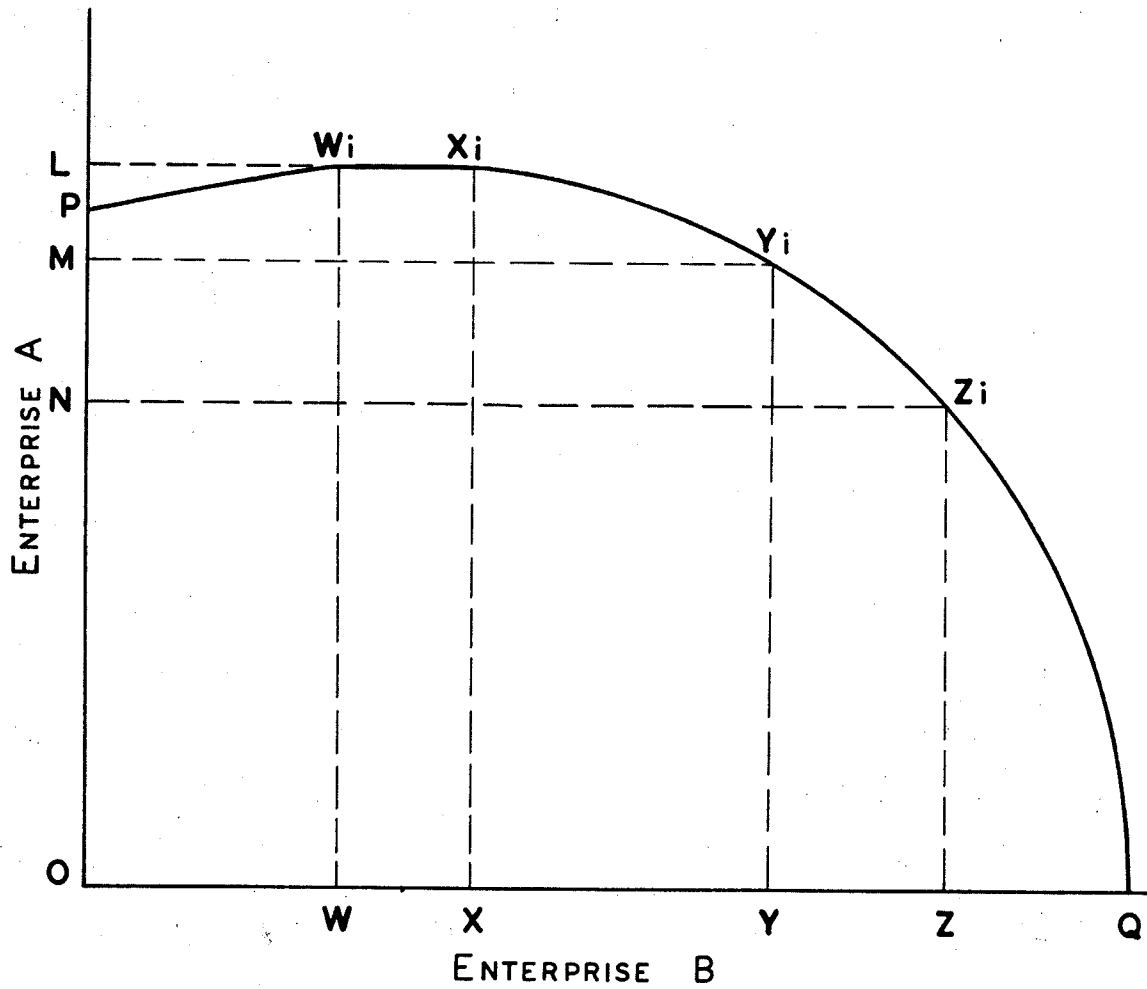


FIGURE 2

ILLUSTRATION OF ENTERPRISE RELATIONSHIPS



Equating Substitution and Price Ratios in the Competitive Range of Enterprise Relationships. Moving from point P to Point Xi on the production possibility curve, the output of enterprise A is not adversely affected by increasing the proportion of given resources employed in production of B. However, over the range of the curve from Xi to Q, a reduction in the output of A occurs for every increase in output of B, resulting from the shift of units of resource from A to B. From the curve it is apparent that the first unit of resource transferred from A to B, moving downward from point Xl, will result in a greater output of B than the loss in output of A. If the price of B is greater or similar to that of A, it would pay the entrepreneur to make this transfer. In other words, total revenue is increased because the additional output of B times the price of B will be greater than the decrease in output of A times the price of A. However, as succeeding units of resource are transferred from production of A to production of B, the marginal increase in output of B will tend to become increasingly smaller (diminishing marginal return to resources) while the marginal decrease in production of A will tend to become increasingly larger. This phenomena is often referred to as the "diminishing marginal rate of transformation". As additional units of resource are transferred from A to B, an equilibrium point will eventually be reached where a unit of resource is equally valuable in each enterprise. At this point, the increased output of B times the price of B is equal to the decreased output of A times the price of A. The sub-

stitution and price ratios of the two enterprises have been equated, represented by Point  $Y_1$  on the diagram. Beyond this point any increase in production of B by transferring resources from enterprise A will result in a decline in total revenue. This is the point where the marginal value productivity of resources used in B equals the marginal value productivity of the same resources used in A, which is the point of optimum efficiency in resource allocation between the two enterprises. Under conditions of certainty or approaching certainty, this is the point of maximum profits.

Diversification as an Uncertainty Precaution

(Intensive Diversification.)

Suppose in our diagram that the output of the two enterprises A and B are extremely variable and unpredictable, but that the factors causing variation in the output of A, have little effect on the output of B. Conversely, those factors causing fluctuation in the output of B have little effect on the output of A. Examples include insects and diseases which attack one product and not the other. Similarly, one enterprise might be much more subject to weather variations and extremes, or to different types of weather conditions than the other. For example, wheat is comparatively frost resistant in the spring compared with flax and corn. Under these conditions, it might be more profitable over the long run to divide the resources differently between enterprises A and B than the "optimum" point indicated above. Production could then resemble that shown at point  $Z_1$  on the curve, with ON

output of A and OZ output of B. In any one year the maximum output from the fixed resources probably would not be obtained (point  $Y_i$ ), but under extremely hazardous and uncertain conditions, over the long run, it is quite conceivable that a more stable output would be realized in this way.

This is what was meant by the term "intensive diversification" referred to on pages 1 and 13. It is the value of this form of diversification that will be analyzed and tested statistically in the following pages. Although the other three types of diversification are also quite important, their value would persist in the absence of uncertainty. This is not true of this fourth type which would cease to be useful in the presence of known or highly predictable circumstances affecting farm income. It is this type of diversification which has been referred to as a method of overcoming or at least cushioning the effects of uncertainty. Before beginning the statistical analysis, some discussion of the significance of diversification is necessary. In the following discourse, the word diversification will be used in reference to the "intensive diversification" definition unless otherwise specified, although in many cases application to one or all of the other types may be apparent.

## II. MOTIVES FOR DIVERSIFICATION

Diversification in agricultural production is carried on for a number of reasons or motives, of which "safety" is one of the foremost.

Safety has been an important motive for diversification in order to reduce the anticipated variations in income and profits.<sup>1</sup> Variations in the aggregate value of several products may be less than the aggregate variation of each product taken separately (as measured by the coefficient of variation.) This is because diversification should lead to the selection of commodities which have a lower variation in yield and price when taken as a group than the average variation of the commodities making up the group when each is considered separately.

A second motive for diversification is to obtain a more even or seasonal distribution of farm receipts.<sup>2</sup> This may be accomplished by combining enterprises that have rather different time distributions, and also by including an enterprise which produces products for sale throughout the year, (dairying).

A third situation leading to diversification is the possibility of producing some crop or livestock product with a very high degree of price and income stability.<sup>3</sup> An example of this might be the production of sugar beets or vegetable crops under prearranged contracts.

These reasons for "intensive diversification" grow largely out of the capital market, and are the direct outcome of the presence of uncertainty. If there were no restrictions on the amount of funds

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<sup>1</sup>D. G. Johnson, Forward Prices for Agriculture (Chicago: University of Chicago Press, 1947), p. 48.

<sup>2</sup>Ibid., p. 49.

<sup>3</sup>Ibid., p. 49.

which could be borrowed, there would be no incentive to reduce the dispersion of income, or to alter the time distribution within the year or between years from that which would result from the combination of enterprises leading to maximum income. In other words, the farm entrepreneur could proceed to organize his farm management program in the way most likely to maximize returns in the long run, without having to worry about uncertainties which could upset his program in the short run. If cases occur in which farm income is reduced below normal, the farmer could supplement his income by borrowing capital to tide his business over until cash returns are again above the subsistence level. Borrowings made in low income years could be repaid in above average income years. Each of the above motives is in actuality but a different aspect of the distribution of income over time.<sup>4</sup> Lowering the dispersion of profits is an important goal in agriculture because the capital market is restricted and most farm entrepreneurs cannot withstand heavy losses even if at the same time the probability of a large gain exists in the longer run.

### III. DIVERSIFICATION AND SPECIALIZATION

Specialization may be defined as the tendency for persons or entrepreneurs to work at only one task or to produce only one product, (normally the one in which they are most adept or for which the greatest

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<sup>4</sup>Ibid, p. 49.

return may be achieved per hour of labor or per unit of resource) and to sell the resulting product and use the proceeds to purchase all other requirements. Diversification, on the other hand, may be defined as the tendency to produce two, three or even more products in order to take advantage of any inter-product complementary and supplementary relationships in production that may exist, and to spread production risks and uncertainties over several products. This appears at first glance to be contrary to the principle of specialization. Adhering to the specialization principle an entrepreneur would apply all his effort to one product, while following the diversification principle he would spread his efforts over a number of products. Compatibility may be reached between these two apparent opposites when it is noted that a farm entrepreneur cannot usually make full use of his resources by specializing in one product. For example, if a farmer specialized in wheat production, through much of the year both his labor and machinery resources would be idle. Any other enterprises which could be added to his business that would make better use of these resources but not in competition with the wheat enterprise, would add to farm income. Similarly, diversification would not normally yield the highest possible returns to a farm entrepreneur if resources were diverted from one enterprise to another for the sake of diversification, when the productivity of the resources was somewhat less in the second use. These factors indicate that although both principles have advantages, there are certain disadvantages inherent in each. Some midpoint in which the

advantages of each one could be incorporated would appear to be indicated.

When the goal of the farm entrepreneur is taken as the situation in which the marginal cost is equal to the marginal revenue for all possible combinations of enterprises, so that returns are maximized, then these two principles can be applied without being contrary to each other. This would involve specialization to the extent that the enterprise or enterprises with the greatest comparative advantage would be adopted. It would involve diversification to the extent that complementary and supplementary relationships of these enterprises would be exploited and new enterprises would be added to make the fullest use of all available resources. This situation may be called the optimum position between the extremes of specialization and diversification. Departing from this position in order to adopt a more "intensive diversification" as a means of offsetting income fluctuations, will usually result in a lower average income because a part of the advantage of specialization will be lost by each successive step toward extreme diversification. In other words, transferring resources from their optimum use to the production of new products, will by definition tend to lower average income. Only if the newly added enterprises are less subject to the factors causing instability in income will there be any possibility of raising average income. As the analysis of correlation in Chapter VIII will show, the likelihood of this occurring is rather remote for most of the common Manitoba farm products.

## CHAPTER VI

### ANALYSIS OF CORRELATION AND DIVERSIFICATION

Income variability in agriculture may be lessened through diversification only if the prices, yields or cash incomes accruing from the products bear the proper correlations. Correlation is a measurement of the degree to which variables (yields, prices, etc.,) tend to vary together, presumably owing to influences or factors that are common to both. For example, yields of different crops under dry land farming would tend to vary together assuming that precipitation is the more important factor influencing production. The closer the correlation coefficient between two products approaches plus 1.0, the greater the degree to which the yields, prices, etc., of two products tend to vary together, and the poorer substitutes the two products are of each other for diversification purposes.

If the prices, yields or cash incomes have a correlation coefficient of plus 1.0, a combination of two or more products will not reduce variability. This is because each product varies in exactly the same pattern as the others. Similarly, if the correlation coefficient is minus 1.0, the two enterprises serve optimally as an uncertainty precaution. This is because one will tend to vary in exactly the opposite pattern as the other. In other words, the conditions that produce a high yield or price for the first product will tend to induce a low yield or price for the second product. The



reverse would also be true. Such products are excellent substitutes for diversification purposes. Correlation coefficients of or near zero indicate little or no relationship between products either of a positive or of an inverse nature.

The preceeding discussion would indicate a rather straightforward and simple way of measuring the effectiveness of products for diversification. This is not altogether the case. There is another factor or characteristic of prices, yields, and cash incomes of farm products that must be taken into consideration. Variation between years for products must also be taken into account when measuring values for diversification. A measurement of average yearly variations in yields, prices and cash incomes is presented in Table III on page 52, Using wheat as an example, the table indicates that the average variation in yield per acre for this crop has been 25.7 percent each year between 1926 and 1955.

It stands to reason that even if two products have a correlation coefficient approaching plus 1.0, if the average yearly variations in yield, price and cash income are widely different, then diversification from the highly variable product to one with a lesser variation would reduce uncertainty somewhat. An examination of Table III at this point will assist in determining the importance of this variability factor. The cash income column is the most significant one, arising as it does out of variable yields and variable prices. The most obvious point is that variability in crops is greater in aggregate than is variability

connected with livestock products. Therefore, even if say, wheat and beef production (cattle and calves) have a high correlation coefficient (0.84 for cash income), uncertainty could be reduced somewhat by transferring resources from the former to the latter. This is because wheat has a variability of 33.9 percent while cattle and calves have a variability of 22.6 percent.

The significance of this variability factor is not altogether easy to determine. However, several conclusions may be drawn at this point. First, all other factors being equal, the farm entrepreneur should choose the products with the lowest variability. Unfortunately, production of the commodities with the lowest variation in cash income, including dairy products, eggs, and vegetables have a limited market in Manitoba, while production of livestock in general, also involves production of highly variable products such as oats and barley. In spite of this, there is obviously some merit in choosing products which have the lowest year to year variation in cash returns.

## CHAPTER VII

### INSTABILITY CHARACTERISTICS OF MANITOBA AGRICULTURE

#### I. FACTORS USED

All the most important crop and livestock products grown in Manitoba for which there are records reaching back to 1926, were used in this analysis. These products accounted for over 94 percent of the average annual farm cash income received from 1926 to 1954. The factors were classified in three different ways, according to yield, price and farm cash income each year from 1926 to 1955. In reference to farm cash income, the period from 1926 to 1954 was used because the final figures for 1955 were not available when this study was compiled. A thirty year period was selected because it was suitable for statistical analysis.

Livestock marketings were included with yields in this analysis. There are several disadvantages to this method of handling, namely, that total marketings of livestock is more related to total marketings of grain and also livestock marketings are largely controlled by the farm entrepreneur. In spite of these disadvantages an analysis was made of livestock marketings and they were included with yields in order to facilitate handling of statistics. Actually this analysis is not very significant because livestock marketings are not an uncertainty to the farm entrepreneur but are determined by him. Livestock marketings are affected by uncertainties to the extent that

they must be sold before they are ready for market because some unexpected need for cash has arisen.

In the statistical material published by the Dominion Bureau of Statistics used in this discussion, hay and clover were under one classification. To designate this fact the two words are connected by a hyphen in the following tables.

Yields. The yields for the various crops in this analysis are yields of all grades of each crop in each year for the Province of Manitoba. Coding of yields, as well as prices and cash incomes was done to facilitate statistical analysis. The period from 1945 to 1949 was used as a basis for coding because it was marked by neither unusually high or low yields.

Prices. Prices received for wheat, oats, barley, rye and flax are simply weighted average prices in dollars per bushel of all grades at the farm level. Hay-clover, alfalfa and fodder corn are in terms of dollars per ton at the farm level. Considering livestock prices, changes in classification have tended to render statistics for different periods of time not truly comparable. However, steps were taken to ensure consistency, and the figures recorded are quite satisfactory for the purpose of this analysis. The following grades of livestock were used, and the prices are those received by the producer at Winnipeg.

Steers- medium-up to 1000 lbs. (1926-29, 700 to 1000 lbs.)  
(1930-45, up to 1050 lbs.)

Calves- medium to good, milk fed. (1926 - 29, good, veal.)

Hogs- Bi (1926 - 29, thick smooth; 1930-39, bacon)

Lambs- good handyweights.

The object was to use characteristic classifications, or those which were the most common, and also similar throughout the years under study. The period from 1935 to 1939 was used as a basis for coding. Although this period may have some disadvantages, price relationships were not affected by war and not as much by depressionary factors as any other five year period between 1926 and 1955.

Cash Incomes. Statistics on farm cash income show the actual cash return at the farm level from the sale of farm products. Supplementary, and any subsidy payments are included as far as possible. The period from 1945-1949 was again used for coding purposes.

Table I on page 47 provides an indication of the relative importance of each of the products or factors used in this analysis. Each column represents the percentage of the total cash income received by the different enterprises on the average for that particular five year period. Exceedingly small or miscellaneous sources of income are excluded, so that the totals do not necessarily balance exactly.

Several points stand out in this table. The relative importance of cash income received from wheat has declined from nearly 42 percent of total cash income in the 1926-1930 period, to some 27 percent in 1951-1954. At the same time the total cash income received from all crops declined from about 64 percent to some 57 percent of total farm cash income. Wheat is responsible for this entire decline which

TABLE I

## Relative Importance of Farm Enterprises

Five Year Averages, Manitoba 1926 - 1954

(based on percent of total farm cash income)

	<u>1926-1930</u>	<u>1931-1935</u>	<u>1936-1940</u>	<u>1941-1945</u>	<u>1946-1950</u>	<u>1951-1954</u>
wheat	41.6	39.2	40.7	25.0	31.0	27.4
oats	3.5	2.3	1.9	5.3	5.4	6.4
barley	12.9	5.3	7.9	10.9	10.7	16.2
flax	1.5	0.3	0.6	2.2	6.6	4.1
potatoes	0.7	0.8	0.6	0.4	0.3	0.3
rye	1.5	0.4	0.7	0.4	0.6	0.5
vegetables	0.4	1.0	0.7	0.5	0.6	1.0
Total crops	63.9	51.3	55.8	47.7	57.3	57.4
cattle & calves	10.3	12.3	14.3	14.3	16.9	14.1
hogs	6.7	7.7	8.2	13.4	7.0	8.0
sheep & lambs	0.4	0.8	0.7	0.7	0.5	0.2
dairy prod.	8.9	13.8	11.1	10.8	9.2	6.4
poultry & eggs	7.8	8.7	6.3	7.7	5.9	8.0
Total Livestock	35.5	47.4	43.0	49.0	41.0	40.7
Total Farm Cash Income	99.4	98.7	98.8	96.7	98.3	98.1

For this purpose, a calculation was made of the average year to year fluctuation in yield, price and cash income for each product, as well as the gross value of all agricultural production, (including that consumed on the farm), the cash farm income and the net farm income. This was arrived at by computing the percent change from year to year in each case. Ignoring plus and minus signs, the figures for each individual product or classification were added together, and the average percent change derived by dividing the total by the number of years involved in each case. Table II page 50, will show the variations in farm income and the value of production. Table III page 52, will be used to illustrate yields, prices and cash income for the various products.

In Table II it will be noted that the gross value of agricultural production fluctuated on the average, over twenty percent each year during the twenty-nine year period. Because this figure is an average, it should be noted that there were times in which variation ranged all the way from one to sixty percent between years. Net farm income showed over three times as much variation. The reasons for this are fairly obvious. Net income is of course, cash income less farm expenses. It is the return to the farm entrepreneur's labor (wages) and capital. As farm expenses are fairly constant the net income variability in actual dollars is very much the same as that for cash income. However, calculated on a smaller base (net income is, of course, less than cash income) the average yearly variation is considerably higher.

TABLE II

## Average Year to Year Variation in Farm Returns

Manitoba 1926 - 1954

(- percent -)

	<u>1926-54</u>	<u>1945-54</u>	<u>1950-54</u>
Gross Value of Agricultural			
Production	20.5	11.3	11.6
Farm Cash Income	19.6	15.7	14.0
Net Farm Income*	71.0	28.1	27.0

\* A negative Figure occurred in 1931. In calculating the percentage change from 1930 to 1931 (positive to negative Figure) and from 1931 to 1932 (negative to positive) a percentage change of 100 percent was arbitrarily used in each case.



It is this type of variation that complicates the efficiency of resource use and builds up the characteristic of risk aversion in the farm entrepreneur. Similarly outside sources of capital hesitate to lend under such risks. This is the sort of circumstances that has encouraged the practice of diversification. The importance of any method of lowering this variability is obvious in light of the high fluctuation in net income.

It will be noted that the variability of net farm income was substantially less between 1945 and 1954, than for the longer period. This resulted because of the extreme variability of the early 1930's, when net income was actually a negative value during one year (1931.) Gross farm expenses exceeded gross farm income for the entire agricultural industry. Even in the last ten years, with variability averaging 28 percent, net farm income fluctuated over four-times as much as personal income for the rest of the economy.<sup>1</sup>

Table III provides a more detailed breakdown of year to year variations for the thirty-year period. Using wheat yields as an example, it will be noted from the table that the average year to year variation is greater than 25 percent. This means that during the period from 1926 to 1955, the yield of wheat in Manitoba, fluctuated over 25

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<sup>1</sup>During the last ten years, total personal income accruing to Manitobans fluctuated 6.6 percent each year on the average. In all but 1954 the movement was positive, (showing an increase). Farm net income was positive only four times out of the ten years.

TABLE III

## Average Year to Year Variation in Yields, Prices and Cash Incomes

Manitoba 1926 - 1955 (a)

(- percent -)

	<u>Yield</u>	<u>Price</u>	<u>Cash Income</u>
wheat	25.7	15.6 (b)	33.9
oats	33.0	25.1	43.7
barley	25.2	25.8	45.6
flax	20.4	21.6	54.9
potatoes	28.3	39.7	28.1
rye	16.0	36.6	55.6
vegetables	-	-	21.9
hay-clover	20.2	16.2	-
alfalfa	17.0	12.7	-
fodder corn	24.3	13.4	-
<b>Total Crops</b>	-	-	29.8
steers	30.6	17.8	22.6 (c)
calves	17.2	17.3	-
hogs	19.8	14.4	20.8
lambs	20.7 (d)	12.0	15.3 (d)
eggs	-	16.5	15.8 (e)
dairy products	-	-	11.8 (f)
butter	-	10.4	-
<b>Total Livestock</b>	-	-	12.7
<b>Total Farm</b>	-	-	19.6

(a) 1926 to 1954 in the "cash income" column.

(b) Excluding the period of regulated prices (1946-1955) the variability is 22.3 percent.

(c) Includes sales of all types of livestock.

(d) Includes sheep as well as lambs,

(e) Includes all income from poultry and poultry products.

(f) Includes butter also.

percent each year on the average. As a matter of interest, the range was from a low average of 9.0 bushels per acre in 1935, to a high average of 27.5 bushels per acre in 1942.

The uncertainty characteristic of agriculture is especially shown in the third column. Total farm cash income has fluctuated nearly twenty percent annually during this period. The fluctuation in income from crops averaged almost thirty percent, which is considerably greater than the thirteen percent variation indicated for livestock products. Flax, rye, barley, oats and wheat are all especially variable.

A similar detailed table (Table IV page 54) was also calculated for each of the most recent five and ten year periods. Although in the majority of cases the average year to year change in cash income is smaller for each of these periods than for the longer period previously analyzed, there is still considerable variability indicated. It should also be pointed out that during this ten-year period, the agricultural industry was not faced with any major or sharp economic change. Relatively speaking, this was probably the most stable ten-year period in the brief history of agriculture in this Province.

It will be noted that the variation in income from total livestock is considerably less than variation shown for individual livestock products. This would appear to be caused largely by the effects of the various cycles of production existing for different livestock products (hogs notably). In other words, total income from livestock shows relatively little variation because the cycles for different livestock

TABLE IV

Average Year to Year Variation in Yields, Prices and Cash Incomes.

Manitoba 1946 - 1955 and 1951 - 1955 (a)

	<u>Yield</u>		<u>Price</u>		<u>Cash Income</u>	
	<u>5 Yrs.</u>	<u>10 Yrs.</u>	<u>5 Yrs.</u>	<u>10 Yrs.</u>	<u>5 Yrs.</u>	<u>10 Yrs.</u>
wheat	26.0	25.2	4.7	2.7	43.9	35.5
oats	23.9	25.3	5.8	12.0	23.3	20.0
barley	16.4	23.3	5.2	15.7	21.1	19.9
flax	11.4	10.2	12.7	19.1	21.1	51.7
potatoes	7.9	13.8	45.3	28.0	25.6	18.5
rye	11.9	10.2	18.8	26.6	26.5	47.5
vegetables	-	-	-	-	27.5	32.6
hay-clover	14.3	24.5	10.1	13.5	-	-
alfalfa	13.6	20.0	9.5	10.0	-	-
fodder corn	19.2	24.9	6.2	7.8	-	-
Total Crops	-	-	-	-	29.2	24.3
steers	18.9	21.0	19.4	18.7	10.5	20.0 (b)
calves	20.2	12.8	19.5	18.0	-	-
hogs	24.4	17.6	13.2	12.9	16.9	15.8
lambs	11.2	16.8	14.8	16.4	16.4	13.1 (c)
eggs	-	-	27.7	20.1	14.7	10.6 (d)
dairy products	-	-	-	-	7.1	14.1 (e)
butter	-	-	6.3	13.1	-	-
Total Livestock	-	-	-	-	3.9	6.6
Total Farm Cash Income	-	-	-	-	17.4	15.7

(a) 1950 to 1954 and 1945 to 1954 in the "cash income" column.

(b) Includes all types of livestock.

(c) Includes sheep as well as lambs.

(d) Includes all income from poultry and poultry products.

(e) Includes butter also.

products tend to balance each other out in spite of the considerable variation each may show through its particular cycle.

One interesting sidelight to this discussion may be seen by comparing the figures for wheat between the 30 year period and the 5 and 10 year periods. Yields show a relatively steady rate of variation. Price variation has been reduced to a very small figure under the government wheat marketing system in the latest two periods. What effect has this had on cash income? It has not shown less but rather more variability under the system of stabilized prices. This appears to be an indication that the attempt to stabilize farm income by stabilizing prices has been relatively ineffective.

## CHAPTER VIII

### CORRELATION OF PRICE, YIELD, AND CASH INCOME INSTABILITY

#### I. STATISTICAL ANALYSIS

The statistical tool applied in this analysis is called the correlation coefficient.<sup>1</sup> It is a measure of the amount of variation in one variable that is associated with variation in another variable or variables. Correlation is not necessarily the effect of one variable on another, but rather the degree to which the variables vary together, owing presumably to influences that are common to both. It is a measure of the degree of association in the movement of the two or more variables. On page 41, it was noted that correlation is measured by the extent to which the coefficient falls close to plus 1.0 (positive) or minus 1.0 (negative).

This is a very brief indication of the statistical procedure, as it is not of any value to cover this in any more detail at this time. It is important, however, that the meaning of this measurement be kept

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<sup>1</sup>The equation for the correlation coefficient "r" is as follows:

$$r = \frac{\sum xy}{\sqrt{\sum x^2 \sum y^2}} \quad \text{where } \sum xy = \sum XY - \frac{\sum X \sum Y}{N}$$
$$\text{and } \sum x^2 = \sum X^2 - \frac{(\sum X)^2}{N} \quad \text{and } \sum y^2 = \sum Y^2 - \frac{(\sum Y)^2}{N}$$

constantly in mind. The correlation coefficient measures the proportion of the variation in one factor or product which is associated with another, and therefore is a measure of the relative importance of the concomitance of variation in the two factors. It merely tells how closely the variance of one variable is associated with that of another; whether the association is due to, or can be taken as evidence of a cause and effect relationship is another matter, which is outside the scope of this statistical analysis.

## II. OBSERVATIONS

Correlation Coefficients. The following three tables show the correlation coefficients that were found to exist between yields, prices and cash income received from various farm products. It will be observed that there is generally a fairly high degree of correlation between most farm products in Manitoba in all three tables. Prices are especially highly correlated, followed by cash incomes and lastly by yields. The latter classification shows much less correlation generally, than is found in the other two tables. Most products in the analysis show at least some degree of positive correlation. The red figures denote a negative correlation.

It will be noted in Table V that yields of cereal crops such as wheat, oats and barley are highly correlated. Crops such as flax, potatoes and rye show somewhat lower correlation while hay-clover, alfalfa and fodder corn are generally less correlated with other pro-

TABLE V

Correlation Coefficients of Annual Yields (Marketings), for Pairs of Products

Manitoba 1926 - 1955

	<u>Wheat</u>	<u>Oats</u>	<u>Barley</u>	<u>Flax</u>	<u>Potatoes</u>	<u>Rye</u>	<u>Hay Clover</u>	<u>Alfalfa</u>	<u>Fodder Corn</u>	<u>Steers</u>	<u>Calves</u>	<u>Hogs</u>	<u>Sheep</u>
Wheat	1.00	.90	.82	.53	.42	.38	.02	.20	.03	.12	.34	.53	.34
Oats		1.00	.88	.59	.54	.56	.22	.42	.02	.14	.39	.47	.23
Barley			1.00	.66	.60	.53	.30	.41	.12	.05	.27	.38	.21
Flax				1.00	.39	.50	.38	.49	.18	.32	.41	.36	.22
Potatoes					1.00	.68	.57	.58	.50	.07	.01	.10	.24
Rye						1.00	.44	.57	.36	.13	.14	.07	.13
Hay-Clover							1.00	.86	.45	.24	.08	.21	.11
Alfalfa								1.00	.35	.11	.44	.25	.01
Fodder Corn									1.00	.33	.18	.21	.44
Steers										1.00	.46	.20	.13
Calves											1.00	.28	.67
Hogs												1.00	.46
Sheep													1.00



TABLE VI

## Correlation Coefficients of Annual Prices for Pairs of Products

Manitoba 1926 - 1955

	<u>Wheat</u>	<u>Oats</u>	<u>Barley</u>	<u>Flax</u>	<u>Potatoes</u>	<u>Rye</u>	<u>Hay Clover</u>	<u>Alfalfa</u>
Wheat	1.00	.94	.92	.90	.79	.80	.75	.75
Oats		1.00	.96	.92	.80	.76	.78	.78
Barley			1.00	.89	.80	.70	.77	.77
Flax				1.00	.77	.83	.74	.73
Potatoes					1.00	.58	.75	.77
Rye						1.00	.59	.56
Hay-Clover							1.00	.98
Alfalfa								1.00

	<u>Fodder Corn</u>	<u>Steers</u>	<u>Calves</u>	<u>Hogs</u>	<u>Lambs</u>	<u>Butter</u>	<u>Eggs</u>
Wheat	.82	.79	.78	.85	.80	.83	.87
Oats	.81	.82	.81	.87	.83	.88	.88
Barley	.79	.85	.84	.89	.87	.88	.84
Flax	.74	.78	.76	.82	.78	.83	.82
Potatoes	.62	.81	.79	.74	.76	.76	.66
Rye	.66	.50	.48	.54	.50	.56	.65
Hay-Clover	.78	.73	.74	.76	.74	.82	.73
Alfalfa	.80	.77	.79	.78	.78	.82	.75
Fodder Corn	1.00	.75	.76	.77	.77	.76	.84
Steers		1.00	1.00	.92	.99	.90	.84
Calves			1.00	.91	.99	.89	.84
Hogs				1.00	.94	.86	.88
Lambs					1.00	.92	.86
Butter						1.00	.91
Eggs							1.00

TABLE VII

## Correlation Coefficients of Annual Cash Incomes for Pairs of Products

Manitoba 1926 - 1954

	<u>Wheat</u>	<u>Oats</u>	<u>Barley</u>	<u>Flax</u>	<u>Potatoes</u>	<u>Rye</u>	<u>Vegetables</u>	<u>Total Crops</u>
Wheat	1.00	.87	.81	.68	.77	.62	.69	.96
Oats		1.00	.95	.63	.80	.51	.78	.95
Barley			1.00	.60	.85	.62	.83	.92
Flax				1.00	.62	.53	.64	.76
Potatoes					1.00	.71	.68	.84
Rye						1.00	.46	.65
Vegetables							1.00	.79
Total Crops								1.00

	<u>Cattle &amp; Calves</u>	<u>Sheep &amp; Hogs</u>	<u>Dairy Lambs</u>	<u>Dairy Products</u>	<u>Poultry &amp; eggs</u>	<u>Total Livestock</u>	<u>Total Farm Cash Income</u>
Wheat	.84	.64	.52	.81	.74	.81	.92
Oats	.92	.84	.63	.91	.91	.94	.97
Barley	.85	.79	.43	.87	.91	.89	.93
Flax	.72	.50	.43	.77	.63	.70	.75
Potatoes	.81	.70	.42	.77	.75	.81	.84
Rye	.48	.33	.07	.48	.47	.47	.59
Vegetables	.78	.61	.31	.85	.90	.82	.82
Total Crops	.91	.75	.54	.91	.86	.91	.98
Cattle & Calves	1.00	.78	.67	.93	.86	.96	.95
Hogs		1.00	.74	.88	.85	.90	.83
Sheep & Lambs			1.00	.67	.55	.71	.63
Dairy Products				1.00	.95	.98	.96
Poultry & Eggs					1.00	.95	.92
Total Livestock						1.00	.97
Total Farm Cash Income							1.00

ducts. Livestock marketings exhibit even less correlation and some inverse or negative correlation exists in some instances. This may be an indication that when crop yields are low, livestock marketing often has to be increased, both because a farmer may not have enough feed to maintain his herd or he may have to increase marketings in order to obtain funds to meet obligations he normally would have paid through returns from crops.

The most striking feature of the analysis carried out was the especially high correlation found to exist in prices (Table VI). This illustrates that these prices must be affected for the most part by the same factors and in a similar way, and therefore, all follow a closely related pattern from year to year. This high correlation obviously helped to make the correlation among cash incomes relatively high for the various products (Table VII).

Scatter Diagrams. It may be difficult to visualize how high the relationship between two products is by their correlation coefficient. This may be more easily seen by the use of what is commonly called a scatter diagram. The values of any pair of farm products (for example wheat and oats) for each year are plotted. The figures for wheat may be represented as ordinates and those for oats as abscissas, so that each pair (representing one year) can be indicated by a dot on the diagram. The final result is a figure that represents in a general way, by the arrangement of the dots, the relation between the two products. The more closely the dots arrange themselves in a

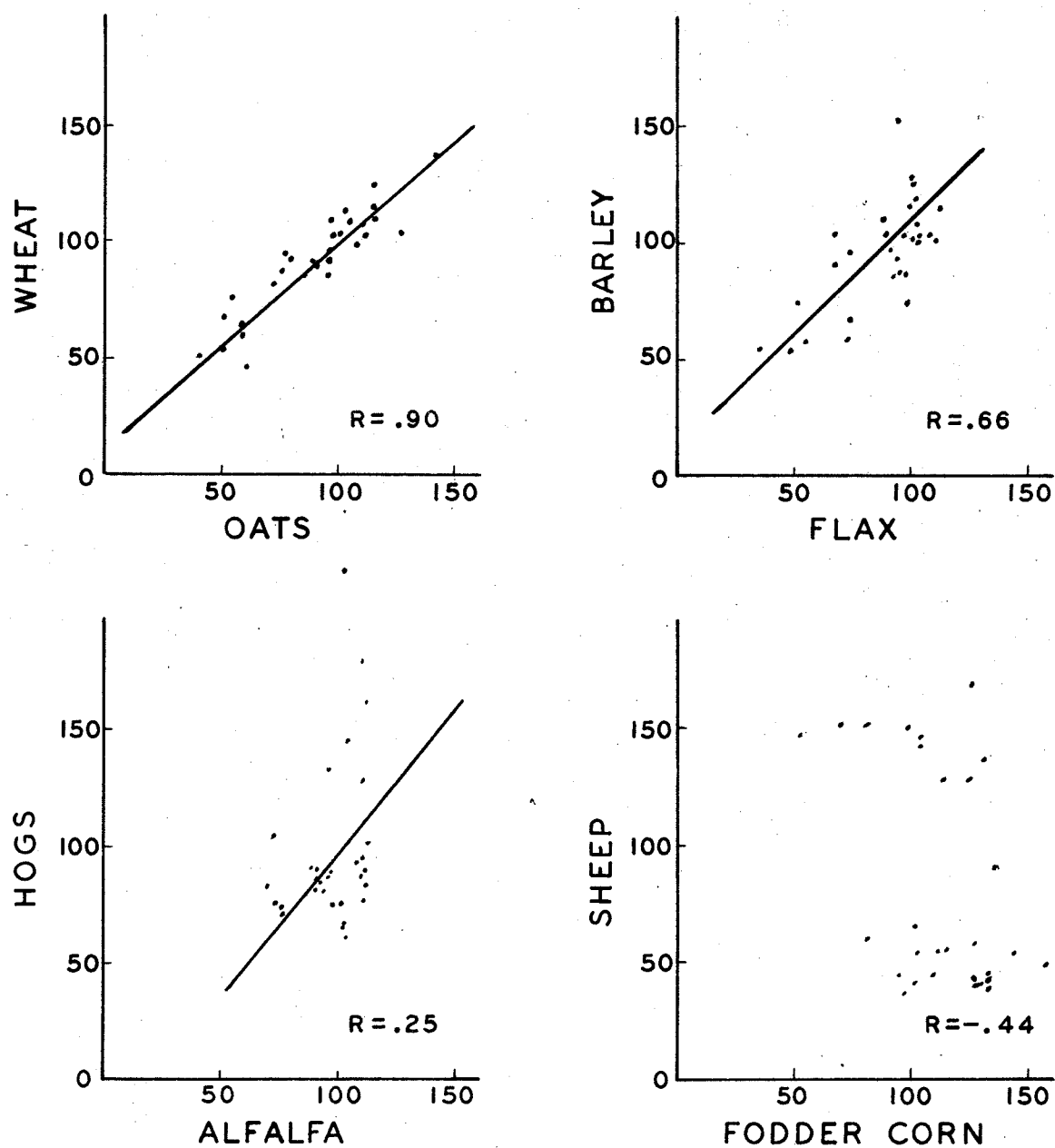


FIGURE 3

CORRELATION COEFFICIENTS FOR YIELDS

Manitoba 1926 - 1955

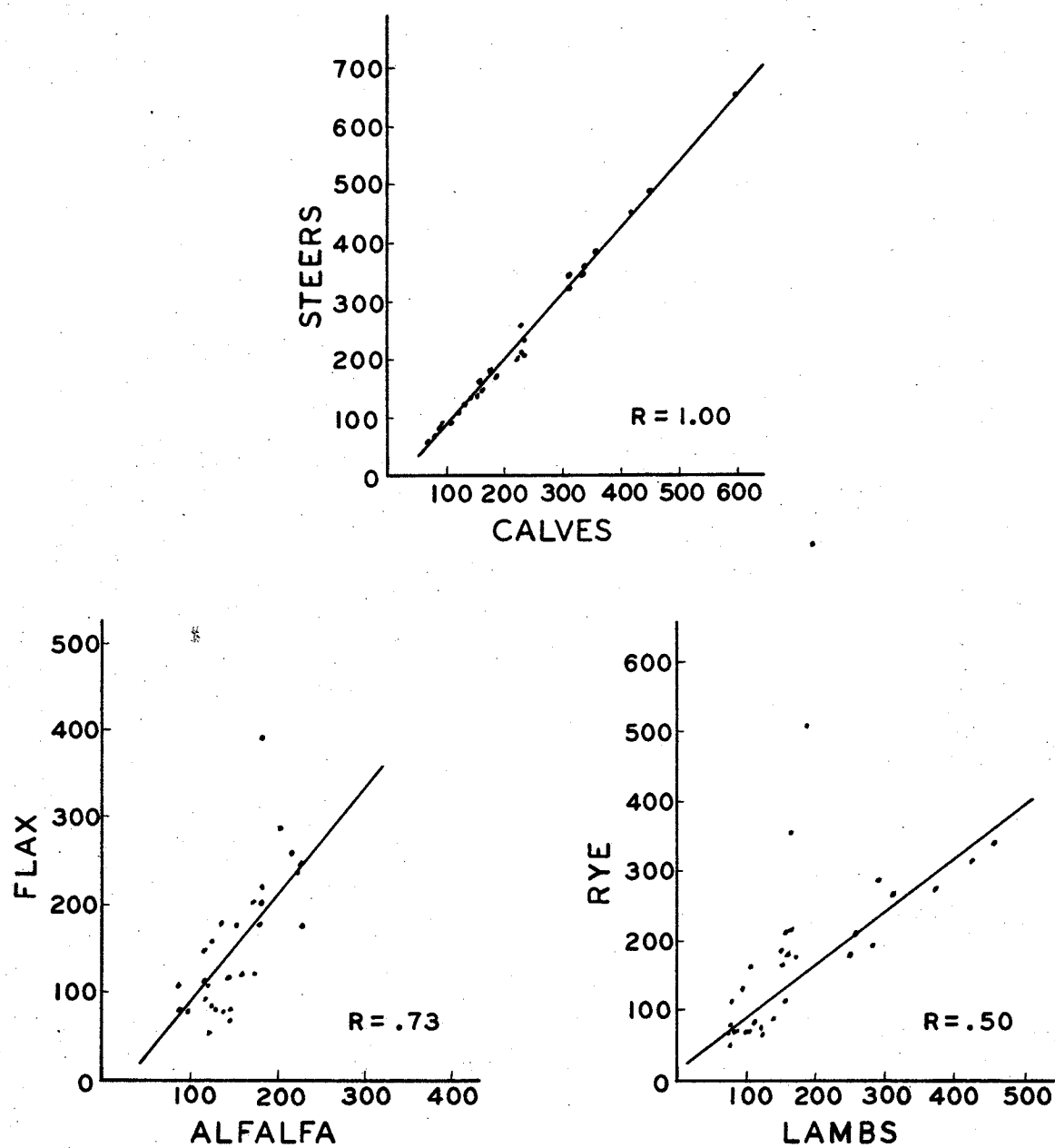


FIGURE 4

CORRELATION COEFFICIENTS FOR PRICES

Manitoba 1926 - 1955

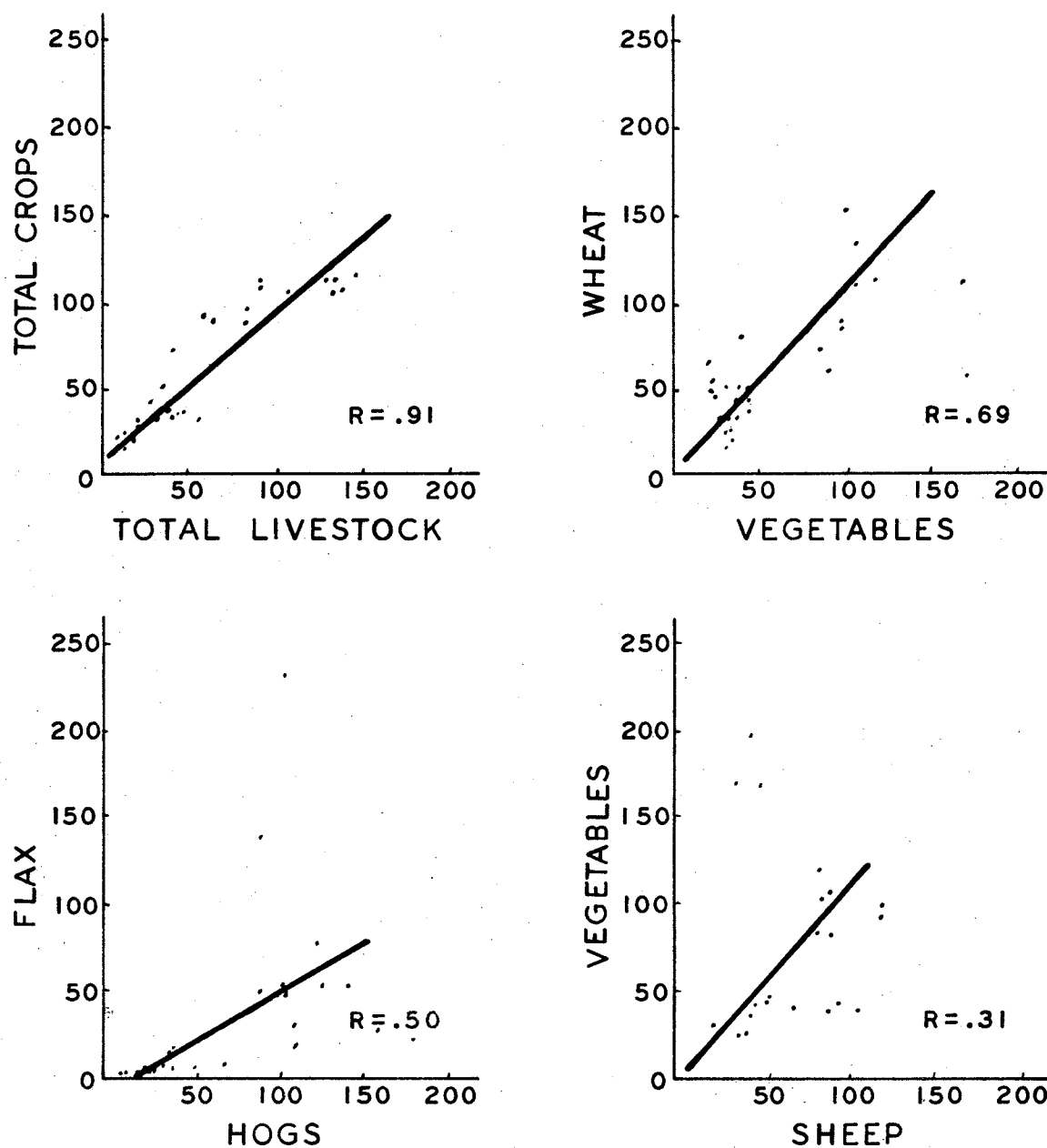


FIGURE 5

CORRELATION COEFFICIENTS FOR CASH INCOMES

Manitoba 1926 - 1954

straight line, the higher the correlation. Although the scatter diagram does not give a mathematical measure of the relationship, it does indicate quite clearly whether any significant relationship exists between the variables.

In Figures 3, 4 and 5, selected correlation coefficients have been graphed, in order to provide a better idea of the difference between the various levels of relationship outlined previously for the yields, prices and cash incomes. Each figure includes an example of a high positive correlation ( $r$ ) followed by succeeding lower positive correlations, with one exception. In Figure 3 an example of a negative correlation is shown between sheep and fodder corn.

Substitutability Classification. The following classifications were set up in order to further analyze the correlation coefficients obtained:

<u>Correlation Coefficient</u>	<u>Correlationship</u>	<u>Substitutability</u> <sup>1</sup>
.70 plus	High	Very Poor
.50 to .70	Medium	Poor
.20 to .50	Low	Fair
.20 minus	Very Low	Good

In Table VIII an evaluation of the degree of substitutability is made for each product, according to these classifications. Very

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<sup>1</sup>Substitutability refers here to the usefulness of a product for diversification purposes, to overcome uncertainty. If two products or enterprises are highly correlated, it is obvious that they make very poor substitutes.

TABLE VIII

## Classification of Products According to Substitutability

Manitoba 1926 - 1955

	<u>Yields</u>	<u>Price</u>	<u>Cash Income</u>
<u>Wheat</u>			
Good	hay-clover, fodder corn, steers	-	-
Fair	potatoes, rye, alfalfa, calves, sheep	-	-
Poor	flax, hogs	-	rye, flax, vegetables, hogs, sheep
<u>Oats</u>			
Good	fodder corn, steers	-	-
Fair	alfalfa, hay-clover, hogs, calves, sheep	-	-
Poor	potatoes, flax, rye	-	flax, sheep, rye
<u>Barley</u>			
Good	fodder corn, steers	-	-
Fair	alfalfa, hay-clover, hogs, calves, sheep	-	sheep
Poor	flax, rye, potatoes	rye	rye, flax
<u>Flax</u>			
Good	fodder corn, steers, hogs, calves, sheep	-	-
Fair	alfalfa, potatoes, hay-clover	-	sheep
Poor	wheat, oats, barley, rye	-	vegetables, livestock, poultry, wheat, oats, barley, rye, potatoes, hogs
<u>Potatoes</u>			
Good	steers, calves, hogs, sheep	-	-
Fair	wheat, flax, fodder corn	-	sheep
Poor	oats, barley, rye	Fodder corn	flax, vegetables,
	alfalfa, hay-clover	rye, eggs	hogs



TABLE VIII (Continued)

	<u>Yields</u>	<u>Price</u>	<u>Cash Income</u>
<u>Rye</u>			
Good	steers, calves, hogs, sheep	-	sheep
Fair	wheat, hay-clover, fodder corn	calves, lambs	livestock, vegetables, dairy, poultry, hogs
Poor	oats, barley, flax, potatoes alfalfa	butter, fodder- corn, hay-clover, barley, eggs, alfalfa, steers, hogs, potatoes	wheat, oats, barley, flax, crops, FCI*
<u>Vegetables</u>			
Good	-	-	-
Fair	-	-	rye, sheep
Poor	-	-	wheat, flax, potatoes, hogs
<u>Hay-Clover</u>			
Good	wheat, steers, calves, hogs, sheep	-	-
Fair	fodder corn, wheat, oats, barley, flax	-	-
Poor	potatoes	rye	-
<u>Alfalfa</u>			
Good	steers, sheep	-	-
Fair	fodder corn, wheat, oats, Barley, flax, calves, hogs	-	-
Poor	potatoes, rye	rye	-

\* FCI - Farm Cash Income

TABLE VIII (Continued)

		<u>Yields</u>	<u>Price</u>	<u>Cash Income</u>
<u>Fodder Corn</u>				
Good	steers, calves, hogs, sheep	-	-	-
	wheat, oats, barley, flax			
Fair	hay-clover, potatoes	-	-	-
	rye, alfalfa			
Poor	-	potatoes, rye	-	-
<u>Total Crops</u>				
Good	wheat, oats, barley, flax, potatoes	-	-	-
Fair	-	-	-	-
Poor	-	-	rye	-
<u>Steers</u>				<u>All Cattle</u>
Good	wheat, oats, barley, flax, potatoes	-	-	-
	fodder corn, rye, hay-clover, alfalfa			
Fair	-	-	rye	-
Poor	-	rye	-	-
<u>Calves</u>				
Good	flax, potatoes, rye, hay-clover	-	-	-
	fodder corn,			
Fair	wheat, oats, barley, alfalfa	rye	-	-
Poor	-	-	-	-
<u>Hogs</u>				
Good	flax, potatoes, rye, hay-clover	-	-	-
	fodder corn			
Fair	oats, barley, alfalfa	-	rye	-
Poor	wheat	rye	wheat, flax, potatoes	-
			vegetables	-

TABLE VIII (Concluded)

	<u>Yields</u>	<u>Price</u>	<u>Cash Income</u>
<u>Lambs</u>			<u>All Sheep</u>
Good	flax, potatoes, rye, hay-clover fodder corn, alfalfa	-	rye
Fair	oats, barley, alfalfa	rye	barley, flax, potatoes, vegetables.
Poor	-	-	wheat, oats, cattle, crops, poultry, dairy products, FCI.
<u>Butter</u>			<u>Dairy Products</u>
Good	-	-	-
Fair	-	-	rye
Poor	-	rye	sheep
<u>Eggs</u>			<u>Poultry &amp; Poultry Products</u>
Good	-	-	-
Fair	-	-	rye
Poor	-	potatoes, rye	flax, sheep
<u>Total Livestock</u>			
Good	-	-	-
Fair	-	-	rye
Poor	-	-	flax
<u>Cash Income</u>			
Good	-	-	-
Fair	-	-	-
Poor	-	-	sheep, rye

poor substitutes are not included for the sake of brevity and because they are of no particular value as far as "diversification" is concerned.

This Table outlines very clearly the results of the statistical calculations carried out. It now remains to evaluate the findings and examine the importance of each farm product in relation to its usefulness in "extensive diversification". Substitutes, to be of value for diversification purposes, should have a correlation coefficient of less than zero. In the preceeding analysis, it will be remembered that there were a few correlations of zero or less, as some yield and marketings correlations approached this point. There were, therefore, a few good substitutes revealed. Pairs of products with correlation coefficients of less than 0.50 are also considered to be of minor importance. Coefficients above this point (0.50) have very limited value or significance as diversification substitutes.

Yields and Diversification. The only "good" field crop substitute for the commonly grown grain crops in Manitoba (wheat, oats and barley) was found to be fodder corn, a relatively unimportant crop in the Province. It is also not a cash-crop, and in this respect, not a true substitute for wheat, oats, barley or flax. The same is true of hay-clover, which is a "good" substitute for wheat and a "fair" substitute, along with alfalfa, for each of oats, barley and flax. Potatoes are listed as a "fair" substitute for wheat and flax, but the unsuitability of this crop over much of Manitoba, coupled with

the specialized machinery and labor requirements, largely offset any value it might have for diversification purposes alone. Wheat and rye are "fair" substitutes but the latter is subject to such high variability in yield that it is of small value in this respect.

The correlation coefficients that were arrived at for marketings of livestock present a rather confusing picture. There is some although not much significant correlation among the marketings of the four classes of livestock and between this group and the main field crops, wheat, oats, barley and flax. (The exception is for steers which are not correlated to any extent with wheat, oats and barley). Between the livestock classes and such crops as potatoes, fodder corn and hay-clover, some inverse correlation coefficients were recorded. In other words, substantial substitutability is indicated. This obviously reflects the changes in crop yields, which may make it possible for entrepreneurs to retain extra breeding stock in favourable years, (to increase future marketings) while in others, when yields are low, livestock marketings will have to be increased to the extent that the available fodder will carry the remaining livestock over the winter. Lack of correlation between livestock marketings and crop production is therefore inclined to be a cause and effect relationship. Diversification to more livestock production is of course, no way to overcome a decline in crop production, especially the fodder crops.

The correlation coefficients calculated for the yields of various grain crops were relatively high because the limiting factors

are similar. Yields of these crops depend to much the same extent on moisture, soil and general climatic conditions. Fodder crops (with the exception of fodder corn) are somewhat more hardy and thus are not as closely correlated with grain crops. Livestock marketings are much more "man determined" and the resulting correlation coefficients are not as valuable. Generally, livestock marketings depend on prices and inversely with the availability of feed crops.

The value of diversification for the sake of overcoming yield uncertainty is therefore rather limited. Although there may be some value in substituting "feed crops" for "cash crops", a livestock enterprise would be required to convert production into cash. It will be noted that the relationship between the prices of cash crops and steers is so high that substitution for "diversification purposes" would also be of little value.

Prices and Diversification. There is considerably less grounds for the practice of diversification to offset the uncertainty of farm prices, than there was in the case of yields. In other words, the prices of farm products generally, show a very high degree of correlation. There was not one case in which "good" substitutes were found, and only two instances of "fair" substitutes were recorded. This occurred between rye and calves, and rye and lambs. The same conclusion must therefore be drawn, that the uncertainty characteristic of farm prices cannot be offset or reduced significantly by diversification in the production of field crops and livestock products.

The significantly high correlation coefficients recorded between prices of farm products, indicates that all these prices are influenced by the same or similar factors. Such factors as the general level of income, and the existing general price levels in the economy tend to influence farm prices. Because individual farm producers have no control over total production and total marketings, farm prices tend to fluctuate more than other prices in the economy.

Farm Cash Incomes and Diversification. Referring again to Table VIII, page 66, it is apparent that in order to reduce the uncertainty of farm cash income, the only "good" substitutes are rye and sheep. This is of little value to the majority of farmers in Manitoba, due to the relative unimportance of these products. Less than one percent of the farm cash income in 1954 was received from these two enterprises together. Further analysis indicates that the only instances of "fair" substitutes also involves either rye or sheep. The unsuitability of sheep to most of the grain producing areas of Southern Manitoba, plus the fact that rye is subject to highly variable fluctuations in cash income, tend to nullify any value of these enterprises derived out of their "fair" status of substitutability. The final conclusion that must be drawn again is that the uncertainty of cash income resulting from various farm products cannot be effectively lessened by the practice of diversification.

The preceding analysis has indicated the comparative weakness of the diversification practice as applied to the average farm in Mani-

toba. This of course, is not in any way meant as an acceptance of complete specialization as a desirable practice either. In reference to earlier discussion (pages 31 to 36), the conclusions reached here discount the importance of "intensive" diversification only.

Diversification for the purpose of taking advantage of complementary and supplementary farm product relationships, as well as to make full or more complete use of farm resources, is something else again, as was pointed out earlier.



## CHAPTER IX

### LIMITATIONAL FACTORS OF IMPORTANCE

Inter-year Variability and Correlation. It was noted in Chapter VII that even with a correlation coefficient of plus 1.0, the entrepreneur could still gain by diversification if one product has significantly less year-to-year variation than another. The variability factor tends to put a question mark on the significance of the correlation coefficients previously calculated. If year-to-year variation is significant then the lack of substitutability that was shown to exist between agricultural products grown in Manitoba and the resulting case against "intensive diversification" is not exactly settled. A further examination of Table III, "Average Year-to-Year Variations in Yields, Prices and Cash Incomes", page 52, is warranted. The analysis will be confined to the "cash income" column which is the most significant.

Cash income from crops varies almost thirty percent each year compared with some thirteen percent for livestock. Variability in crops reflects the extremely high values shown for rye and flax (both over 50 percent) and oats and barley (both over 40 percent). The first two products account for less than ten percent of annual income from crops, or less than five percent of total cash income. Their significance can be discounted somewhat on these grounds. Variation in cash income received from oats and barley reflects not only changes in yield

and prices, but also changes in quantity fed to livestock as well. Hence the actual variability would be somewhat less than indicated in Table III.

Analyzing cash income from livestock, it will be noted that "dairy products" are the only item below the variation shown for all livestock. Dairy products are responsible for only twenty percent of cash income from livestock products, but appear to be a very important factor in lowering variability of income received from livestock to some 13 percent. Add to this, the fact that specialized dairying is largely confined to the immediate areas surrounding the urban centers of the Province and it will be readily seen that the variability for livestock products outside the "urban ring" would undoubtedly be higher than 13 percent. This argument receives added weight from the steers, cattle and hog categories which exhibit annual variation averaging over twenty percent. These classes account for approximately half of the cash income received from livestock, so are quite important.

Indications from this analysis are that while variability from crops appears to be over rated, variability from livestock appears to be under rated. Much of the difference in variation between the two classes, crops and livestock may thus be explained away.

It also might be pointed out that in diversifying to the extent of taking advantage of complementary and supplementary relationships existing between some farm products, the entrepreneur would take the variability factor into account. Certainly in choosing between two enterprises, the entrepreneur would tend to choose the one with the

lowest variability, providing all other considerations were relatively the same. If this was done at the "optimum" (see page 34) level of diversification, the additional gain in stability resulting from re-application at any level of "intensive diversification" would obviously be small.

On these grounds, the variability factor has been divorced from this thesis. It is obviously of some importance, but does not appear to adversely affect the outcome of the analysis to any important extent. However, variability is worthy of detailed study in its own right, and is suggested as a subject for further analysis.

Sporadic Instability. The conclusions reached earlier have shown that farm products are generally highly correlated, both among yields, prices and cash incomes. From the definition of correlation (page 56), this indicates that the yields of all products are affected by the same or similar factors. The same is true for prices and cash incomes. This raises the question "what about those sporadic factors such as the foot and mouth disease, aster yellow on flax, aphids on barley and oats, and of course rust, each of which occasionally occurs"? Is diversification effective in overcoming the effects of these occurrences? Theoretically, because of the specific nature of these sporadic factors, diversification should be useful in offsetting the effects. However, it would be questionable to employ "intensive" diversification, depending upon the probable regularity of such contingencies occurring.

In the statistics used in the preceding analysis, there were

undoubtedly cases in which "specific" factors affected the price or yield of one product and not others. For example, crop years such as 1935, 1936 and 1954, stand out as years in which rust reduced the yield of wheat. Similarly, 1955 stands out as a year in which aphids seriously reduced barley yields. These factors undoubtedly reduce correlation coefficients of pairs of products, but due to the infrequent nature of their occurrence, the effect has not been overly serious. The indication is that the correlation coefficients would be even higher if the few "unusual" years were dropped out of the records for each product.

The importance or effect of sporadic instability has been divorced from this analysis for several reasons. Firstly, it was assumed that in taking advantage of complementary and supplementary relationships that might prevail, and in making full use of labor resources, a degree of diversification (three to five enterprises per farm) would be in existence anyway, and would, therefore, provide the necessary protection against sporadic instability. In other words, diversification to this extent would provide nearly as much protection as "intensive diversification" but without the disadvantages of this practise. Secondly, since the specific causes of sporadic instability are mostly associated with diseases and insects, it is reasonable to expect, that as farm technology advances, each one of these occurrences will become less and less likely to occur. The development of disease resistant crop varieties and various chemical methods of des-

troying insects is a good indication that the relative importance of each of these specific factors will continue to decline in the future as has been the case in the past.

There are three methods which might be used to assist the farm entrepreneur in overcoming the effects of sporadic instability. First, by making capital available at reasonable terms with debt repayment tied to farm income, the entrepreneur will not be faced with the prospect of bankruptcy in the short-run, if anticipated returns fail to materialize because of sporadic factors. Second, some form of disaster insurance or emergency credit program might be set up to protect the entrepreneur against unfavorable contingencies. Third, the government might adopt a policy to provide assistance in case of widespread disasters of this type. Practises or policies such as these would provide protection against most sporadic occurrences that might strike the farm economy.

## CHAPTER X

### IMPLICATIONS FOR FARM MANAGEMENT PRACTICES IN MANITOBA

Historical farm policy in Manitoba has encouraged an undefined but widely recognized practice of diversification. This loose advocacy of the "spreading of risks over a large number of enterprises" has been followed in a more or less haphazard fashion. However, farm entrepreneurs generally do not know how far the practice should be carried, how many enterprises should be established under any set of actual conditions, or have they much knowledge of the financial implications of diversification. (This is in reference to the lessening of maximum profit opportunities on the one hand and providing a lower but more stable income on the other). All the farmer has known was that diversification meant the growing of numerous products, a generally recommended practice.

In Manitoba there are probably just as many farms where diversification is not carried far enough, as there are cases in which it is carried too far. ("Far enough" refers to the maximum profit point,  $Y_1$  on the diagram on page 33, the importance of which was previously discussed). The most significant point is that although most farm entrepreneurs undoubtedly feel diversification is of some value, they don't know exactly why, or to what extent they should diversify, or what price in the form of lower profit expectations they are paying.

Implications toward present farm management policy from the

conclusions reached in this thesis, are more for a change in emphasis than in actual practise. It might be more directly stated as clarification of the aspects of diversification, in order that the farm entrepreneur may understand both the value of diversification (complementarity, supplementarity, etc.) and also its limitations in overcoming uncertainty, that were established in the preceding analysis.

## CHAPTER XI

### CONCLUSIONS

The conclusion that can be drawn from the preceding analysis, is that the effectiveness of diversification as a means of offsetting fluctuations in the income of the entrepreneur in agriculture, appears to be over-rated. Diversification for the sake of not having all the farm "eggs in one basket", that is "diversification for the sake of diversification", is a rather ineffective way of overcoming the problem of instability in farm income. It is ineffective because the yields of most crops, and the prices for crops and livestock products tend to be highly correlated, remaining in much the same relationship from year to year.

This does not mean that an entrepreneur should adopt a policy of complete specialization. In the analysis, it was the value of what was defined as "intensive" diversification only that was judged to be of little value. Diversification in order to take advantage of any supplementary and complementary relationships that may exist, or simply to make use of otherwise idle resources, will obviously increase the efficiency of the farm unit, for example, the introduction of a beef cattle enterprise to a grain farm. The cattle enterprise will not compete with the crop enterprise for labor in the summer, and will make some use of the otherwise idle labor in the winter. At the same time the two enterprises will be of mutual assistance to each other;



the crop enterprise will supply the source of feed, and the cattle enterprise will be a source of fertilizer.

The condemnation of "intensive" diversification is aimed at the growing of four, five or even six different crops together with several livestock enterprises, when for technical, physical and economic reasons it would be better to specialize in two or three. An illustration of this is the growing of say wheat, oats, barley, rye and flax on any one farm. If on the particular farm, soil and climate suitability, and price relationships are such that, say wheat will normally yield the highest rate of return on first crop after summer-fallow, and the same is true for oats on second crop; then it would be unwise for the farm entrepreneur to sow anything except wheat on first crop and oats on second crop. Conditions are such in Manitoba that the yields and prices of all crops are affected by much the same factors, and thus tend to move in a similar way or pattern. Thus there is not only no advantage in further diversification, there is a decided disadvantage. The entrepreneur would not be making use of his comparative advantage in wheat and oats. Farm income would be reduced to the extent that the substitute enterprises differ from wheat and barley in profitability, and society as a whole would lose in that resources would not be allocated according to their most productive use.

Similarly in the case of livestock, keeping a few pigs, a few chickens, and a small number of cattle for the purpose of spreading

out the risk of low prices, is very inefficient in the long run. As the preceding analysis indicated, this practise comes nowhere near accomplishing the intended purpose. Livestock prices, together with crop prices, tend to follow a similar pattern, especially over any length of time. If the price of beef is low, the price of pork will most likely be low also. The farm entrepreneur would obviously be much better off in specializing in the one or perhaps two livestock enterprises that fit in most favorably with his resources and his crop pattern. In this way the entrepreneur could gain the advantages of production on a larger scale in those enterprises in which the possible returns are highest.

These conclusions may be summarized by the following three points. (1) The yields of different farm crops in Manitoba tend to fluctuate together. (2) The prices of farm products are affected by much the same factors and all tend to fluctuate on a similar pattern also. (3) Therefore, income instability cannot be reduced any more by having a large number of enterprises on an individual farm, than by having only three or four. An entrepreneur should therefore specialize in those enterprises in which his comparative advantage is greatest. These will be the enterprises which would normally provide the maximum income to his particular combination of resources.

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