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Responses of farmers to differences in crop yield variability in two counties in North Dakota

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UMI
RESPONSES OF FARMERS TO DIFFERENCES IN CROP YIELD VARIABILITY IN TWO COUNTIES IN NORTH DAKOTA

by

Philip J. Thair

A Dissertation Submitted to the Graduate Faculty in Partial Fulfillment of The Requirements for the Degree of DOCTOR OF PHILOSOPHY

Major Subject: Agricultural Economics

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I. THE PROBLEM SITUATION

A prominent characteristic of many firms in agriculture is the variability and uncertainty of their incomes. Objections to this instability have been voiced on many platforms and in many papers in our history, though the meaning has not always been precise. A farmer's net income is highly variable, that is, it fluctuates greatly from year to year. At the same time it is more or less uncertain, that is, the size of the income cannot often be predicted very far in advance. Not only is the farmer subject to wide swings in his income from year to year, but he cannot tell six months in advance what his income is going to be.

A. Components of Variable and Uncertain Income

One of the more useful ways of classifying the elements that give rise to variable and uncertain incomes in agriculture is by the different areas or fields where the variability and uncertainty arise or manifest themselves to the farmer. These areas are prices, yields, innovations, persons, and institutions.

A farmer faces variable and uncertain prices. Both the prices that he pays for the things he buys and the prices he receives for the products he sells are subject to change without much notice. One possibility is that all prices advance or fall together and even this would
probably be attended by uncertainty. More likely, however, are situations where relative prices change. Costs may rise and prices received may fall or vice versa. Various cost prices may change relative to each other, and similarly with the prices of the things he sells. The farmer has inadequate information for predicting the changes in these price relationships.

Farmers, like those in other industries, engage in transforming collections of resources into products which they use or sell. In many industries these relationships or rates at which resources are transformed can be described within fairly narrow limits. That is, it is known with considerable accuracy that a given amount of resources of various kinds will produce a given amount of finished products. In agriculture the yield from a set of resources seems much more inaccurately known. This is not because the fundamental transformation relationships in farming are fickle but because the farmer does not have all his resources under precise control. Agriculture is a biological enterprise, and much of it is also subject to meteorological factors. Man has made great progress in biology and even a little in meteorology, but a great many unforeseen events occur to make agricultural yields quite variable and quite uncertain. Given the best known varieties, breeds, feeding rates, seeding rates, disease and pest controls, and other cultural and management practices, crop yields and livestock yields are still subject to diseases, pests, and the vagaries of the weather in varying degrees.

Reference was made above to the "best known" practices. These are not static either. Innovations are continually being made in methods,
breeds, and equipment. Considerable investment is involved in adapting to new technology and it is never certain in advance whether the new will be better or more profitable than the old, or how soon it will be superseded by something still better.

Agriculture still involves persons, and persons are social animals living in a social environment. Besides being a person himself, the farmer uses the personal services of many other people. The continual flow of these and his own services are not known with certainty. People die, their health may change, marital status may change, they may commit various unethical acts, or betray a trust. With himself included, the farmer is never certain how persons will affect his farming enterprise.

In addition to persons and personalities, many of the services that farming and living require are performed by institutions. Banks, churches, governments, schools, insurance companies, and customs, to mention a few, all have their impact on the farmer and his farm. Changes in policies, laws, and customs cannot be seen far in advance. Actions initiated on the basis of one set of conditions may come to fruition under another set, which, if they could have been known in advance, might have indicated other actions as most desirable.

B. Critical Impacts of Variable and Uncertain Incomes

In the preceding section some of the outstanding elements of variable and uncertain incomes have been set forth. But is this variability and uncertainty undesirable? Is it bad? What is the problem? In order
to isolate the problem, if any, we must investigate the impacts of this variability and uncertainty on the farmer, that is, how and in what ways it affects him. Two main types of impacts will be presented. One is the sacrifice of income (as seen afterwards) because of incorrect expectations, and the other is the danger of insolvency from extreme income variability.

In most cases, a farmer has to make decisions and commit resources before he has accurate information regarding the outcome. If we assume that he tries to make his net income as large as possible over time, in some years he will employ too many resources, in some years not enough. Or he may find that he applied them in the wrong proportions. In many years his income will be less than it could have been had he known everything in advance. The income lost in this way, and the costs involved in making adjustments, may be considerable.

Another impact of the variable and uncertain nature of farm incomes is the danger of insolvency. In some parts of agriculture, income is so variable from year to year that there is considerable danger of receiving a negative net income on the low swing, or more frequently, not high enough to provide a decent minimum living for the farm family and service fixed capital charges. This is in spite of the possibility that the average level of income from the farm over time may be quite adequate and satisfactory, though this knowledge may be of little solace to a farmer who has become bankrupt. Uncertainty is involved here also because, if all magnitudes relevant to the committing of resources had been known in advance, other alternative courses of action might have been taken, perhaps
not so profitable on the average, but possibly providing the continuity necessary for achieving incomes in future years.

C. Focus of This Study

In the foregoing pages there have been hints of many problems. Variability and uncertainty of farm income arise from many causes and have their impact on the farm business in several ways. For this study an attempt will be made to select an important and relevant aspect of this whole broad set of problems. It is proposed to make this selection relevant for conditions of dry-land farming in North Dakota, although it will have considerable application generally throughout the Great Plains.

Of the five conceptual areas presented in section A which give rise to variability and uncertainty, crop yield variability is chosen for this study. This is not to say that uncertainty arising from changes in prices, innovations, persons, or institutions is not important. It is simply to say that, while all these areas are of considerable importance, it is believed that crop yield variability is a critical factor contributing to farmers' income variability in North Dakota from year to year.

Coefficients of variation of county average wheat yields in North Dakota, as compiled for the years 1926-48, range to as high as 76 per cent, and more than two-thirds of the counties were above 50 per cent. Being county averages, it is very likely the figures represent many farmers whose yields varied even more than this.

\footnote{U. S. Bureau of Agricultural Economics. Variability of Wheat Yields. 1951. mimeo. p. 50.}
The whole picture is not shown by coefficients of variation. It has been observed that years of similar yields, either above or below average, have occurred in runs. Whether the occurrence of these runs is significantly different from what might be expected in a random series is a moot question. The fact remains that they do occur, and that they are largely unpredictable. For North Dakota as a whole, during the 70-year period of 1879-1948, there were three separate periods when wheat yields were above average for a run of three or more years, and two of these runs lasted nine years each. In four separate periods, yields ran below average for three or more years in a row; one of these was five and another twelve years long. The other periods were of two years or less, including nine times when the yields alternated above and below average each year.¹

In section B two categories of the impacts of income variability and uncertainty were indicated. For purpose of this study a selection will also be made here, again choosing one that is of critical significance in North Dakota dry-land farming. The danger of insolvency has been selected. The problem of reducing the amount of non-realized potential income through improving expectations and decision-making techniques is one that is common to most of agriculture and even to most industries, and much attention has been devoted to this in recent years. The problem of bankruptcy, when it occurs through no fault of the entrepreneur and with no particular benefit to the creditors, is a critical one in North Dakota and the Great Plains generally and has not received as much explicit attention as the other.

In summary, then, it is proposed that this study focus its emphasis on the problem of insolvency in North Dakota farming and the important contributing factor of annual variations in crop yields, especially those which occur beyond the control of current average management ability. Part of the problem will be to show that farmers in areas of high yield variability are sensitive to the risk of bankruptcy, and part will be to explore farmers' motivations in the actions that they take to adjust to the situation.
II. CONTRIBUTION OF ECONOMICS REGARDING THE FORMULATION OF
FARMERS' OBJECTIVES AND RATIONALITY OF BEHAVIOR

When attempting to gain an understanding of a problem, certain assumptions have to be made as to the nature of the framework or setting. Moreover, successful solution of the problem may depend on the extent to which these assumptions are realistic and representative of the actual situation. The reference here is to assumptions about farmers' objectives and rational behavior in the light of these objectives.

From a multitude of problems affecting farmers, one, or at least one subset, has been chosen: the variability and uncertainty of farm income with its roots in crop yield variability and its impact in the perils of bankruptcy. Instrumental towards an improvement in the situation is an examination of farmer's basic objectives and behavior. Some relevant highlights from the record of economic analysis will be presented so that the contribution of this discipline to our problem can be assessed.

A. Static Economic Theory

A common assumption throughout the development of economic science was that economics as such is not responsible for peoples' objectives, goals, or ends. Once given these objectives, the role of economics lay in pointing out the most economical means of achieving them. Often the econ-
omists were not provided with a clear and operative statement of objectives, and it fell to them to substitute what they thought were reasonable goals and then to work out their analyses in relation to them. Naturally, their selection of objectives was influenced by the nature of their tools and analytical concepts. While this was defensible in many cases, there was a tendency for a set of objectives to become commonly accepted with little criticism. Some of our techniques and concepts developed on these grounds.

Until the 1920's or later, most economic thought centered around analysis that was essentially static. Relationships between variables were considered constant and precise, and perfect knowledge was assumed. Under these conditions, the goal of maximum profits for the firm and maximum utility for the individual or household seemed quite reasonable. By a neat and logical process, these objectives were transformed into a set of marginal conditions which were to be the criteria for rational behavior.

There are types of problems where these assumptions serve a useful purpose, but at the same time their shortcomings have become increasingly apparent. An outstanding example is the case at hand in Great Plains dry farming, where yield and income variability is of critical importance.

In this setting, the motive of maximum annual profits or maximum average profits over time avails little if the farmer is unable to remain solvent. Rational behavior under the profit motive in the static sense may not result in greatest actual realized profits. If one of a series of annual incomes is so low as to force the individual into bankruptcy, the opportunity for participating in the rest of the series may be lost,
or only regained at considerable cost. For the individual farm, the basis for predicting crop yields six months or even three months in advance is extremely meagre. For prices, the predictability is a little better, but even here the price received will bear no recognizable relation to the size of the crop, making a high price with a high yield or low price with low yield just as likely as any other combination.

It was also customary throughout much of the development of economics to separate firm analysis from household analysis, the only interaction being in the market place. No one denied that entrepreneurs are also consumers and perhaps even heads of households. But in an exchange economy, the consumption of one's own produce was considered of little importance and so a dichotomy arose. Again, in some types of industries and firms, this does not do a very great injustice to the facts, but it should not be stretched to include many parts of agriculture, especially those where income variability with the ever-present threat of bankruptcy is present. Under these conditions, a farmer who has not studied formal economics may never think of separating his family and their consumption needs from the rest of the farm business. To him it is not a "firm" and a "household," but a "farm," with minimum living expenses as important as seed expenses. Family living has to be considered along with gasoline bills, mortgage payments, and taxes. A farmer probably will not consider his income problem solved when his income is just great enough to cover the expenses of his "agricultural firm."

Some of the legacies of the old, essentially static economics have been presented, and their inadequacy with respect to our present
problem has been pointed out. A scheme of analysis using a set of equi-
librium conditions based on profit maximization and a dichotomy between firm
and household does not fit our needs. While North Dakota farmers may de-
sire profits as much as anybody, they cannot pursue this exclusively or
they may be eliminated from the enterprise or industry. The concept of
equilibrium, even moving equilibrium, hardly suits these farmers. They
are continually facing crises, either at hand, or just over the horizon
with unknown probabilities. They have to make adjustments continually to
new situations, moving first one way and then the other. The farmer, under
these conditions, cannot disassociate his family and household from the
farm as a business because the one can hardly exist without the other.

B. Dynamic Economic Theory

In the static theory of the firm, economists typically made several
simplifying assumptions. Production or transformation functions were as-
sumed precise and stable and therefore subject to accurate prediction.
Prices of factors and products were assumed stable and known throughout
a production period. In the last 30 years, these assumptions have become
increasingly suspect because it was apparent that these magnitudes were
not precise, stable, and predictable with certainty.

In 1921 Professor Frank H. Knight\(^1\) set forth his suspicion of the
earlier assumption, and attempted to lay the foundation for a dynamic the-
ory under conditions of uncertainty. He divided the field into risk and

\(^1\)Frank H. Knight. Risk, Uncertainty, and Profit. Boston. Houghton
Mifflin Co. 1921. p. 197-263.
uncertainty. Under "risk" he placed those instances where the distribution of outcomes for a set of events is known, even though the outcome of a particular event may not. In this case, the uncertainty is not really uncertainty at all because it is measurable, and hence insurable, and hence budgetable. Perfect planning is not precluded under conditions of "risk." He restricted the meaning of uncertainty to those instances where the probability distribution of the outcomes of a set of events is not known and, therefore, not measurable or easily insurable.

Knight offered two types of measures for reducing uncertainty and the impact of uncertainty—grouping and specialization. By grouping situations which are similar in character, some of the benefits of insurance may be gained. Shifting the uncertainty to specialists who are better prepared and equipped is the other alternative. These individuals may also be able to make use of the grouping principle by building up a whole portfolio of various uncertainties or risks.

Hicks\(^1\) introduced the dynamic aspect by dating the inputs and outputs. Inputs of a factor entering the productive process at different times were considered different factors. Outputs of a product produced at different times were considered different products. Anticipations of future prices were still assumed single-valued, that is, predictable with certainty. From here the analysis proceeded as under the static case.

A generalization involving removal of some other assumptions was

presented by Tintner. He treated cases where the transformation functions are not completely known and where price anticipations are not known with certainty either. The individual may view each of these uncertainties as a probability distribution. But these probability distributions of the anticipated events may not be expected with certainty either. In this case there may be a probability distribution of the probability distributions of the particular variable, or perhaps even distributions of a higher order. However, at some level, the individual is able to form a probability distribution of anticipated total discounted net profits. How will the individual evaluate this information, and how will he behave if he is faced with sets of discounted net profits and their probabilities? Tintner introduces an uncertainty preference functional which the individual tries to maximize. This expresses the individual's preferences, with respect to the probability distribution of anticipated total discounted net profits, in terms of the mean, standard deviation, and skewness, etc. The amounts of factors hired and outputs produced will be those amounts which will maximize his risk preference functional.

Meanwhile Hart took a slightly different approach. He visualized the strategic nature of planning and held that the entrepreneur's fundamental means of meeting uncertainty is the postponement of decisions until more information becomes available.

That is to say, he tries to preserve flexibility in his business


plan and in his organization, depending on the cost. The individual begins a production period with a provisional plan in mind. He visualizes the dispersion of possible prices and coefficients about the expected values to become greater as he looks further into the future. As the date to which they apply approaches, he hopes to reduce that dispersion of his estimates because more information will be available. Hence, he will postpone decisions as long as he can and also keep his plans and business reasonably flexible, so that changes can be made to take advantage of new conditions.

The foregoing authors and their theories represent some of the more important lines of theoretical development that bear on nonstatic problems. Most of them used the goal of maximum profits, though most of them would probably agree with Knight that "the mental operations by which ordinary practical decisions are made are very obscure . . ." ¹ These contributions have a definite logical appeal, but are operationally rather difficult to apply and quantify in practical situations. Nearly all economists have been plagued with the choice of assumptions pertaining to the objectives of the individual or firm. As one tries to make his analysis more dynamic, it becomes increasingly evident that the ordinary maximum profits assumption is unsatisfactory. Maximum profits or net revenue are desirable, of course, but this objective may not be feasible when the entrepreneur does not control all the factors.

For a long time economists have wondered why many firms, such as in agriculture, were not larger. Observations also indicated that for

¹Knight. op. cit. p. 211.
greatest profits, the proportion of capital to labor in agriculture was far too low, and should be increased. As an explanation, Kalecki\(^1\) introduced his principle of increasing risk which says that the rate of risk increases with the amount of investment, because at a given time one would have to borrow capital to expand, thus decreasing one's equity so that there is an increased likelihood of loss of control by an unfortui-
tous turn of events. This is important for our problem because it indi-
cates that fear of "loss of control," in other words, insolvency, may be a consideration that may override the profit motive in risky situations.

Boulding\(^2\) also dissatisfied with the shortcomings of the static marginal analysis with its emphasis on income, reconstructed economic theory in terms of the balance sheet instead. He considers the preferences of the firm with respect to types of assets and to asset ratios (ratio of the amount of one type of asset to the total). This opens the way for study of the magnitudes as they affect preservation of the firm.

Professors Heady\(^3\) and Schickele\(^4\) have also indicated that firms, at certain stages of their development or under conditions of great uncer-
tainty, may believe that the objective of security or survival is paramount and be willing to sacrifice immediate income for this purpose.

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In recent years there have been a number of studies made in agricultural economics enlarging and extending the contributions to dynamics briefly outlined above. Many of these have probed the methods and mental processes by which farmers form anticipations and make decisions on the basis of incomplete information. While they have not dealt with the particular problem of this thesis, they have some methodological implications, and two have been selected for comment here.

Brownlee and Gainer\(^1\) in Iowa, by means of a survey, explored the formulation of price and yield anticipations and the relation of these anticipations to production plans. Among other things, the farmers were asked (in March) what they thought the most probable price for corn would be in December. Later on in the interview, they were asked to state the lowest price at which they would contract now for delivery in December. Nearly all the farmers answering the question named a price as high or higher than their anticipated price, which, on the face of it, would indicate a preference for uncertainty, though the authors, to their credit, discount this conclusion.

In a later study in Illinois Williams\(^2\) asked similar questions and received similar answers. He concludes definitely that farmers have a negative certainty preference since the contract price had to be higher than the expected price, or even higher than the upper limit of the expected range of prices.


These examples have been presented to illustrate the dangers of getting nonsense results from asking hypothetical questions. To a person untrained in abstract thinking, there may be no correspondence between reactions to hypothetical situations and reactions to real situations. It is also questionable whether any certain situation can ever be truly equivalent to an uncertain one. Lange describes an indifference function in which high uncertain incomes are equivalent to lower but certain ones. This indifference curve approach for evaluating individuals' preferences regarding uncertainty bearing seems not entirely realistic. It infers a "once and for all" type of decision, with no provisions for revisions through time as more information becomes available, and suggests that "equivalent" in terms of preferences means "equivalent" in terms of action. It is doubtful if a truly uncertain situation can be reduced to a certain situation as implied in Lange's approach.

Similarly, hypothetical and other sure-chance questions relating to uncertainties are dangerous things on which to judge behavior. It is quite possible, however, that something of the sort could be used to study the psychology of answering hypothetical questions.

The examples of this chapter have been selected to indicate the broad lines of development of economic theories and empirical studies that relate directly to the problem of this thesis. The inadequacies illustrated were the maximum profits objective, the separation of firm and household, the concept of certainty equivalents, and the use of hypothetical questions in interviews. On the positive side, the most useful development for our

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purpose was the growing realization that an objective along the lines of firm security or preservation was needed for the development of a realistic theory of rational choice and behavior. This suggests that under conditions of uncertainty such as in the Great Plains, the farmer has a twofold objective in his farming: One is the fairly reasonable hypothesis that he tries to maximize his income, while the other is that he tries to avoid insolvency. These two goals co-exist, with perhaps one or the other dominant, depending on conditions at various times. At times they may be co-operative; at others competitive. Both are essential to a satisfactory explanation of rational behavior in agriculture. Under such conditions, uncertainty is more than just a cost deductible from income. It also contains the danger of bankruptcy which would disrupt the continuity necessary for maximum profits.

To illustrate the interaction of the two goals, an analogy may be useful. Suppose a person pays a considerable sum for the privilege of playing a penny-tossing game with a coin loaded slightly in his favor. In the long run, his objective is to win as many pennies as possible, and the odds (again in the long run) are that he will be successful. But the load on the coin and the long-run odds do not make his success a certainty. In fact, if he starts with a very small reserve, he could easily become bankrupt after the first few times and would no longer be able to participate in the game and draw the fruits of the favorable odds. When his reserve is down to one or two pennies say, he may concentrate entirely on the short-run objective of solvency in staying in the game, and may even be willing to sacrifice the chances of part of his future profit probabilities if it
will assist him in the present. If he has a family to maintain and some fixed charges to meet, his short-run objective may gain complete ascendancy till the emergency is past. On the other hand, the larger his beginning fortune or the larger his reserves become through a run of good luck, the greater the likelihood that he will be able to withstand an unfavorable run in the future and the more he will concentrate on the maximum income objective.

As in all analogies the implications are limited, but as far as we have gone they are obvious with respect to farming under conditions of great uncertainty. In agriculture there is the further consideration that the very "load on the coin" is itself partly a function of past outcomes. That is, in agriculture there are the twin problems of capital accumulation and scale. This works in two ways. After a number of successes, capital has accumulated so that the scale of the enterprise can be increased for the purpose of greater efficiency and profits. That is, with greater efficiency, a farmer can cover costs with a lower yield, thus improving his chances for success. At the same time, the increased capital and equity itself acts as a reserve which lessens the danger of bankruptcy. If negative incomes do occur, the increased efficiency makes a recovery more likely and more speedy. In these two ways, successes increase the likelihood of further successes. The problem faced by low-capital farmers is how to stay in the game long enough so that they may experience enough good years to put them across this "hump" in capital accumulation where the odds seem to be working for them instead of against them. A farmer with a small amount of capital may find progress extremely difficult and uncertain,
because his critical limit of survival in terms of yields is higher. This makes bankruptcy more likely and recovery more difficult and slow even in years of high yields.

Mention was made before of the possibility that the dual objectives of maximum income and security were sometimes competitive. There are two senses in which this can hold. One is in the capital accumulation framework as described in the last paragraph. When capital and equity are small, the two objectives may be in conflict. Where capital is large, the following of the profit objective may also maximize the security objective. The other type of interaction between the two objectives relates to management practices. For instance, in certain types of farming, diversification of enterprises may not only provide security and stability of income, but may also be the most efficient system in terms of profits. In other cases where a monoculture is most efficient in the long run, deliberate diversification for security's sake may reduce profit expectations.

It should be made clear that the foregoing propositions exist in the setting of capital rationing, both external and internal, and a credit system based on rigid repayment schedules. It is this that makes the question of reserves and capital accumulation of such critical importance. Credit institutions, with their traditional rigid repayment schedules, and resulting experience with default, have imposed rule-of-thumb limits on the amount a farmer may borrow, usually related to the collateral or equity that he has to offer. Thus the fewer resources a farmer owns, the fewer he is able to borrow. The lower a farmer's equity, the less likely is he able to protect it. Joint stock organization, which has been able to
spread the risk in many parts of industry and commerce, has never taken
hold in the riskier areas of agriculture in any important way.

Let us summarize the factors which determine the relative weights
an individual will assign to the two objectives. First should be men­
tioned the farmer's own personality (other things being equal some people
are more conservative than others) and his family responsibilities. The
amount of capital and reserves he commands, or scale of business, will be
important as well as his equity and the degree of encumbrance. This in
turn is related to the availability of credit and the terms under which
it is to be repaid. Also affecting his views and decisions will be the
inherent degree of variability or uncertainty (in our case, weather and
crop yields), that pervades the region, and related to this is the basic
opportunity for efficient diversification that exists. These and other
factors and the components of corresponding rational behavior will be dis­
cussed further in the next chapter on hypothesis formulation.
III. HYPOTHESIS FORMULATION: ADAPTATION OF THE FARM TO CONDITIONS OF UNCERTAINTY ARISING FROM EXTREME YIELD VARIABILITY

Having presented the problem in Chapter I, and having examined the contribution of economic theory to this in Chapter II, several hypotheses are suggested here that describe the interaction of the dual objectives in farmers' anticipations and the components of rational behavior adjustments in uncertainty situations.

First, some items of procedure should be indicated. The agricultural firm and household will be considered as a unit called the "farm," and the word "farmer" will be used to designate the entrepreneur combined with farm-household consumer. Since there is some doubt as to whether the uncertainties involved, namely crop yields, have the aspects of true risk or not, in Knight's sense, the word "risk" will be used as a synonym for "uncertainty." Thus, we can use the expression "high-risk area" meaning a farming area where the variability or uncertainty of yields is extraordinarily high under present culture and knowledge. A "high-risk-area farmer" is one who farms in such an area. In general, the hypotheses will be stated in a positive manner even though testing (Chapter IV) requires the null form. The hypotheses will be of two major categories. Primary hypotheses will be comparative statements related to motives and adjustments as between areas with different degrees of yield risk or uncertainty.
Secondary hypotheses will be comparative statements related to motives and adjustments caused by differing degrees of vulnerability aside from differences in area-yield risk or uncertainty. Under each of the two categories, there will be a considerable number of extensions to the various items of motivation and adjustment.

In connection with the farmer's dual objective of solvency and maximum profits, the concepts of "vulnerability" factors and "security" practices have been introduced. Vulnerability factors are those fundamental or independent characteristics of the farms in an area, in addition to, or even a result of, yield variability, which are more or less beyond the practical control of the average farmer, but which place him in a hazardous position with respect to his likelihood of becoming bankrupt or insolvent. "Practical control" is interpreted in relation to what is normally feasible in an area where trial and error over the years has pretty well determined the best-adapted practices. For example, the choice of whether or not to raise wheat in a specialized wheat-growing area is excluded from the practical control of most farmers. Another example is the amount of a farmer's equity or net worth. This too is largely beyond his control, at least in the short run.

Security practices, on the other hand, are those farm characteristics over which the farmer has a considerable measure of control and which he can change more or less at will in accordance with his current objective. They are measures that will give him some degree of security from bankruptcy and may or may not give him a higher income expectancy. For example, it is within the power of his choice to decide whether or not
he wants to take crop insurance, or whether or not he wants to maintain part of his assets in the form of liquid reserves or invest them in something more productive with respect to income.

The sets of hypotheses that follow in the next two sections are based on several propositions developed from study and observation of farmers in relation to uncertainty in the high-risk area of the Great Plains. These general propositions are:

1. Farmers have a positive certainty preference or aversion to risk. Prima facie evidence to the contrary, turned up in such studies as those by Brownlee and Gainer, and Williams, is spurious, a result of inadequate research techniques.

2. Farmers take positive actions to achieve security, even at some cost, but not if the cost is too high.

3. The more vulnerable farmers are, the more security measures they will practice.

4. Various security practices are to some extent substitutable.

A. Primary Hypotheses

The primary hypotheses relate to the difference in farmer's motives and behavior as a result of differences in the degree of crop yield variability assuming the same average yield over the years. Two major primary hypotheses are presented, each with a number of extensions. The various

1 Brownlee and Gainer. op. cit.

2 Williams. op. cit.
items of extension are not all independent of each other but are analytically useful nonetheless.

1. High-risk area farmers, on the average, are more vulnerable than low-risk area farmers with respect to 12 vulnerability measures as follows: (In each case, the comparison will be for high-risk area farmers as compared with low-risk area farmers.)

High-risk area farms or farmers—

(a) will have a lower equity or employ a smaller amount of self-owned capital.

(b) will have a lower ratio of equity to total farm assets.

Farmers in a high-risk area accumulate capital with considerable difficulty unless they strike a run of good years at the right time. At any particular time, the amount of capital a farmer owns or his total equity is beyond his power of choice in any practical way. Hence, items (a) and (b) suggest that high-risk area farmers are deficient in this respect as compared with farmers in an area of lower risk.

(c) will have a higher ratio of value of real estate and machinery to total farm assets.

(d) will have less livestock.

(e) will have a lower ratio of amount of livestock to total farm assets.

Items (c), (d), and (e) reflect the proposition that the keeping of a livestock enterprise as a supplement to grain growing depends more on the inherent natural and physical characteristics of the area than upon the desire for any security value provided by the diversity. That is to say, while high-risk area farmers may be expected to keep some livestock for complementary or diversity reasons, this practice will be rather limited. Where precipitation is highly variable, around a mean that is not
much above minimum needs, feed supplies will also be variable and the live-
stock may turn into a liability. Consequently, it is postulated that there
will be less livestock in the high-risk area and that livestock will con-
stitute a smaller share of the total farm assets.

(f) will have a smaller total farm acreage.

(g) will have a greater wheat acreage.

(h) will have a smaller acreage of pasture and waste.

(i) will have a greater ratio of wheat and flax acreage (cash crop
acreage) to total crop acreage.

Items (f) through (i) are the converse of items (c), (d), and (e)
to some extent. Because of the inherent characteristics of such an area,
specialized cash crops may still be the safest enterprise, considering the
nature of livestock feed requirements. In this sense it is reasonable to
say that farmers in such areas have no real choice in the matter.

(j) will have a smaller ratio of those who feel they could keep their
livestock in case of a drought year, to those who feel they would have to
reduce their livestock.

(k) will have a smaller number of farmers who feel they have a reliable
or drought-resistant supply of slough hay.

(l) will have a smaller number of farmers who feel they could survive
a year of complete cash crop failure.

Some evidence for the preceding propositions with respect to live-
stock enterprises and stability of feed supply will be sought under hypoth-
eses (j), (k), and (l). These relate directly to the reliability of feed
supplies under different conditions of yield variability.
2. High-risk area farmers practice more security measures than low-risk area farmers, with respect to 25 items, as follows:

(a) will borrow less or have smaller total liabilities.
(b) will have fewer and smaller farm mortgages.
(c) will have fewer and smaller chattel mortgages.
(d) will have done less borrowing for current running expenses in recent years.
(e) will have fewer and smaller current liabilities.
(f) will have a lower ratio of total liabilities to total farm assets.
(g) will have a lower ratio of current liabilities to value of livestock and reserves.
(h) will have a lower ratio of total liabilities to total equity.

Under security practices are classed those items over which the individual farmer has some practical choice and control. In his financial structure, the presumption is that due to risk aversion (in the setting of conventional rigid credit repayment terms), the farmer in the high-risk area will try to minimize his debt load. The various manifestations of this motive suggest the eight measures above, items (a) through (h).

(i) will have more rented land.
(j) will have a larger ratio of rented land to total farm assets.
(k) will have a larger amount of feed and grain reserves on hand.
(l) will be more numerous who believe they have sufficient feed and grain on hand for one whole year in advance.

(m) will have a greater amount of liquid reserves, that is, cash, bank accounts, bonds, et cetera.
(n) will have a greater amount of total reserves on hand both physical and liquid.
(o) will have a greater ratio of total reserves to total farm assets.

(p) will be more with nonfarm income.

Items (i) and (j) suggest that in a high-risk area more of the land factors will be obtained by renting so that the risks will be divided between the operator and the landlord. If high-risk-area farmers, as indicated in items (k) through (o), have a positive certainty preference they will prefer to have more of their assets, and a greater proportion of their assets, in the form of reserves of various kinds both physical and monetary that can be drawn on in time of adversity. Farmers interested only in the static concept of maximum profits would likely put these reserves to some immediately productive use. Actually, reserves held as a cushion against risk are in a sense productive: they produce security. Another type of reserve is nonfarm income as stated in item (p).

(q) will have less flax acreage.

(r) will have more summerfallow acreage.

(s) will have a greater ratio of fallow acreage to total cultivated acreage.

(t) will do more weed spraying.

(u) will practice more strip cropping.

Other measures that a security-minded farmer may practice are those relating to his farming methods and cultural techniques. These are stated in items (q) through (u). While cash crops have been indicated as an inherent characteristic, the farmer still can exercise choice as to which cash crop he raises. Flax is generally considered to be a riskier crop than wheat and presumably less of it will be grown in a high-risk area.
It is also reasonable to expect that high-risk-area farmers will adapt to cultural practices that will help to make a good crop more certain, hence there will be more summerfallow, more weed spraying, and more strip cropping.

(v) will be more numerous who have ever taken hail insurance and more who have hail insurance currently.

(w) will be willing to pay a higher premium to guarantee farm operating costs, and a higher premium to guarantee all minimum costs including farm operating costs, living costs, and debt payments.

(x) will be more disposed to join a rain-making scheme.

High-risk-area farmers might be expected to be more insurance-minded if they are interested in security since this will help to guarantee them part of their income. One would expect them to subscribe more heavily to hail insurance and crop insurance as stated in items (v) and (w). Item (x) on rain-making suggests that they may have a propensity to grasp at straws if there is any chance that it may help their yield problem.

(y) will be related to their landlords in greater numbers.

Lastly, it is suggested in (y), that another arrangement that can provide some security is to be related to your landlord. Such a person may be more understanding and more lenient than a nonrelated person or stranger.

B. Secondary hypotheses

Two sets of hypotheses, each with their extensions, have been called "secondary" to distinguish from the sets in section A. The first relates to differences in farmers' motives and behavior caused by differing
degrees of vulnerability, aside from differences in area-yield variability.
That is, farmers may be subject to essentially the same degree of yield
variability or uncertainty and yet vary markedly in their degree of vul-
nerability to bankruptcy. Then, since one of the current major action
programs for the purpose of reducing the impact of variable yields is the
Federal Crop Insurance Corporation program, it is proposed to test the gen-
eral hypothesis that the more vulnerable farmers tend to subscribe to crop
insurance.

However, crop insurance is not the only means for attaining secur-
ity, and under certain conditions which we shall explore, it is proposed
to test the general hypothesis that crop insurance and the other security
devices are substitutable. These will be stated in the second of the sec-
ondary sets of hypotheses.

1. More high-vulnerability farmers subscribe to federal crop insur-
ance than those with low vulnerability. The extensions are as
follows: (Again, they are not all independent of each other.)

(a) More farmers with low equity take crop insurance.

(b) More farmers with a low ratio of equity to total farm assets
take crop insurance.

(c) More farmers with a higher ratio of value of real estate and ma-
chinery to total farm assets take crop insurance.

(d) More farmers with less livestock take crop insurance.

(e) More farmers with a lower ratio of livestock to total farm assets
take crop insurance.

(f) More farmers with a smaller total farm acreage take crop insurance.

(g) More farmers with a greater wheat acreage take crop insurance.
(h) More farmers with a smaller acreage of pasture and waste take crop insurance.

(i) More farmers with a greater ratio of wheat and flax acreage (cash crop acreage) to total crop acreage take crop insurance.

(j) More farmers who feel they could keep their livestock in case of a drought year, as compared with those who feel they could not, take crop insurance.

(k) More farmers who feel they do not have a reliable or drought-resistant supply of slough hay take crop insurance.

(l) More farmers who feel they could not survive a year of complete cash-crop failure take crop insurance.

(m) More farmers who feel they could not obtain backing from relatives in time of emergency take crop insurance.

(n) More farmers who have a large number of family members to support take crop insurance.

(o) More farmers who have few family members of working age take crop insurance.

(p) More farmers who have a higher ratio of supportees to workers take crop insurance.

(q) More farmers who have recently had large medical expenses take crop insurance.

2. Farmers with crop insurance, which presumably gives them a measure of security, tend therefore to practice fewer additional devices. That is, crop insurance is substitutable for other security techniques.

It would be expected that many of the following extension hypotheses or such hypotheses be rejected because it is quite possible or even likely
that security-minded, but vulnerable, individuals would use a combination of security measures. Moreover, the particular combination used by an individual might not necessarily include crop insurance. However, as a method for exploring combinations or patterns of behavior and adjustment, the positive form for the hypotheses will be retained. They are as follows:

Farmers with crop insurance:

(a) will borrow more or have greater total liabilities.
(b) will have more and larger farm mortgages.
(c) will have more and larger chattel mortgages.
(d) will have done more borrowing for current running expenses in recent years.
(e) will have more and larger current liabilities.
(f) will have a higher ratio of total liabilities to total farm assets.
(g) will have a higher ratio of current liabilities to value of livestock and reserves.
(h) will have a higher ratio of total liabilities to total equity.
(i) will have less rented land.
(j) will have a smaller ratio of rented land to total farm assets.
(k) will have a smaller amount of feed and grain reserves on hand.
(l) will be fewer who believe they have sufficient feed and grain on hand sufficient for one whole year in advance.
(m) will have a smaller amount of liquid reserves.
(n) will have a smaller amount of total reserves, both physical and liquid.
(o) will have a smaller ratio of total reserves to total farm assets.
(p) will be fewer with nonfarm income.
(q) will have more flax acreage.
(r) will have less summerfallow acreage.
(s) will have a smaller ratio of fallow acreage to total cultivated acreage.
(t) will do less weed spraying.
(u) will practice less strip cropping.
(v) will be fewer who have ever taken hail insurance and fewer who have hail insurance currently.
(w) will be less disposed to join a rain-making scheme.
(x) will be related to their landlords in fewer numbers.
IV. EMPIRICAL TESTING AND ANALYSIS

Farmers in North Dakota, and in the Great Plains generally, are faced with extreme weather and crop yield variability. At the same time, average weather conditions are close enough to the critical limit for growth requirements that these variations take on unusual significance. Moreover, these variations in crop yields are for the most part unpredictable. Yet farmers have to meet from year to year annual expenses, debt payments, living costs, and the like. The ultimate objective of such a study as this should be to find ways of helping farmers in bringing their variable and uncertain incomes in better relationship with their pattern of expenditures, and avoid bankruptcy and substandard living conditions where crop failures occur through no fault of the farmer under average management.

This study is indeed dedicated to the above mentioned objective but can only hope to make a slight advance in preparing the groundwork, of which there is a great need. Before lasting solutions can be found, certain fundamental questions need answers, as a basis on which to build, and it is in this area that the immediate objective of the present research lies. Examples of the type of questions referred to are: What are the factors that enter into the farmer's decision-making process in the face of uncertain events? What is the specific nature of the farmer's objectives regarding security, risk-taking, and profits? What adjustments do farmers
make in pursuit of this objective? In Chapter III, a number of hypotheses have been developed as partial answers to the above questions. If they are to be of any use, they must be subjected to empirical testing in as rigorous a manner as possible.

The present study hinges mainly on farmers' reactions to income variability and uncertainty and is limited to that significant part of income variability and uncertainty which is caused by variations in crop yields. The experimental method would be an ideal way of testing the hypotheses if it were possible to hold all variables constant except the one that is being studied, in this case risk, or yield variability. In economics and other social sciences, the experimental method is generally impossible, but evidence can sometimes be gleaned from approximations where enough variables happen to be similar so that fairly valid comparisons can be made. This is the method used for testing the hypotheses of this study. A survey was conducted, by means of which it was considered likely that the risk element could be isolated, thus permitting observation of the effect of risk on farmers' motives and practices.

A. Survey Design

It was found possible to arrange a field survey as part of a larger study of risk and crop insurance in North Dakota. This meant that it was impossible to design the survey to meet the specific needs of this study exactly, but a reasonably good approximation was made.

To isolate the risk factor two counties of North Dakota were selected
that had virtually the same long-time county average wheat yields but differed greatly in the coefficient of variation. The two were Eddy County with an average wheat yield (1926-40) of 9.8 bushels per acre and a coefficient of variation of 49 per cent and Burke County with an average yield of 9.9 bushels and a coefficient of variation of 73 per cent. According to the 1950 U.S. census of agriculture, sales from crops exceeded sales from livestock in both counties, and wheat was the biggest single crop in both counties.

The federal crop insurance program was the major focus of the larger study (of which this was a part), and the most efficient sample seemed to be one that was stratified by participation in the crop insurance program. In one sense, for the purpose of this present study, it would have been better (though far more costly) not to have stratified on this basis, so that crop insurance participation could have appeared as a dependent variable. On the other hand, it was found impossible to make a fair comparison of crop insurance participation anyway, because one county had been in the program longer and previous informal studies had indicated that participation was related to local administration. There seemed no way for standardizing local administration. In addition to this, crop insurance was also of some importance in the present study and presumably the efficiency from stratification would also apply here. Finally, there was no need to observe crop insurance activity as a dependent variable for the purpose of estimating participating numbers, because this information is readily available at state and county offices. As a matter of fact,

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they constitute convenient sampling lists.

For the foregoing reasons, the sample was stratified on the basis of crop insurance participation: those who had crop insurance (in 1952, the year of the survey) and those who did not. As far as the testing and analysis are concerned, the crop insurance stratification made it necessary to invert the first set of the secondary hypotheses, but evidence shown in this way should be applicable nevertheless.

Within the counties selected and within the strata, the sample was randomly drawn from lists of the Federal Crop Insurance Corporation and the Production and Marketing Administration. The sampling unit and the observation unit were the farm operator. In Burke County, 93 usable schedules were obtained, consisting of 40 with crop insurance and 53 without. There were 39 with crop insurance and 55 without, making a total of 94, in Eddy County.

One of the principles in the questionnaire construction was to exercise restraint in using hypothetical questions relating to the farmer's motives and actions under highly imaginary circumstances. Instead, the emphasis was on what the farmer had done under various real situations, and from these attempt to draw valid conclusions. A sample of the questionnaire is appended to this study.

B. Evidence from Secondary Data

The choice of Burke and Eddy counties was made on the grounds that they had similar long-run county average wheat yields with widely divergent
degrees of variability. The necessary assumption was that individual farms within the counties experienced a similar type of yield history. Without a detailed yield history on each parcel of land there is no way of checking this, but there is no reason, a priori or empirical, suggesting that a random sample would contain any systematic bias. Actually, however, it is likely that individual farms within each county experienced greater variability than the respective county averages, but here again there is no reason to suspect that the difference in variability between counties would be materially changed.

There are several pieces of evidence from secondary sources, shown in Table 1, illustrating and explaining the rather unusual situation where a similar yield average is accompanied by a very different variability coefficient. In short, Burke County, the high variability or high-risk county, has heavier soil but less average rainfall than Eddy County. Average April to September precipitation is 11 inches in Burke County and 14 inches in Eddy. Percentage of years with less than 16 inches of precipitation is 65 per cent for Burke and only 35 per cent for Eddy County. The lower mean rainfall received in Burke County is offset by heavier soil, which happens to make the yield average about the same in the two counties. The yield variability is greater in Burke because the precipitation variability is greater and because it is more subject to hail loss. In addition to this, Eddy County, due to its proximity and relationship with the James River, has a higher water table, which helps to put a floor under crop yields in that county, and may also act as a ceiling by insufficient drainage in years of excessive precipitation.
Table 1. Data Relating to Level and Variability of Yields and Income in Burke and Eddy Counties, North Dakota.

<table>
<thead>
<tr>
<th>Item</th>
<th>Burke County</th>
<th>Eddy County</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average annual precipitation(^a)</td>
<td>15&quot;</td>
<td>18&quot;</td>
</tr>
<tr>
<td>April-September precipitation(^a)</td>
<td>11&quot;</td>
<td>14&quot;</td>
</tr>
<tr>
<td>Percentage of years with less than 16&quot; of precipitation(^a)</td>
<td>65%</td>
<td>35%</td>
</tr>
<tr>
<td>Annual evaporation from tanks(^a)</td>
<td>35&quot;</td>
<td>31&quot;</td>
</tr>
<tr>
<td>Average hail loss rates 1927-51(^b)</td>
<td>4.10%</td>
<td>3.26%</td>
</tr>
<tr>
<td>(Total losses paid/total risk written)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BAE average wheat yield 1926-45(^c)</td>
<td>9.9 bu.</td>
<td>9.8 bu.</td>
</tr>
<tr>
<td>Coefficient of variation(^c)</td>
<td>73%</td>
<td>49%</td>
</tr>
<tr>
<td>BAE average wheat yield 1911-26(^d)</td>
<td>11.5 bu.</td>
<td>11.4 bu.</td>
</tr>
<tr>
<td>FCIC wheat coverage level 1952(^e)</td>
<td>5.6 bu.</td>
<td>5.6 bu.</td>
</tr>
<tr>
<td>FCIC wheat premium rate 1952(^e)</td>
<td>0.8 bu.</td>
<td>0.6 bu.</td>
</tr>
<tr>
<td>FCIC wheat check yield 1926-45(^e)</td>
<td>9.7 bu.</td>
<td>9.7 bu.</td>
</tr>
<tr>
<td>Emergency feed and seed loans 1930-40(^f)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(average per farm 1935 census)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average number of loans per farm(^f)</td>
<td>6.0</td>
<td>2.2</td>
</tr>
<tr>
<td>Average amount loaned per farm(^f)</td>
<td>$1170</td>
<td>$421</td>
</tr>
<tr>
<td>Livestock value (average per farm) 1950(^g)</td>
<td>$1708</td>
<td>$4063</td>
</tr>
<tr>
<td>1945(^g)</td>
<td>$1559</td>
<td>$2751</td>
</tr>
<tr>
<td>Number reporting cattle and calves 1950(^g)</td>
<td>70.7%</td>
<td>88.3%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


\(^b\) N. D. Hail Insurance Department. Unpublished data.

\(^c\) U. S. Bureau of Agricultural Economics. Variability of Wheat Yields. 1951. mimeo.

\(^d\) U. S. Bureau of Agricultural Economics. Unpublished data.

\(^e\) Federal Crop Insurance Corporation, Fargo, N. D. Unpublished data.

\(^f\) Farmers Home Administration, Bismarck, N. D. Unpublished data.

Federal Crop Insurance Corporation actuarial rates also demonstrate the similarity in level and difference in variability of county average yields. Insurance coverages are related directly to (approximately 60 per cent of) long-run average yields. Premiums are a function of coverage level and variability. Where coverages are the same, differences in premium rates are related only to variability. As shown in Table 1 Federal Crop Insurance Corporation wheat coverages were 5.6 bushel per acre in 1952 in both counties. Premium rates, reflecting variability, were 0.8 bushels in Burke County and 0.6 bushels in Eddy.

The critical nature of income variability and vulnerability is indicated by the number and size of emergency feed and seed loans in the two counties. On the average, during the 1940's farmers in Burke County had nearly three times as many loans and the average loan was nearly three times as large as in Eddy County.

The lack of a suitable livestock base in Burke County as compared with Eddy County is also shown in Table 1. Eddy County had more than twice the value of livestock per farmer in 1950 and nearly twice as much in 1945.

C. Survey Evidence: Hypothesis Testing

In Chapter III four sets of hypotheses were developed. Two of these, which were called primary hypotheses, related to differences in motives and behavior between two groups of farmers divided on the basis of county average wheat yield variability. The other two, called secondary hypotheses, were related to differences in motives and behavior of farmers
on the basis of stimuli other than differences in county average yield variability. The theory relating to each of those four major hypotheses was extended to a number of subhypotheses, which were subjected to empirical testing. While these were stated in a positive manner in Chapter III and in the summary tables of the present chapter, it was actually the corresponding negative forms or null hypotheses that were tested for statistical significance.

The t test was used for testing the differences between strata and between counties. In the case of the difference of two means

\[ t = \frac{\overline{y}_1 - \overline{y}_2 - (\mu_1 - \mu_2)}{s (\overline{y}_1 - \overline{y}_2)} \]

where \( \mu_1 - \mu_2 = 0 \) (the null hypothesis), \( \overline{y}_1 \) and \( \overline{y}_2 \) are the sample means, and \( s (\overline{y}_1 - \overline{y}_2) \) the standard deviation of the difference of the two means.

In the case of the difference of two frequencies, expressed as the difference of two percentages,

\[ t = \frac{\hat{P}_1 - \hat{P}_2 - (\pi_1 - \pi_2)}{s (\hat{P}_1 - \hat{P}_2)} \]

where \( \pi_1 - \pi_2 = 0 \) (the null hypothesis), \( \hat{P}_1 \) and \( \hat{P}_2 \) are the sample percentages, and \( s (\hat{P}_1 - \hat{P}_2) \) the standard deviation of the difference of the two percentages. For county estimates and between county comparisons, the strata estimates were weighted according to their respective population ratios because of unequal strata populations. For sample sizes over 10 per cent, the variances were adjusted by the term \( 1 - n/N \).

The estimated values obtained from the survey are shown in Tables 2 through 5, each corresponding to one of the four major hypotheses. The numbers of the individual items in the tables correspond to the subhypothesis-
thesis numbers of Chapter III. The direction of the differences, as stated in the alternate or positive form, are shown by inequality symbols.

The statistical significance of the differences are also shown in Tables 2-5. The eight right-hand columns represent a probability distribution with columns (shown here with equal widths) indicating standard deviations left and right of the mean. The percentage probabilities shown are the probabilities of getting as great, or greater, differences from continued sampling if the two populations were actually one. Since the direction of differences was stated in the subhypotheses, entries on the left-hand tail or side of this diagram indicate evidence against the null hypotheses of "no difference," or in favor of the hypotheses as stated in the alternate or positive form. The degree of statistical significance, for or against the subhypotheses, is shown by the extent to which the entries approach columns of low probability. The symbol "X" is used to indicate the significance of differences between high-risk Burke County farmers and low-risk Hedy County farmers with respect to each subhypothesis. The symbols "B" and "E" are used to indicate differences between those with crop insurance and those without in Burke County and in Eddy County respectively, again with reference to each subhypothesis.

When testing an hypothesis with a single empirical measure, it is customary to select some level of probability, say 1 per cent or 5 per cent or other depending on the type of data, and declare the evidence significant only if it has a lower probability of occurrence. In the present study an attempt is made to focus evidence on four major hypotheses by testing four sets of subsidiary hypotheses which are theoretical extensions, conse-
quences, or manifestations of the four major ones. In this case consistency of direction, or the extent to which a set of results is predominantly either for or against the hypotheses, may be even more important than individual levels of significance. The schematic presentation of the test results was used so that both consistency of direction and levels of significance could be shown together. This provides a composite picture of the evidence that is necessary for judgment of the major hypotheses. However, when examining any one of the individual factors in isolation, considerations of confidence would require the use of higher levels of significance than when tested together in a battery.

Some of the subhypotheses relate to the difference of two means, some to the difference of two frequencies, and some to the difference of two ratios. Some are more closely related to the major hypothesis than others, and hence more important. Thus the subhypotheses are not all independent or additive in their effect. Nevertheless, each provides additional information and insight into the various ramifications of the major hypotheses.

1. Primary hypothesis number 1

The first major hypothesis stated that high-risk-area farmers are more vulnerable than low-risk-area farmers with respect to a number of magnitudes which are independent of short-run practical control of the farmer. These items are probably dependent on area differences in risk in the long run, and for the farmer, making short-run day-to-day decisions, they are
Table 2. Primary Hypothesis Number 1: High-risk Area Farmers Are More Vulnerable Vulnerability by County Average Yield Variability, and Tests of Sub

<table>
<thead>
<tr>
<th>Subhypothesis number</th>
<th>Measures of vulnerability</th>
<th>Mean, ratio, or frequency</th>
<th>County average yield variability</th>
</tr>
</thead>
<tbody>
<tr>
<td>1a.</td>
<td>Owned capital or net worth</td>
<td>M $32,269</td>
<td>&lt; $36,406</td>
</tr>
<tr>
<td>1b.</td>
<td>Equity/total farm assets</td>
<td>R .722</td>
<td>&lt; .774</td>
</tr>
<tr>
<td>1c.</td>
<td>Real estate and machinery/total farm assets</td>
<td>R .795</td>
<td>&gt; .731</td>
</tr>
<tr>
<td>1d.</td>
<td>Value of livestock</td>
<td>M $4,451</td>
<td>&lt; $9,702</td>
</tr>
<tr>
<td>Number reporting livestock</td>
<td>F 89.3%</td>
<td>&lt; 96.7%</td>
<td></td>
</tr>
<tr>
<td>1e.</td>
<td>Livestock/total farm assets</td>
<td>R .124</td>
<td>&lt; .223</td>
</tr>
<tr>
<td>1f.</td>
<td>Total farm acreage</td>
<td>M 738</td>
<td>&lt; 868</td>
</tr>
<tr>
<td>1g.</td>
<td>Wheat acres</td>
<td>M 239</td>
<td>&gt; 192</td>
</tr>
<tr>
<td>1h.</td>
<td>Pasture and waste acres</td>
<td>M 236</td>
<td>&lt; 364</td>
</tr>
<tr>
<td>1i.</td>
<td>Wheat and flax/total crop acres</td>
<td>R .773</td>
<td>&gt; .524</td>
</tr>
<tr>
<td>1j.</td>
<td>Could keep stock through year of drought</td>
<td>F 36.1%</td>
<td>&lt; 42.4%</td>
</tr>
<tr>
<td>1l.</td>
<td>Reliable slough hay in dry years</td>
<td>F 14.8%</td>
<td>&lt; 45.5%</td>
</tr>
<tr>
<td>ll.</td>
<td>Survive year of failure without borrowing</td>
<td>F 49.2%</td>
<td>&lt; 51.6%</td>
</tr>
</tbody>
</table>

a Given the null hypothesis as true.

b The probability figures are cumulated from both tails toward
Area Farmers Are More Vulnerable than Low-risk Area Farmers: Measures of Farmers' Yield Variability, and Tests of Subhypotheses.

<table>
<thead>
<tr>
<th>County average yield variability</th>
<th>Probability of obtaining observed &quot;t&quot; or greater&lt;sup&gt;a&lt;/sup&gt;</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>For the hypothesis&lt;sup&gt;b&lt;/sup&gt;</td>
<td>Against the hypothesis&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>0% 0.13% 2.27% 15.87% 50% 15.87% 2.27% 0.13% 0%</td>
<td></td>
</tr>
<tr>
<td>32,269 &lt;</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>.722 &lt;</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>.795 &gt;</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>$36,451 &lt;</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>89.3% &lt;</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>.121 &lt;</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>738 &lt;</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>239 &gt;</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>236 &lt;</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>.773 &gt;</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>36.1% &lt;</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>.44.8% &lt;</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>.49.2% &lt;</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> Probability values are cumulated from both tails toward the middle.

<sup>b</sup> As true.
Table 3. Primary Hypothesis Number 2: High-risk Area Farmers Practice More Security Measures of Security Practices by County Average Yield Variability

<table>
<thead>
<tr>
<th>Subhypothesis number</th>
<th>Measures of security practices</th>
<th>Mean, ratio, or frequency Burke County</th>
<th>High-risk Hypothesis</th>
<th>Low-risk Hypothesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a.</td>
<td>Total liabilities</td>
<td>M $2,683</td>
<td>$4,312</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F 53.8%</td>
<td>61.7%</td>
<td></td>
</tr>
<tr>
<td>2b.</td>
<td>Farm mortgages</td>
<td>M $2,741</td>
<td>$4,439</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>F 29.9%</td>
<td>10.5%</td>
<td></td>
</tr>
<tr>
<td>2c.</td>
<td>Chattel mortgages</td>
<td>M $1,692</td>
<td>$2,304</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>F 32.1%</td>
<td>42.2%</td>
<td></td>
</tr>
<tr>
<td>2d.</td>
<td>Borrow recently for expenses</td>
<td>F 23.5%</td>
<td>36.2%</td>
<td></td>
</tr>
<tr>
<td>2e.</td>
<td>Current liabilities</td>
<td>M $1,186</td>
<td>$1,579</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>F 52.8%</td>
<td>60.1%</td>
<td></td>
</tr>
<tr>
<td>2f.</td>
<td>Liabilities/total farm assets</td>
<td>R .432</td>
<td>.706</td>
<td></td>
</tr>
<tr>
<td>2g.</td>
<td>Current liabilities/livestock</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>and reserves</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2h.</td>
<td>Total liabilities/net worth</td>
<td>R .172</td>
<td>.254</td>
<td></td>
</tr>
<tr>
<td>2i.</td>
<td>Total rented real estate</td>
<td>M $12,327</td>
<td>$1,386</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>F 66.8%</td>
<td>55.1%</td>
<td></td>
</tr>
<tr>
<td>2j.</td>
<td>Rent/total farm assets</td>
<td>R .357</td>
<td>.311%</td>
<td></td>
</tr>
<tr>
<td>2k.</td>
<td>Value grain and feed reserves</td>
<td>M $2,262</td>
<td>$1,293</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>F 83.0%</td>
<td>81.0%</td>
<td></td>
</tr>
<tr>
<td>2l.</td>
<td>Feed and grain reserves</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>sufficient for one year</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2m.</td>
<td>Liquid reserves</td>
<td>M $4,815</td>
<td>$2,581</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>F 90.9%</td>
<td>81.0%</td>
<td></td>
</tr>
<tr>
<td>2n.</td>
<td>Total reserves</td>
<td>M $6,355</td>
<td>$3,417</td>
<td></td>
</tr>
<tr>
<td>2o.</td>
<td>Total reserves/total farm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>assets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2p.</td>
<td>Nonfarm income</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2q.</td>
<td>Flax acres</td>
<td>M li</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>F 25.8%</td>
<td>51.5%</td>
<td>X</td>
</tr>
<tr>
<td>2r.</td>
<td>Fallow acres</td>
<td>M 204</td>
<td>130</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>F 98.4%</td>
<td>86.0%</td>
<td>X</td>
</tr>
<tr>
<td>2s.</td>
<td>Fallow acres/total cult. acres</td>
<td>R .395</td>
<td>.230</td>
<td>X</td>
</tr>
<tr>
<td>2t.</td>
<td>Spray weeds this year or last</td>
<td>F 68.0%</td>
<td>43.6%</td>
<td>X</td>
</tr>
<tr>
<td>2u.</td>
<td>Strip cropping</td>
<td>F 31.8%</td>
<td>33.6%</td>
<td>X</td>
</tr>
<tr>
<td>2v.</td>
<td>Ever had hail insurance</td>
<td>F 53.2%</td>
<td>43.1%</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Had hail insurance this year</td>
<td>F 37.6%</td>
<td>21.0%</td>
<td>X</td>
</tr>
<tr>
<td>2w.</td>
<td>Would pay as high as 10% to</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>guarantee operating costs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>total minimum costs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2x.</td>
<td>Would subscribe to rainmaking</td>
<td>F 17.8%</td>
<td>3.2%</td>
<td>X</td>
</tr>
<tr>
<td>2y.</td>
<td>Related to landlord</td>
<td>F 29.6%</td>
<td>15.6%</td>
<td></td>
</tr>
</tbody>
</table>

aGiven the null hypothesis as true.

bThe probability figures are cumulated from both tails.

<table>
<thead>
<tr>
<th>Average yield variability</th>
<th>Probability of obtaining observed &quot;t&quot; or greater^a</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eddy County</td>
<td>For the hypothesis^b</td>
</tr>
<tr>
<td>Low-risk</td>
<td>0%</td>
</tr>
<tr>
<td>Eddy County</td>
<td></td>
</tr>
<tr>
<td>Hypothesis</td>
<td></td>
</tr>
<tr>
<td>$4,312</td>
<td>X</td>
</tr>
<tr>
<td>61.7%</td>
<td>X</td>
</tr>
<tr>
<td>$4,439</td>
<td>X</td>
</tr>
<tr>
<td>40.5%</td>
<td>X</td>
</tr>
<tr>
<td>$2,301</td>
<td>X</td>
</tr>
<tr>
<td>42.2%</td>
<td>X</td>
</tr>
<tr>
<td>$1,579</td>
<td>X</td>
</tr>
<tr>
<td>60.4%</td>
<td>X</td>
</tr>
<tr>
<td>.706</td>
<td>X</td>
</tr>
<tr>
<td>.254</td>
<td>X</td>
</tr>
<tr>
<td>.179</td>
<td>X</td>
</tr>
<tr>
<td>$1,862</td>
<td>X</td>
</tr>
<tr>
<td>55.1%</td>
<td>X</td>
</tr>
<tr>
<td>.314</td>
<td>X</td>
</tr>
<tr>
<td>$1,293</td>
<td>X</td>
</tr>
<tr>
<td>84.8%</td>
<td>X</td>
</tr>
<tr>
<td>13.9%</td>
<td>X</td>
</tr>
<tr>
<td>$2,581</td>
<td>X</td>
</tr>
<tr>
<td>83.0%</td>
<td>X</td>
</tr>
<tr>
<td>$3,417</td>
<td>X</td>
</tr>
<tr>
<td>.070</td>
<td>X</td>
</tr>
<tr>
<td>12.6%</td>
<td>X</td>
</tr>
<tr>
<td>75</td>
<td>X</td>
</tr>
<tr>
<td>51.5%</td>
<td>X</td>
</tr>
<tr>
<td>130</td>
<td>X</td>
</tr>
<tr>
<td>86.0%</td>
<td>X</td>
</tr>
<tr>
<td>.230</td>
<td>X</td>
</tr>
<tr>
<td>43.6%</td>
<td>X</td>
</tr>
<tr>
<td>33.6%</td>
<td>X</td>
</tr>
<tr>
<td>43.1%</td>
<td>X</td>
</tr>
<tr>
<td>24.0%</td>
<td>X</td>
</tr>
<tr>
<td>37.1%</td>
<td>X</td>
</tr>
<tr>
<td>35.6%</td>
<td>X</td>
</tr>
<tr>
<td>3.2%</td>
<td>X</td>
</tr>
<tr>
<td>15.6%</td>
<td>X</td>
</tr>
</tbody>
</table>

^a Probabilities are cumulated from both tails toward the middle.

^b Hypothesis as true.
Table 4. Secondary Hypothesis Number 1: More High-vulnerability Farmers Take Federal Measures of Farmers’ Vulnerability by Crop Insurance Participation, an

<table>
<thead>
<tr>
<th>Subhypothesis number</th>
<th>Measures of vulnerability</th>
<th>Mean, ratio, or frequency</th>
<th>Crop insurance participation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Burke County Haves Hypoth.</td>
</tr>
<tr>
<td>1a. Owned capital or net worth</td>
<td>M</td>
<td>$30,550</td>
<td>$32,553</td>
</tr>
<tr>
<td>1b. Equity/total farm assets</td>
<td>R</td>
<td>.664</td>
<td>.752</td>
</tr>
<tr>
<td>1c. Real estate and machinery /total farm assets</td>
<td>R</td>
<td>.825</td>
<td>.791</td>
</tr>
<tr>
<td>1d. Value of livestock</td>
<td>M</td>
<td>$5,104</td>
<td>$4,248</td>
</tr>
<tr>
<td>1e. Livestock/total farm assets</td>
<td>F</td>
<td>85.0%</td>
<td>90.6%</td>
</tr>
<tr>
<td>1f. Total farm acreage</td>
<td>M</td>
<td>826</td>
<td>727</td>
</tr>
<tr>
<td>1g. Wheat acres</td>
<td>M</td>
<td>268</td>
<td>225</td>
</tr>
<tr>
<td>1h. Pasture and waste acres</td>
<td>M</td>
<td>268</td>
<td>232</td>
</tr>
<tr>
<td>1i. Wheat and flax/total crop acres</td>
<td>R</td>
<td>.784</td>
<td>.771</td>
</tr>
<tr>
<td>1j. Could keep stock through year of drought</td>
<td>R</td>
<td>.294</td>
<td>.372</td>
</tr>
<tr>
<td>1k. Reliable slough hay in dry years</td>
<td>F</td>
<td>38.5%</td>
<td>44.2%</td>
</tr>
<tr>
<td>1l. Survive year of failure without borrowing</td>
<td>F</td>
<td>42.5%</td>
<td>54.2%</td>
</tr>
<tr>
<td>1m. Emergency backing from relatives</td>
<td>F</td>
<td>25.0%</td>
<td>23.1%</td>
</tr>
<tr>
<td>1n. Number to support</td>
<td>M</td>
<td>4.1</td>
<td>3.8</td>
</tr>
<tr>
<td>1o. Number to work</td>
<td>M</td>
<td>2.0</td>
<td>1.9</td>
</tr>
<tr>
<td>1p. Number to support/number to work</td>
<td>R</td>
<td>2.09</td>
<td>2.08</td>
</tr>
<tr>
<td>1q. Large medical expenses recently</td>
<td>F</td>
<td>15.8%</td>
<td>22.6%</td>
</tr>
</tbody>
</table>

a. Given the null hypothesis as true.

b. The probability figures are cumulated from both tails.
High-vulnerability farmers take federal crop insurance than those with low vulnerability: by crop insurance participation, and tests of subhypotheses.

<table>
<thead>
<tr>
<th>County</th>
<th>Eddy County</th>
<th>Probability of obtaining observed &quot;t&quot; or greater</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Haves Hypoth.</td>
<td>Have nots</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$32,553</td>
<td>$28,527</td>
<td>&lt;</td>
</tr>
<tr>
<td>.752</td>
<td>.714</td>
<td>&lt;</td>
</tr>
<tr>
<td>.791</td>
<td>.753</td>
<td>&gt;</td>
</tr>
<tr>
<td>$42,825</td>
<td>$7,625</td>
<td>&lt;</td>
</tr>
<tr>
<td>90.6%</td>
<td>97.1%</td>
<td>&lt;</td>
</tr>
<tr>
<td>.127</td>
<td>.212</td>
<td>&lt;</td>
</tr>
<tr>
<td>727</td>
<td>774</td>
<td>&lt;</td>
</tr>
<tr>
<td>225</td>
<td>195</td>
<td>&gt;</td>
</tr>
<tr>
<td>232</td>
<td>297</td>
<td>&lt;</td>
</tr>
<tr>
<td>.771</td>
<td>.566</td>
<td>&gt;</td>
</tr>
<tr>
<td>.372</td>
<td>.412</td>
<td>&lt;</td>
</tr>
<tr>
<td>.41%</td>
<td>.47%</td>
<td>&lt;</td>
</tr>
<tr>
<td>54.2%</td>
<td>47.2%</td>
<td>&lt;</td>
</tr>
<tr>
<td>54.2%</td>
<td>41.7%</td>
<td>&lt;</td>
</tr>
<tr>
<td>23.1%</td>
<td>20.5%</td>
<td>&lt;</td>
</tr>
<tr>
<td>3.8</td>
<td>.2%</td>
<td>&lt;</td>
</tr>
<tr>
<td>1.9</td>
<td>3.2%</td>
<td>&lt;</td>
</tr>
<tr>
<td>&gt; 2.08</td>
<td>&gt; 2.18</td>
<td>&gt;</td>
</tr>
<tr>
<td>&gt; 22.6%</td>
<td>&gt; 34.2%</td>
<td>&gt;</td>
</tr>
</tbody>
</table>

Hypothesis as true.

Figures are cumulated from both tails toward the middle.
Table 5. Secondary Hypothesis Number 2: Farmers with Crop Insurance Tend to Practice Measures of Additional Security Practices by Crop Insurance Participation

<table>
<thead>
<tr>
<th>Subhypothesis number</th>
<th>Measures of security practices</th>
<th>Mean, ratio, or frequency</th>
<th>Crop insurance participation</th>
<th>Burke County Haves Hypoth.</th>
<th>Burke County Have nots</th>
<th>Eddy County Haves Hypoth.</th>
<th>Eddy County Have nots</th>
</tr>
</thead>
<tbody>
<tr>
<td>2a. Total liabilities</td>
<td>M $2,752</td>
<td>F 65.0%</td>
<td></td>
<td>$2,664</td>
<td>71.7%</td>
<td>$2,641</td>
<td>71.7%</td>
</tr>
<tr>
<td>2b. Farm mortgages</td>
<td>M $2,971</td>
<td>F 10.0%</td>
<td></td>
<td>$2,681</td>
<td>71.7%</td>
<td>$2,600</td>
<td>71.7%</td>
</tr>
<tr>
<td>2c. Chattel mortgages</td>
<td>M $2,011</td>
<td>F 35.0%</td>
<td></td>
<td>$1,656</td>
<td>13.8%</td>
<td>$2,012</td>
<td>13.8%</td>
</tr>
<tr>
<td>2d. Borrow recently for expenses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2e. Current liabilities</td>
<td>M $1,265</td>
<td>F 65.0%</td>
<td></td>
<td>$1,265</td>
<td>71.1%</td>
<td>$1,226</td>
<td>71.1%</td>
</tr>
<tr>
<td>2f. Liabilities/total farm assets</td>
<td>R .086</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2g. Current liabilities/ livestock and reserves</td>
<td>R .357</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2h. Total Liabilities/net worth</td>
<td>R .253</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2i. Total rented real estate</td>
<td>M $15,185</td>
<td>F 70.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2j. Rented/total farm assets</td>
<td>R .407</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2k. Value grain and feed reserves</td>
<td>M $2,302</td>
<td>F 72.5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2l. Feed and grain reserves sufficient for one year</td>
<td>F 17.5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2m. Liquid reserves</td>
<td>M $2,916</td>
<td>F 92.5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2n. Total reserves</td>
<td>M $4,625</td>
<td>F 95.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2o. Total reserves/total farm assets</td>
<td>R .088</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2p. Nonfarm income</td>
<td>F 20.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2q. Flax acres</td>
<td>M 32</td>
<td>F 22.5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2r. Fallow acres</td>
<td>M 212</td>
<td>F 100.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2s. Fallowacres/total cult. acres</td>
<td>R .379</td>
<td></td>
<td></td>
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<td>2u. Strip cropping</td>
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<td>2v. Ever had hail insurance</td>
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<td>2w. Would subscribe to rainmaking</td>
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<td>2x. Related to landlord</td>
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*a* Given the null hypothesis as true.

*b* The probability figures are cumulated from both sides.

**Note:** The percentage differences are not directly comparable due to the nature of the calculations and data presentation.
Crop Insurance Tend to Practice Fewer Additional Security Devices; 


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All hypothesis as true.

ity figures are cumulated from both tails toward the middle.
largely beyond the realm of his economic choice. The evidence as shown in Table 2 would seem to be consistent with the general hypothesis. While several of the items are of dubious statistical significance individually, every one is in the direction postulated.

The survey results indicate that the high-risk-area farmer has a financial structure and a farm organization that is unsafe relative to farmers in the low-risk area. In the high-risk county of Burke equities are lower, both absolutely and as a proportion of total capital. There is less livestock but more investment in real estate and machinery. There is greater dependence on cash crops as a whole and wheat in particular, probably because of less suitable pasture and reliable feed supplies. More farmers expressed the view that they would not be able to feed livestock through a drought year in Burke County than in Eddy.

2. Primary hypothesis number 2

The second major hypothesis states that high-risk-area farmers practice more security measures than low-risk-area farmers. The assumption is that these farmers, being more vulnerable, will place a greater value on the objective of security as compared with the objective of immediate profits than will the less vulnerable low-risk-area farmers. Moreover, many of these safety devices are obtained only at a sacrifice of efficiency and profits in the static sense. In general the survey evidence, as shown in Table 3, supports this hypothesis. Again the preponderance of the items is consistent in direction as stated in the hypothesis.
The high-risk-area farmers attempt to protect themselves by exercising more restraint in the use of borrowed capital and by renting a greater proportion of their assets instead. They maintain more idle reserves, both physical and monetary, as a protection against adversity, both absolutely and as a proportion of total farm assets. While they have very little choice between cash crops and livestock, they do try to grow less flax which is a very risky crop, and to have more of their land in fallow. They are more insurance-minded and look with more favor on hail insurance, rain-making schemes, and other insurance devices.

3. Secondary hypothesis number 1

The third major hypothesis states that more high-vulnerability farmers subscribe to the federal crop insurance than those with low vulnerability. As mentioned in section A of this chapter, it was not possible in this survey to treat crop insurance participation as a dependent variable, so this hypothesis and all its extensions were inverted for testing purposes. Thus, it would say in effect, "Farmers with crop insurance are basically more vulnerable, with respect to the vulnerability factors of the first hypothesis, than those without crop insurance." This hypothesis assumes that with risk held constant the farmers that have crop insurance took it because they were more vulnerable. Comparisons are made between the "Haves" and the "Have Nots" within each county and are shown in Table 4. The test results are shown by the symbols "B" for Burke County and "E" for Eddy County.
A considerable majority of the items are consistent in direction with the stated subhypotheses, but the levels of significance are not as strong as with the two primary hypotheses. Presumably this would indicate that differences in vulnerability are not as important between those who have crop insurance and those who do not within each area, as they are between areas of different yield variation coefficients. It could also indicate that the vulnerability factors used explain crop insurance participation only moderately well within any given degree of yield variation.

While differences between farmers with crop insurance and those without, with respect to vulnerability characteristics, are not as pronounced as in the case of between-county comparisons, the same overall pattern is evident. The farmers who subscribe to crop insurance are generally the ones who have low equity, a larger proportion of their farm suited for cash crops, and less able to carry their livestock through a year of drought. They are the ones who consider themselves most likely to need credit in order to survive a year of crop failure.

It was expected that family considerations would be a vulnerability factor affecting crop insurance participation. However, as shown in items m through p in Table 4, no strong relationships were observed. Numbers in the family requiring support or numbers able to contribute to the working force were not significant factors. No consistent relationship was observed between crop insurance participation and the burden of large medical bills.
4. Secondary hypothesis number 2

The final major hypothesis states that farmers with crop insurance, which presumably gives them some degree of security, tend to practice fewer of the other security devices. The assumption is that crop insurance and other security devices are substitutable. However, it was mentioned in Chapter III that while this is a convenient statement for testing, it would be expected that many farmers would have a combination of security practices of which crop insurance might or might not be one. This would mean that the evidence should in some way be divided, some in favor of the hypothesis and some against.

As shown in Table 5 the survey data bear this out. The items are divided on the significance scale almost half and half, for and against. However, care should be exercised in drawing conclusions as to particular patterns of security practices on the basis of this fact alone since the individual magnitudes tested are not all independent. Some unexplained inconsistencies are also observed where the evidence in one county supports the hypothesis while in the other county it is against it.

To the extent that the individual items are significant, entries on the lefthand side or tail of the scale indicate items that are substitutable with crop insurance while entries on the right tail indicate items that are combined with crop insurance. From the evidence, there would seem to be an indication that crop insurance and lack of debts are substitutable. Or perhaps more realistically, that when a farmer borrows capital he attempts
to recover some security by taking crop insurance. This also seems to be the case with reserves where the "Haves" in both counties have less reserves—both physical and monetary—than the "Have Nots."

With respect to various farm cultural practices and land use the evidence, while it is not highly significant, suggests that these practices are complementary to, or combined with, crop insurance instead of substituting for it. There is some slight evidence that farmers with crop insurance also are the ones who tend to avoid flax, practice strip cropping, and look with favor on other types of income insurance.

The case of hail insurance, item 2v, is interesting. The evidence is contrary to the first part of this hypothesis that fewer "Haves" have ever had hail insurance than "Have Nots," but it is consistent with the second part of the hypothesis that fewer "Haves" had hail insurance in the current year. This suggests that hail insurance is complementary to all-risk crop insurance over time, that it was used as the result of similar motives when there was no crop insurance available; but that it is competitive in the present since fewer crop-insurance participants had hail insurance than nonparticipants.
V. INTERPRETATION AND CONCLUSIONS

A. Motives and Behavior under High-risk Conditions

It is the method of this study to draw conclusions regarding farmers' motives and objectives by observing their behavior and adjustments in the face of various stimuli. The principal circumstance or stimulus was wheat yield variability. An attempt was made to isolate this factor by choosing two counties as nearly alike as possible in most relevant characteristics except for a substantial difference in yield variability over time. Additional auxiliary factors also contributing to farmers' vulnerability were set forth in primary hypothesis number 1 as basic circumstances insofar as they are generally outside the limits of the average farmer's choice or control. Without exception these factors were found to pose a greater threat to farmers' security in high-risk Burke County than in low-risk Eddy County. That is, farmers in Burke County had smaller equities, both absolutely and as a proportion of their total assets. They were obliged by practical circumstances to have a larger proportion of their total assets in the form of real estate and machinery, and a smaller proportion in livestock. Natural conditions greatly favored a cash crop economy in Burke County with very little scope for diversification. These vulnerability factors, together with the high yield variability, are the stimuli; vulnerability stimuli that are strong in Burke County, relatively weak in Eddy County.
The adjustments or behavior expected to result from these stimuli, on the assumption that farmers desire security, were stated under primary hypothesis number 2. These adjustments or behavior responses were various security-achieving techniques which the high-risk area farmer should practice more diligently if he in fact does place a premium on security. According to the data nearly all the behavior responses occurred in the manner predicted. For example, Burke County farmers, as compared with Eddy County farmers, refrained from using as much borrowed capital, had more reserves both liquid and physical, maintained more flexible arrangements in their farm organization, practiced certain security-giving cultural techniques more extensively, such as summerfallow, and were more inclined to favor various income-hazard insurance schemes.

Having isolated the stimuli, and having observed the behavior responses, the conclusions regarding motives follow. The farmers in this study have shown that the desire for security, or protection from insolvency, is an important motivating force. In one sense this goal of security is merely a means to an end—the end of maximum income—and under conditions of absolute certainty would be completely submerged by this superior end. But uncertainty and risk is the rule, not the exception, and under these conditions of risk it may even become dominant and farmers may behave as if it were the superior end for all practical purposes. Thus the farmer in the high-risk situation can be expected to try to protect himself even at considerable cost or inefficiency so long as various vulnerability features threaten his security. However, there are limits to the extent to which farmers will sacrifice chances of maximum income prospects in favor
of increasing the likelihood of remaining solvent. These limits vary between farmers and depend upon personal preferences regarding security and risk, natural environmental conditions, anticipations of future hazards and incomes, and the relative costs and benefits involved in alternative risk-bearing techniques.

Under the secondary hypotheses an attempt was made to relate the auxiliary vulnerability factors to behavior responses and adjustments with yield variability held constant. Within each county vulnerability comparisons were made between farmers that currently have federal crop insurance and those that do not. The relationships exhibited in this case were much weaker than formerly, presumably because the element of yield variability was neutralized. Nevertheless most of the measures were consistent with the hypothesis. Hence the general conclusion is drawn that, given the same county average conditions of yield variability, farmers who are in a more vulnerable position will more likely subscribe to crop insurance than those who are less vulnerable. Individual characteristics of vulnerability related to crop insurance participation are the amount of owned capital or equity the farmer possesses, the proportion of total assets that must be invested in the relatively fixed ones of real estate and machinery, the degree to which the area is unsuited for livestock production, the degree to which the type of farming is confined to production of cash crops, and the degree to which they feel they could not survive a year of crop failure without credit. It was not shown that crop insurance participation was related in any important way to size of family, medical bills, or whether or not they thought they could obtain support from relatives in time of emergency.
Along with, or instead of, crop insurance are a number of other practices that farmers employ to achieve protection from the adverse effects of low yields. Several relationships emerged from the study but many of them were rather weak. From the evidence it is concluded that crop insurance participation is related positively to the amount of liabilities that a farmer has, both absolutely and as a proportion of total farm assets. Liquid reserves and reserves of feed and grain are related negatively to crop insurance. Most of the items related in a complementary way to crop insurance, that is are employed along with crop insurance, are generally recommended as good farming practices which will increase income as well as security. Among these were renting more land, more nonfarm income, and more summerfallow and strip cropping.

B. Application of Findings

The major purpose of this study has been to improve the foundation for research in agricultural economics by attempting to clarify farmers' motives and behavior so that solutions and recommendations will have greater applicability in real-life situations. While the emphasis here is on the research stage, some conclusions can be drawn from the study which do have application at a more practical level. Some inadequacies in present practices and programs can be noted and some suggestions can be made with respect to farmers and to institutions.

Perhaps the most apparent deficiency in high-risk area farming is the lack of sufficient capital. Insofar as economies of scale exist, or
in the range in which they do exist, security, or tolerance to low yields, can be improved by operating on a larger scale. Secondly, average annual incomes may be larger and hence the opportunity is improved for further expansion or building reserves. And finally, if one of the less frequent losses, less frequent because of greater efficiency, does occur, it is easier and quicker to recoup in succeeding years. But how is this stage to be reached? With farms of small size and limited equity the farmer finds himself in a rather vicious circle. Because of small scale he breaks even at a relatively high yield level, perhaps not too far below the long-run average yield. He makes smaller profits and the years in which profits occur are fewer. In the same way he sustains more frequent losses and can only recoup with greater difficulty. Thus the undercapitalized farmer has greater need for security yet is less able to reach it. If he is fortunate enough to accumulate some profits he can either expand his business or keep a reserve of cash balances. If he tries to expand by buying more land so that he can gain both income and security he may spread his equity so thin that he is in grave danger of becoming bankrupt in the short run. If instead he chooses to increase his cash reserves and to refrain from borrowing, he achieves a small degree of short-run security at the sacrifice of the chance of both long-run income and security.

This troublesome choice that faces the farmer must be considered in the setting of the customary capital market where loans are granted on the basis of a conservative proportion of the collateral offered and with rather rigid repayment schedules. This compares with the low equity position and extremely variable income of high-risk area farmers. Lenders be-
come reluctant to lend and farmers reluctant to borrow. The result is, as we have seen, that many farmers have no choice but to try to protect what little they have by avoiding debt and trying to gain what safety they can from idle reserves. Imagination and perseverance are urgently needed to develop a type of credit more adequately suited to the variable income areas of agriculture.

A second deficiency suggested by this study is the limited benefit to high-risk-area farmers from diversification by keeping livestock in addition to cash grain production. Where the limiting factor is precipitation and accompanying low yields, the keeping of livestock seems to be related more to the basic conditions of pasture and feed supplies than to the need for security. A livestock enterprise may earn a return greater than a cash reserve in the bank so long as feed is plentiful, but it can easily turn into a liability to the high-risk-area farmer at the same time that cash crops fail.

Unless a farmer is prepared to market his herd when feed supplies are short at a time when other farmers may be liquidating their herds also, he should gauge the size of his livestock enterprise by the feed normally available from the nontillable land at his disposal. In addition to this, carrying at least a year's supply of feed, probably on a revolving basis, would appear to be sound practice in areas where yields are so variable.

The Federal Crop Insurance Corporation sells all-risk crop insurance for the purpose of enabling farmers to protect themselves against the hazards of low yields. The aim of the program is not to insure against
loss of profits but against loss of actual investment in the crop. In this way it is similar to a deductible type of insurance. North Dakota ranks very high in participation, but there is no evidence to show that county participation is related to county average yield variability. Our study has shown that the farmers, in each county, who have crop insurance also exhibit the greatest degree of vulnerability but the relationships are not strong. Why do not more farmers, and especially those in the high-risk areas, subscribe to crop insurance? The reasons are several. Premiums are high relative to levels of coverage because premium rates are a function both of coverage level and of variability. Thus where yield variability is highest and protection is most needed, premiums are also highest. The deductible feature is misunderstood and resented, and they feel they do not collect enough from the program. Farmers are especially bitter when, after getting a crop at or just above the coverage level, they are faced with a bill for the premium. There is criticism because the program does not distinguish between crops on summerfallow and continuous cropping. There is also criticism because the rates are based on the experience of approximately the last twenty years. This they say weights the poor years too heavily because modern power, equipment, varieties, and cultural practices are gradually raising minimum yields. The Federal Crop Insurance Corporation is continually experimenting and revising the program. These are some of the problems or objections that need to be met before the plan is successful in protecting the majority of farmers from the effects of low yields.

Lastly, another deficiency may be in the field of farmer education.
we refer both to the need for farmers to gain a better understanding of the nature of their predicament, and the need for information more applicable to their problems. Without major changes of an institutional nature, farmers in high-risk areas must bear in mind that yields will continue to fluctuate, that their incomes will vary from year to year, and that a large part of their expenses cannot be postponed. This suggests that farmers need to view their production period as longer than one year, say five years, so that the uneven flow of income over the period may be spread more evenly over the years. They need better information pertaining to the advantages and disadvantages of diversification. In general they need guidepost information of the type that will show the relative costs and benefits from various practices not only with respect to the income prospects but also indicating the security prospects. Only the individual knows the relative values he places on income and security, but with this type of information he could make more rational decisions and hence come closer to maximizing his goals whatever they are.

C. Research Orientation

The implications of the results of this study should have a direct bearing on research relating to high-risk agriculture. Having raised the security objective to a position of importance in the scheme of farmers' objectives, research programs can be examined in a new light. Two types of economic research are suggested. One is improved decision-making techniques that will take account of the dualism of objectives and their inter-
actions. The second is to improve the environmental impacts which constitute the framework in which the farmer makes his decisions and choices.

The first arises from the proposition that farmers assign relative weights to their two objectives according to personal preferences and a variety of conditions including equity, responsibilities, uncertainties, type of farming, and credit rationing, that are beyond the realm of practical choice. To make rational choices and decisions that are most likely to result in a maximization of his objectives as weighted in his own mind, the farmer needs guideposts showing what may be expected as a result of various courses of action. For any course of action, he wants to know how much security he can gain, how much profit he will make, and the costs and probabilities involved. Then he can make more rational decisions as to how much risk he is willing to run for the sake of high income or how much income he is willing to sacrifice for security. The need for this type of information was raised in the previous section, but it is the researcher who will have to provide it.

Farmers in high-risk areas have received plenty of conflicting advice in the past about the merits of specialization on the one hand and of diversification with livestock on the other. These have usually emphasized long-run average profits without regard for security or continuity, or the mistaken notion that any kind of diversity will guarantee security. Actually, there are limits within which diversification will achieve either profits or security. Economic research is urgently needed to examine the merits of diversification in the light of the objective of security as well as income.
Some possibilities for useful research may also lie in developing ways and means for making farm expenses more flexible and postponable so that disbursements can be matched more directly with variable incomes. It is likely that no easy solutions exist, but an obvious need in this regard is in the field of debt servicing, so that farmers with highly variable incomes can use more credit.

We have seen that high-risk-area farmers tend to keep idle reserves of cash and other savings. Investigation here might be able to develop more profitable uses for these balances and still retain the essential security features.

The second avenue of research that is suggested is to investigate possible improvements in the conditions that form the framework of the farmer's choices but lie largely outside it. For example, one of these is the problem of capital rationing. Too often we accept this as given. We say that risk results in rationing by the lender and also that risk (or risk aversion) results in abstinence by the potential borrower. The distinction here is not particularly useful. Actually, both these types of capital insufficiency are caused by a set of institutional customs which have not become adapted to the needs of high-risk agriculture. As mentioned before, custom demands collateral security and a rigid repayment schedule, which are not at all suitable to a fluctuating income. Credit has adapted itself admirably to some other types of enterprise; some imaginative research coupled with an educational program might succeed in making the capital market more useful to high-risk agriculture. Attention might be given to alternative types of collateral or substitutes for it,
to government-insured loans, to longer and more flexible repayment schedules, or to some form of equity financing. Any improvements here would assist farmers in emerging from the capital dilemma described in the previous section.

Part of the farmer's environment consists of the various risk-spreading devices that are available to him. Prominent among these is the all-risk crop insurance program with respect to which several defects have already been mentioned. Research is required in this area to determine the feasibility of setting different rates according to cultural practices such as summerfallow, to study rates based on currently accepted farm practice compared with historical yields. If premium rates cannot be made more attractive in any other way investigation should be made of the possibilities and desirability of subsidizing the scheme. The marginal returns, in terms of increased farmer efficiency through increased security, from such a subsidy may or may not be quite high. They may or may not be greater than money spent on alternative ad hoc disaster programs. Precedent exists for the use of the equalization principle. If research shows the benefits to be great enough its use should be investigated with respect to crop insurance or some alternative.

Finally, research method should be noted. In economics the inclusion of decision-making, thought processes, and motivations is relatively new. Because a researcher is trained in economic analysis does not mean he is trained in the technique of probing the depths of farmers' minds. The individual cannot trace the workings of his own subconscious, let alone describe it to an interviewer. If economic researchers are going to embark
on such studies they need to be thoroughly trained in these psychological
disciplines, or at least enlist the aid of such persons in developing re-
search techniques.

This study has been based on the assumption that useful work can be done on a level that avoids those very dangerous pitfalls. In attempt has been made to draw conclusions based mainly on the observation of real reactions to real stimuli. Relationships were hypothesized, the stimuli were identified, the responses were observed, and finally conclusions were drawn. To the extent that merit exists herein it should be a useful addi-
tion to our body of research methods.
VI. SUMMARY

The focus of this study was on the variability and uncertainty of farm income in North Dakota. The specific problem investigated was limited to that significant part of income variability which is caused by annual variations in crop yields and to that part of the impact of this variability which constitutes the danger of bankruptcy. On the grounds that insufficient recognition has been given to the part played in farmers' value systems by the goal of security and their preference for certainty, part of the problem was to explore farmers' motivations in the actions they take to adjust to the risk of insolvency.

Four sets of hypotheses were developed to explore the relationships between yield variability, other vulnerability factors, crop insurance participation, and other security practices. Each set consisted of a major hypothesis and a number of subsidiary hypotheses that were theoretical extensions of the major one. Vulnerability factors were farm characteristics, in addition to yield variability, that are largely outside the limits of the average farmer's control, but which tend to threaten his security or solvency. Security practices were various practices which farmers employ to gain security.

The method was to draw conclusions regarding farmers' motives and objectives by observing their behavior responses to various stimuli. To
isolate the risk factor two counties in North Dakota, Burke and Eddy, were selected that had virtually the same long-time county average wheat yields (9.9 and 9.8 bushels per acre respectively) but widely divergent coefficients of variation of those wheat yields (73 per cent and 49 per cent respectively). This unusual condition was presumably due to variation around a lower mean rainfall but a heavier type of soil in Burke County than in Eddy County. Further, Eddy County had a higher water table, in effect tending to put both a floor and a ceiling on yields in that county. The sample was stratified on the basis of federal crop insurance participation in the year of the survey—those who had crop insurance and those who had not. In the schedule an attempt was made to avoid hypothetical questions, but rather to relate actual behavior to real stimuli.

In testing hypotheses and judging significance of comparative differences, weight was given both to probability levels of the tests of the individual subhypotheses according to the standard "t" test as applied to the differences, and to consistency of direction that was displayed by a set of subhypotheses as a group. That is, the direction of the differences was stated in each subhypothesis. Hence it was assumed that the greater the proportion of the subhypotheses that showed evidence consistently in the directions stated the greater the confidence in the major hypothesis.

The first two major hypotheses were comparative statements relating to differences in motives and behavior between the two counties divided on the basis of yield variability. The first major hypothesis stated that high-risk-area farmers, on the average, are more vulnerable than low-risk-area farmers with respect to 12 vulnerability measures which constituted
the subhypotheses. Without exception these 12 factors were found to pose a greater threat to farmers' security in high-risk Burke County than in low-risk Eddy County. In summary, the farmers in Burke County had smaller equities, both absolutely and as a proportion of their total assets. They were obliged by practical circumstances to have a larger proportion of their total assets in the form of real estate and machinery, and a smaller proportion in livestock. Natural conditions favored a relatively straight cash-crop economy in Burke County with very little scope for diversification.

Having identified the conditions and stimuli, the second major hypothesis stated that high-risk-area farmers practice more security measures than low-risk-area farmers, with respect to 25 items which constituted the subhypotheses. These security practices were various security-achieving techniques which the more vulnerable farmer should practice more intensively if he places a premium on security. According to the data the behavior responses occurred in the manner predicted with few exceptions. In summary, Burke County farmers, as compared with Eddy County farmers, refrained from using as much borrowed capital, kept more reserves both liquid and physical, maintained more flexibility in their farm organization, practiced certain yield-stabilizing cultural techniques more extensively such as summerfallow, and were more inclined to favor various income-guaranteeing insurance schemes.

The third and fourth major hypotheses were comparative statements related to differences in motives and behavior on the basis of stimuli other than county average yield variability. The third major hypothesis stated
that more high-vulnerability farmers subscribe to federal crop insurance than those with low vulnerability, using the same vulnerability factors as before. The relationships in this case were weaker than formerly, because yield variability was held equal, but most of the measures were consistent with the major hypothesis. Hence the conclusion was that, given the same county average conditions of yield variability, farmers who are in a more vulnerable position will tend to take crop insurance in greater numbers than those who are less vulnerable.

The fourth major hypothesis stated that farmers with crop insurance, which presumably gives them a measure of security, tend to employ fewer additional security devices. The subhypotheses related to the same items as the second major set. The relationships indicated were not strong, but it was concluded that crop insurance participation tends to be high where debts are high and where reserves, both physical and monetary, are low. The suggestion also was that the various cultural practices are employed along with crop insurance.

It was concluded that farmers are sensitive to the conditions of extreme yield variability and hold a strong preference for security, especially when it is threatened. In these circumstances they will make adjustments in order to preserve their solvency even at the expense of a certain degree of long-run income possibilities. However, they will not employ a particular security technique regardless of its cost but will attempt to substitute alternative means or employ several together.

Deficiencies noted in the high-risk area were the lack of sufficient capital, the lack of a sound base for livestock diversification, the limita-
tions of the federal crop insurance program, and lack of farmer education. Research is needed to bring improvements in these conditions and to provide farmers with information to enable them to maximize their goals more efficiently by making more rational choices and decisions. With explicit recognition of the co-existence of the goal of security with the goal of income, a more useful research program should be possible.
VII. SELECTED REFERENCES


Horton, Donald C. Adaptation of the Farm Capital Structure to Uncertainty. Journal of Farm Economics. 31: 76-100. 1949.


The author is indebted to the United States Department of Agriculture and to the North Dakota Agricultural Experiment Station for the primary data used in this study.
IX. APPENDIX
Production Risks and Crop Insurance 1952

1. Farm operator: Name ______________________
   P.O. address ______________________
   Legal location of farmstead Q S T R M

2. No. years on this farm._____ 3. How many years have you been farming._____ 

4. Size and tenure: Total acres operated _____ Acres owned _____
   Acres rented _____

5. Rental terms ______________________

6. Are you or your wife related to the landlord? Yes____ No_____
### I. Farm Organization (Land Use and Livestock)

<table>
<thead>
<tr>
<th>Description</th>
<th>Acres owned</th>
<th>Acres rented</th>
<th>Total acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. Wheat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Oats</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Barley</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Flax</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. Corn</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>15.</td>
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<tr>
<td>16.</td>
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<tr>
<td>17. Seeded pasture and hay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. Summerfallow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. Wild hay and native pasture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20. Waste, roads, farmstead, etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21. Total land operated (check with #14)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| 22. Horses                               | On hand now | Sold during last 12 mo. |              |
| 23. Milk cows                            | On hand now | Sold during last 12 mo. |              |
| 24. Other cows                           | On hand now | Sold during last 12 mo. |              |
| 25. 2-yr.-olds                           | On hand now | Sold during last 12 mo. |              |
| 26. Yearlings                            | On hand now | Sold during last 12 mo. |              |
| 27. Calves                               | On hand now | Sold during last 12 mo. |              |
| 28. Sows & gilts                         | On hand now | Sold during last 12 mo. |              |
| 29. Other pigs                           | On hand now | Sold during last 12 mo. |              |
| 30. Ewes & rams                          | On hand now | Sold during last 12 mo. |              |
| 31. Lambs                                | On hand now | Sold during last 12 mo. |              |
| 32. Laying flock                         | On hand now | Sold during last 12 mo. |              |
| 33. Other chickens                       | On hand now | Sold during last 12 mo. |              |
| 34. Other poultry                        | On hand now | Sold during last 12 mo. |              |
II. Insurance

40. Have you ever had federal crop insurance on this farm since 1944? Yes No

41. Were you ever contacted personally for the purpose of having you take out crop insurance? Yes No

42. Have you ever attended meetings where the federal crop insurance plan was discussed and promoted? Yes No

43. Have you ever had hail insurance on this farm since 1944? Yes No

44. What was your average yield in 1951 for:
   - Wheat _________ bu./acre
   - Oats ____________ bu./acre
   - Flax ___________ bu./acre
   - Barley ___________ bu./acre

45. Compared to last year's wheat yield do you expect your yields on this farm in the long run will average - below this________
   - above this________
   - about the same________

46. Have you kept yield records on this farm? Yes No (If yes, enter in table in #47)

47. If answers to either #40 or #43 is yes check details in this table.

<table>
<thead>
<tr>
<th>Year</th>
<th>Yield bu./acre</th>
<th>Fed. Crop Insurance</th>
<th>Hall Insurance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>check partic.</td>
<td>Indemnity check mark</td>
</tr>
<tr>
<td>1952</td>
<td></td>
<td>Wheat</td>
<td></td>
</tr>
<tr>
<td>1951</td>
<td></td>
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<td></td>
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<td>1950</td>
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<td>1946</td>
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<tr>
<td>1945</td>
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</tbody>
</table>
### Flax

<table>
<thead>
<tr>
<th>Year</th>
<th>Yield bu./acre</th>
<th>Fed. Crop Insurance</th>
<th>Indemnity check mark</th>
<th>Participation S-State, P-Private</th>
<th>Indemnity check mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1952</td>
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<td>1945</td>
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</tbody>
</table>

### Other crop (name)

<table>
<thead>
<tr>
<th>Year</th>
<th>Yield bu./acre</th>
<th>Fed. Crop Insurance</th>
<th>Indemnity check mark</th>
<th>Participation S-State, P-Private</th>
<th>Indemnity check mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1952</td>
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<td>1951</td>
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<td>1945</td>
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</tbody>
</table>

### Multiple

<table>
<thead>
<tr>
<th>Year</th>
<th>Flax X</th>
<th>Other crop (name) X</th>
<th>Multiple X</th>
</tr>
</thead>
<tbody>
<tr>
<td>1952</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1951</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1950</td>
<td>X</td>
<td></td>
<td></td>
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</tbody>
</table>
NOTE: Classify on basis of participation in federal crop insurance since '44.

If he has crop insurance in 1952 complete section A ("Haves")

If he has participated previously but not in 1952 complete section B ("Drops")

If operator has never subscribed, complete section C ("Nevers")

A. "Haves" (for those who have federal crop insurance in 1952)

50. Complete a column for each indemnity received as indicated in 47. (If more space needed, use back of page)

(a) Year

(b) Crop

(c) Type of insurance crop

(d) Amount of indemnity (total $)

(e) Acreage concerned (acres)

(f) Final yield (bu./acre)

(g) Your appraisal of adjustor's estimate, check; too high too low about right

(h) Did you have any complaints with regard to provisions such as reseeding to substitute crops, harvesting, etc.? (Explain in detail giving year and crop in each case)

51. The basic premium and coverage for this area for 1952 is: Premium Coverage (to be filled in by enumerator)

What is your premium and coverage? Premium Coverage
52. How do you feel this basic coverage, based on approximately 60% of the county or area average yield, suits your farm?

Coverage is too high ______; too low ______; about right _______.
Explain ________________________________________________________________
____________________________________________________________________
____________________________________________________________________

53. How do you feel the basic premium, based on average loss experience of the county or area, suits your farm?

Premium too high ______; too low ______; about right _______.
Explain ________________________________________________________________
____________________________________________________________________
____________________________________________________________________

54. Do you have an individual reserve built up? Yes____ No_____

If so, what was the amount of your premium reduction in 1952?___________

55. Did you ever have an indemnity coming and not apply for it? Yes____ No_____
(Give details)____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

56. What are the reasons why you feel you need or want the program? (check most important)

____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________

______ Protect investment and get expenses back
______ Expectation of lower prices
______ I believe in the insurance principle
57. If the crop insurance program were to cease, would you make any changes in your farm business to make up for it in order to protect yourself against poor crops? Yes____ No____ If yes, what changes? (Check most important)

- Keep more livestock
- Try to enlarge the farm
- Reduce size of farm
- Practice more summerfallow
- Try to keep larger reserves of cash, feed, seed.

B. "Drops" (for those who have been in the program but not in 1952)

60. Complete a column for each indemnity received as indicated in 47 (If more space needed, use back of page)

(a) Year

(b) Crop

(c) Type of insurance crop

(d) Amount of indemnity (total $)

(e) Acreage concerned (acres)

(f) Final yield (bu./acre)

(g) Your appraisal of adjustor's estimate, check: too high

- too low

- about right

(h) Did you have any complaints with regard to provisions such as reseeding to substitute crops, harvesting, etc.? (Explain in detail giving year and crop in each case)
61 Why did you drop out? (check most important) (Refer to particular items in 60 if possible)

- Dissatisfied with adjustments: yield adjustment
- substitute crop regulation
- harvesting regulation
- Premium too high
- Coverages too low
- Rely on other means of security: livestock
- fallow
- reserves
- Prefer to take a chance

62. The basic coverage for your farm based on approximately 60% of the county or area acreage yield is (To be filled in and stated by the enumerator).

How do you feel this coverage suits your farm?

Coverage too high ; too low ; about right .

Explain

63. The basic premium for your farm based on the average loss experience for the county or area is (To be filled in and stated by the enumerator).

How do you feel this premium suits your farm?

Premium too high ; too low ; about right .

Explain
64. Why do you feel you don't need it or don't want it? (check most important)

[ ] Need it but can't afford it
[ ] Have decided to employ other practices (What:)
[ ] My yields are better than average.

65. At the present level of coverage, how low would the premium have to be to get you back in the program?

66. Are there other conditions that would persuade you to start again? Yes____ No____. If yes, what conditions? (check most important)

[ ] If I could not keep livestock
[ ] If I lost my reserves
[ ] If field insurance were introduced
[ ] If coverages were raised
[ ] If expensive illness struck the family
[ ] If coverages were raised
[ ] Change in regulations (What?)

67. Since you dropped out, have you made any changes in your farm business to protect yourself against going broke on account of poor crops? (check most important)

[ ] Hail insurance
[ ] Reserves
[ ] Livestock
[ ] Farm size
[ ] Willing to take chances
C. "Nevers" (for those who have never participated in the crop insurance program)

70. Why do you feel you don't need or want crop insurance? (check most important)

- Premium too high for the coverage
- Coverage too low to be worth while
- Feel I can take care of my own risk by
- My yields are better than average

71. The basic coverage for your farm based on approximately 60% of the county or area average yield is ________ (To be filled in and stated by the enumerator). How do you feel this coverage suits your farm?

Coverage too high _____; too low ____; about right ____.

Explain ____________________________

72. The basic premium for your farm based on the average loss experience for the county or area is ________ (To be filled in and stated by the enumerator). How do you feel this premium suits your farm?

Premium too high _____; too low ____; about right ____.

Explain ____________________________

73. At the present level of coverage how low would the premium have to be to get you interested in subscribing? ________

74. Are there other conditions that would make you want to subscribe? Yes No

If yes, what conditions? (check most important) ____________________________

- If I could not keep livestock through poor health, lack of help, etc.
- If I lost my reserves
- If field insurance were introduced
- Change in local administration
- If expensive illness struck the family
- Change in regulations What? ____________________________
Multiple Insurance  A. If county does not have multiple insurance

80. Are you familiar with the multiple insurance plan? Yes___ No_____.
   (If "Yes", enumerator will review plan.)
   (If "No", enumerator will explain plan.)

81. Which feature would seem most important to you in considering whether or not you would be in favor of the plan? (check most important)

   Lower premiums
   Indemnities probably smaller and received less often

82. Do you think you would prefer this plan to the straight commodity type as now provided in this county? Yes___ No____ Do not want any insurance_____

83. Would you prefer insurance (a) at low cost which pays an indemnity only in the worst years?
   or (b) do you prefer to pay higher rates for higher coverages?

B. If county has multiple crop insurance

85. Are you familiar with the multiple insurance plan? Yes___ No____
   (If "Yes", enumerator will review plan.)
   (If "No", enumerator will explain plan.)

86. As you see it, what are the advantages of the multiple plan over the commodity insurance? (check most important)

   Lower premium rates
   Covers the whole farm

87. What are the disadvantages? (check most important)

   Indemnities not so large or paid so often
   Failure in one crop may be offset by fair yield in another
88. On the whole, do you prefer it to the straight commodity type? Yes____ No____
Don't like any crop insurance________

89. Do you prefer insurance (a) at low cost which pays an indemnity only in the
worst years?____ ______________________________
or (b) would you prefer to pay higher rates for higher
coverages?____ ______________________________

Additional Criticisms and Suggestions (to be answered by all)

90. As you may know, the county is divided into several sub-areas, according to
risk and productivity in which different rates apply. Do you have any
criticism of this? (check most important)

________________________
________________________
________________________
________________________
________________________

Individual farm basis more equitable
___ Person with better land should not have more favorable rates.
___ Too many border cases where line doesn't fit.

91. At present you have to insure all of the crop under one ownership unit.
Would you prefer to have the insurance on a field basis, although it would
certainly increase the premium rates? Yes____ No____
Why?________________________

________________________

________________________
________________________

92. In 1951 the premium and coverage, on the basis of 60% (assumed to be the
amount of your costs in the crop) of the 20-year average yield, for your area
was____ and ______(to be filled in beforehand). Would you prefer a
different level of insurance, say 40% or 75%? The following schedule of
rates might apply to your area:

<table>
<thead>
<tr>
<th>Coverage as percent of average yield (percent)</th>
<th>Coverage (bushels)</th>
<th>Premium (bushels)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
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<td>60</td>
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<td>80</td>
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<td>90</td>
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<tr>
<td>100</td>
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</tr>
</tbody>
</table>

(Note: table will be completed in advance from data pertaining to the particular area.)

Which of these alternatives, if any, would you consider as a better proposition?
93. Present crop insurance rates are based on past experience. Do you believe:

This is justified
Future yields will average higher?
Future yields will average lower?

94. Do you have any additional criticisms regarding any aspect of the crop insurance program?

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

95. Can you make any suggestions for improving the program to make it more acceptable and more useful to the farmers?

________________________________________________________________________________________

________________________________________________________________________________________

________________________________________________________________________________________

Other Insurance

98. What other types of insurance do you carry?

<table>
<thead>
<tr>
<th>Type</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire</td>
<td></td>
</tr>
<tr>
<td>Life</td>
<td></td>
</tr>
<tr>
<td>Accident</td>
<td></td>
</tr>
<tr>
<td>Auto</td>
<td></td>
</tr>
<tr>
<td>Farm Liability</td>
<td></td>
</tr>
</tbody>
</table>

III. Farm Practice

100. What crop sequence or rotation do you follow?

________________________________________________________________________________________

Why?

________________________________________________________________________________________

________________________________________________________________________________________

101. Do you practice the clear fallow method? Yes__ No__ If yes, Why? (check most important)

________________________________________________________________________________________

________________________________________________________________________________________

To control weeds
To conserve moisture
102. Do you practice stubble mulching (surface cultivation)? Yes ___ No ___
   If yes, why? (check most important)
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________

   Advantages
   Cheaper; takes less power
   Quicker; operations more timely
   Conserves moisture
   Control soil-drifting

   Disadvantages
   Not a black surface
   Soil doesn't warm as fast
   Doesn't dry as fast in spring

103. How much fertilizer did you use this year? _______ last year? _______
   on what crops?
   Why? ______ Increases yield
   ______ Takes crop earlier

104. Do you think fertilizer helps in dry years? Yes ___ No ___

105. How many acres did you spray for weeds this year? ______ last year? ______

106. Do you practice strip croppping? Yes ___ No ___
   Why or why not? ________________________________________________
   ________________________________________________________________

107. What are your reasons for keeping your other enterprises, livestock, etc.
   (see farm organization)? (check most important)
   ________________________________________________________________
   ________________________________________________________________
   ________________________________________________________________
   ______ For home use
   ______ To make fuller use of time
   ______ To utilize non-plowable pasture
   ______ To provide income in case of poor crop

108. (a) If operator has crop insurance ask: Would you keep more livestock
   if there were no crop insurance program? Yes ___ No ___

(b) If operator does not have crop insurance ask: Would you keep less live-
   stock if you could get some acceptable crop insurance? Yes ___ No ___

109. If a complete drought were apparent in July would you:
   ______ Keep your breeding stock and try to get new sources of feed?
   ______ Reduce your breeding stock down to your feed supply?
   ______ Draw on feed reserves to get through a year of complete drought?

110. Do you have any additional practices that you use to protect yourself against
   going broke on account of poor crops? (Give details) ________________
IV. Reserves, Capital and Credit

120. How much of the 1951, or earlier, crop do you have on hand now?

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
<th>Is this carry-over:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Normal</td>
</tr>
<tr>
<td>Cash grain.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feed g'ain.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hay.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oat bundles</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trench silage</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

121. What are the chief reasons for carrying these reserves? (check most important)

____ To spread income tax
____ To spread income
____ Protection against crop failure

122. Are these reserves sufficient to carry your feeding and farming operations to 1953 harvest? Yes No 1954 harvest? Yes No

123. Do you have any source of feed that is reliable in a drought year such as slough hay, etc.? Yes No

124. If you had a total crop failure this year could you live through the year and get your next crop off without borrowing? Yes No
   If no, where and how much would you have to borrow?

125. In recent years did you borrow any money for seed, feed, fuel, etc., to get the crop in and harvested and carry your livestock? Yes No If yes, when? How much? Why?

126. Do you have a mortgage on your farm? Yes No If yes, How much?
   Total amount: $; annual payment $ Does it have any postponement or prepayment provisions? (Give details)
127. Could you get additional long-term credit? Yes__ No__ If yes, up to how much? __________

128. Do you have any chattel mortgages or machinery debts? Yes__ No__ If yes, how much? __________

129. Could you get additional short-term credit? Yes__ No__ If yes, up to how much? __________

130. How much in the way of debt payments do you have to meet this year?

(126) ________; (128) ________; other current debts ________

131. How much of this would be postponable if your next crop should be a poor one?

__________ __________ __________

132. Could you get backing from relatives in case of crop failure emergency?

Yes__ No__

133. Do you think you could stand poor crops better if you had a larger farm?

Yes__ No__. If yes, why don't you get more land? (check most important)

__________ __________ __________

__________ __________ __________

__________ __________ __________

Suitable land nearby not available

Help is too scarce

Lack of funds

Don't want to get into debt

134. Machinery and Equipment Owned  Item  Size  Age  Estimated Value

Tractor

____________________________________________________

Truck

__________________________

Auto

__________________________

Combine

__________________________

Swather

__________________________

Thresher

__________________________

Hay and baling equip.

__________________________

Other (total)
135. Other assets:

CSV of Life Insurance
Cash on hand or in the bank
Government bonds
Other

136. Do you have any other assets or income that you could call on in a poor crop year? Yes___ No___

V. General

140. Under present conditions, how much gross income would you need to meet:
   (a) necessary operating costs $_______
   (b) minimum necessary family living $_______
   (c) annual debt payments $_______
       Total $_______

141. How much would you be willing to pay per year for an insurance plan that would guarantee that your income would be great enough to cover:
   (a) necessary operating costs $_______
      - 2 per cent $_______
      - 5 per cent $_______
      - 10 per cent $_______

   (Note: enumerator shall compute the percentages of the amount in 140 (a) and state the probes in dollar amounts)

   (b) total minimum costs (refer to total in 140) $_______
      - 2 per cent $_______
      - 5 per cent $_______
      - 10 per cent $_______

   (Note: enumerator shall compute the percentages of the total amount in 140 and state the probes in dollar amounts).

142. Were rain-making contracts offered in your community this year?__________
    Did you subscribe?__________
    Would you subscribe if they were offered?__________
    Explain__________________________

..............................................................................................................
143. Size of household:  
   Husband  
   Wife  
   Sons' ages  
   Daughters' ages  
   Others at home  

144. Other dependents away from home that you are supporting?  

145. Have you had any large medical or hospital expenses in last 3 years?  
   Yes  No  

146. Your age?  

147. Your national origin?