

A STUDY ON THE FEASIBILITY OF A  
CROP-HAIL INSURANCE PROGRAM  
IN MANITOBA

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A Thesis  
Presented to  
The Faculty of Graduate Studies and Research  
University of Manitoba

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

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by  
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August, 1966



## ACKNOWLEDGEMENTS

The author wishes to express his sincere appreciation and gratitude to all those who aided in the preparation of this thesis, especially the Manitoba Crop Insurance Corporation which provided the financial assistance that made this study possible.

The author is deeply indebted to Dr. M.H. Yeh, under whose supervision this thesis was written, for his excellent advice and continuous encouragement. Special thanks are due to Dr. J. C. Gilson for his criticisms and helpful suggestions.

Thanks are also due to Mr. H. E. Tolton, Assistant Manager and Director of Research of the Manitoba Crop Insurance Corporation, for providing some materials used in this study and for his suggestions on many practical problems.

Appreciation is due to Mr. B. E. Owen with whom the joint interviewer administered questionnaire was conducted. Appreciation is also due to the farmers of the Russell and Silvercreek Municipalities for their co-operation in providing data for the study.

Thanks are due to Mrs. Evelyn Arason who typed the final draft of this thesis.

## ABSTRACT

Variations in crop yields cause variations in farm incomes. To help stabilize the income from crop production most Manitoba farmers may insure their crops against unavoidable losses with hail insurance and all-risk crop insurance.

The all-risk crop insurance in Manitoba protects against losses due to all unavoidable losses including hail. However, this insurance does not cover to the full value of the insured crops. The coverage is sixty percent of the long-term average yield of the crop in each area. Only crops which yield below the coverage level are indemnified the amount the actual yield is different from the coverage level. Hail damage on crops is in most cases not to the extent that the crop qualifies for indemnity from all-risk crop insurance. From the field survey in this study cases were found where the crops were damaged from sixty to eighty percent by hail but the average yield of these crops were above the all-risk crop insurance coverage level.

Three alternatives were examined in the study to determine the alternative which would give the best protection against the crop losses due to hail damage and all other unavoidable causes. The alternatives examined were:

- (1) Insuring the crops with both all-risk crop insurance and hail insurance.
- (2) Raising the coverage level of all-risk crop insurance

to eighty percent of the long term average yield.

- (3) Insuring the crops with a proposed crop-hail insurance program.

The proposed crop-hail insurance program offers separate coverage for hail damage under the all-risk crop insurance program.

Some conclusions drawn from the study are:

- (1) All-risk crop insurance does not apparently offer adequate protection against hail damages.
- (2) Separate coverage for hail under the all-risk crop insurance is feasible in an area where hail damage is to the extent that the average crop yield is not brought substantially below the all-risk crop insurance coverage level. A program of this type would be feasible in the Russell and Silvercreek Municipalities of Manitoba.
- (3) A feasible crop-hail insurance program is one which offers better protection to the farmers than any existing formal insurance or any conceivable alternative. It is also a self-sustaining program which may be put into operation by an insurer such as the Manitoba Crop Insurance Corporation, providing that the portion of the yield variability between farms attributable to the risk hail, may be estimated from past records of an all-risk crop insurance program.

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## CHAPTER I

### INTRODUCTION

Agriculture in Manitoba is characterized by much uncertainty. One of the major contributors to uncertainty in agriculture is the year to year fluctuations in crop yields and the resulting variations in income from crop production. Agriculture has many unique risks as compared to non-agricultural industries because of its close contact with nature. To the individual farmer, weather is not predictable and is viewed as uncertainty. However, in the aggregate, the probability of weather conditions may be calculated from past records, changing the uncertainty atmosphere to one of risk.

An individual farm is faced with years of favourable weather conditions, and resulting high incomes from crop production, and years of unfavourable weather conditions and resulting low incomes from crop production. To-day, modern farming requires large capital investments. Usually the bulk of the capital has to be acquired outside the farm, especially in the earlier years of a farm operation. In order to realize the returns from invested capital in future years, the yearly income from crop production must be protected in one way or another in the event of unfavourable weather conditions which would result in low incomes from crop production. A crop

loss due to unavoidable risks may cause the bankruptcy of a farm business at the worst, as is likely in the situation of large amounts of borrowed capital, and in any event a crop loss will retard the growth of the farm business.

Insurance is available to farmers to help them cope with uncertainty. Insurance is a means by which people join together to share the risks they may suffer. A group of people with a common risk may pay a certain amount of premium. In the event of any one person's loss, an indemnity will be paid to him. The premium rates are tied to the past; usually based on the frequency of the unfavourable outcome.

Insurable risks common to urban and rural people are fire, accident, health and life. Risks common to agricultural production are weather, pests, insects, diseases and so on.

### Objectives

The objective of this study in general is to examine the feasibility of a hail-crop insurance program in Manitoba.

Specifically the objectives are;

- (1) to determine the adequacy of coverage by all-risk crop insurance for the hail risk.
- (2) to determine the feasibility of separating hail coverage from the all-risk crop insurance.
- (3) to present the findings of the field survey in the

Russell and Silvercreek Municipalities of Manitoba.

- (4) In light of the above objectives, either one or the other of the following two objectives will apply;
- (a) If separate hail coverage with all-risk crop insurance is feasible, then the statistical structure of a crop-hail insurance program is to be formulated; that is, suggestions of premium rate calculations, coverage levels and so on.
  - (b) If separate hail coverage with all-risk crop insurance is not feasible, then it is the task of this study to give supporting reasons and evidence for this conclusion.

#### Background Information

The Prairie Farmers Assistance Act, Manitoba Crop Insurance and Hail Insurance are three forms of insurance available to Manitoba farmers to help them protect their incomes from crop production. Farmers with crop insurance are not eligible for assistance under the Prairie Farmers Assistance Act. A general description of the three forms of crop income protection insurance is necessary before the problem which arises in this study may be understood.

(a) Prairie Farm Assistance Act. The Prairie Farm Assistance Act, passed in 1939, was the first attempt by the

Canadian Government to protect the Canadian grain farmers' incomes from crop production. The Act covers Manitoba, Saskatchewan, Alberta and the Peace River Block of B.C. The Act may have some features of crop insurance but its main purpose is to supply financial relief or compensation in the event of complete crop losses. The total payments to an individual farm are below operating expenses but may be enough to supply the farmer with seeds and funds for planting a crop in the following year.

Payments are made on the basis of the average yield of wheat in a township. The method of determining payment is as follows:<sup>1</sup> (a) If the average yield of wheat in a township is more than eight but not more than twelve bushels per acre the award is two dollars an acre of the farmer's cultivated land for each cent, or fraction thereof, not exceeding ten, by which the average price is less than eighty cents a bushel. (b) If the average yield of wheat is more than five but not more than eight bushels an acre, the award is two dollars an acre. (c) If the average yield of wheat is more than three and not more than five bushels an acre, the award is three dollars an acre. (c) If the average yield of wheat is not more than three bushels an acre the award is four dollars

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<sup>1</sup> D. W. WARE "Crop and Livestock Insurance in Canada" The Economic Analyst, Vol. XXX No. 4, Aug. 1960, p.p. 108-109

an acre.

Awards are made up to two hundred cultivated acres, making the maximum payment under P.F.A.A. eight hundred dollars. If the average yield in a township is such that the farmers are qualified for payments, the same award will be made to every farmer within the township, regardless of their individual yields.

Each farmer in the designated area contributes one percent of the purchase price paid for all grain by country elevators, grain dealers and other agents for the grains wheat, oats, barley, rye, flax and rapeseed. Farmers with government crop insurance do not contribute to P.F.A.A. and are not eligible for payments.

P.F.A.A. was enacted after a period of drought and chronic distress in the 1930's. An investigation by the Manitoba Crop Insurance Commission resulted in the following general opinion;<sup>2</sup> "The opinion was fairly widely held that under today's farming conditions, P.F.A.A. is inadequate, and that it has outlived any useful purpose it might once have served in Manitoba".

Some of the reasons for the discontent with P.F.A.A. were;<sup>3</sup> (1) A general one percent levy on all farmers does

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<sup>2</sup>"Report of the Manitoba Crop Insurance Commission ", December 1, 1954; p. 12.

<sup>3</sup>Ibid.

not recognize the different productivity of land. (2) The 18-section block used as the basis of qualification is too large to give a fair estimation of individual farm yields, and (3) the Act does not recognize the different sizes of farms beyond four hundred cultivated acres, the maximum payments being fixed.

Manitoba farmers had a particular reason to show discontent with P.F.A.A. since between the period 1939 and July 31, 1964 Manitoba farmers received only \$1.32 for each dollar paid into the fund, whereas Saskatchewan received \$2.44 for each dollar paid and Alberta farmers received \$2.16 for each dollar paid.<sup>4</sup>

The next active government program to assist farmers in protecting their incomes from crop production was all-risk crop insurance.

(b) Crop Insurance The Manitoba Government passed the "Crop Insurance Test Areas Act" in August, 1959 following the passage of the "Crop Insurance Act" on July 18, 1959 by the Canadian Government.

The Crop Insurance Act enables the Minister of Agriculture to enter into agreements with the provinces to assist in

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<sup>4</sup>Report on Activities under the Prairie Farm Assistance Act for the Crop Year 1963-64, Department of Agriculture, Canada.

crop insurance schemes designed by the individual provinces, on condition that a minimum number of farmers enter into the scheme and that the amount of insurance shall not exceed eighty percent of the long term average of each particular area. The contributions provided by Canada to each of the provinces are:

- (1) Payment of fifty percent of the administration costs.
- (2) Payment of twenty-five percent of the premiums, and
- (3) Either (i) loans to the provinces in respect of the costs incurred by the provinces in the operation of an insurance scheme, or (ii) the re-insurance of a portion of the liability of the province for the payment of indemnities under an insurance scheme.

Manitoba became the first province to organize a crop insurance scheme. This was done on an experimental basis in four test areas. The areas covered are gradually being expanded with the hope that eventually all the farmers in the province will have crop insurance available to them. In five years of operation the Manitoba Crop Insurance Corporation expanded coverage from 4.1 million dollars in 1960-61 to 13.7 million dollars in 1964-65.

The Manitoba legislation provides coverage for all unavoidable losses which includes losses caused by hail, drought, flood, frost, wind, disease and pests. Protection is provided for sugar beets under a separate plan.

The coverage is up to sixty percent of the long term average, which is the figure intended to cover the costs of production. The average yield is determined by areas which have similar costs of production and are situated on soils of similar productivity. The productivity of the soil is rated from 10 to 100, 10 being the lowest yielding soil and 100 being the highest yielding soil.

Claims are made on the basis of average yields. If the average yield of an insured crop is below the crop insurance coverage, then an indemnity will be paid to the insured equal to the amount the actual yield differs from the coverage yield. For example; a one hundred acre field of wheat insured at fourteen bushels per acre will have a coverage of fourteen hundred bushels. If the final yield is one thousand bushels or ten bushels per acre, the insured will be indemnified by the amount of four hundred bushels or four bushels per acre. The value of the grain is predetermined at the time the rates are calculated for the crop year.

Premium rates vary with the productivity of the soil. A scientifically established productivity index is used as the basis for calculating premium rates and coverages. The average yield is calculated for the preceding thirty-five years for each soil type area. For any one year, the loss cost ratio is the average loss of the thirty-five years total

loss, that is, the total loss below the coverage level divided by the number of years. As mentioned before twenty-five percent of the premium is paid by the Canadian Government and no administration costs are added to the premium as these are shared equally by the provincial and Canadian governments.

Two types of insurance coverage are offered:

- (1) Combined Adjustment Plan: The total value of all crops insured is subtracted from the total coverage to arrive at the indemnity payments and
- (2) Separate Adjustment Plan: Each crop is adjusted separately and indemnities are paid for losses on individual crops.

The premium rate for the separate adjustment plan is higher than for the combined adjustment plan because of the greater probability of a loss claim on separate crops.

There is also a choice between one hundred percent and seventy-five percent of dollar coverage. Both cover for the same amount of bushels, but the seventy-five percent coverage pays only for seventy-five percent of the value of the bushels loss, at a proportionately lower premium rate.

(c) Hail Insurance. Hail insurance covers crop losses from the single hazard, hail. Protection against hail losses takes the form of a certain coverage per acre. Hail

insurance differs from most other types of insurance in that it does not take the value of the crop into consideration. The only stipulation is that the crop must have been harvestable before the hail damage. For example; a forty bushel per acre crop covered for ten dollars per acre would receive the same indemnity as a ten bushel per acre crop covered for ten dollars per acre, if both crops received the same percentage hail damage.

Claims are made on the percentage basis. A hail adjustor, with the agreement of the insured, determines the percentage damage in a field by selecting from a representatively damaged portion of the field, one hundred plants and examining these plants closely to determine the number damaged. The percentage damaged in a row is used as the percentage damaged in the whole field. Usually one hundred plants are examined per twenty acres. The indemnity paid is the average percentage damage times the amount of insurance. For example; a one hundred acre field insured at ten dollars. A fifty percent hail damage would result in five hundred dollars indemnity.

Premium rates for hail insurance are established by townships. A loss-cost ratio is used in calculating premium rates, which is the amount of loss paid out for each one hundred dollars of insurance sold. Three loss-cost ratios are determined for each township from past records: (1) the

township loss cost - this is calculated from the total amount of loss paid and coverage in each township, (2) the elevation loss cost - all townships are grouped according to the elevation above sea level and a loss cost is calculated for all townships within each group, and (3) the area loss cost - all townships are grouped according to soil zone and a loss cost is calculated for all townships within each area. To arrive at the final premium rate, administration costs are added to the arithmetic mean of the township loss cost, the elevation loss cost and the area loss cost.

Three types of hail insurance coverage are offered: (1) full coverage, (2) ten percent deductible and (3) twenty-five percent deductible. The full coverage hail insurance indemnifies for the the total damage caused by hail. For example; a crop insured for one thousand dollars, receiving hail damages of twenty percent, would receive an indemnity of two hundred dollars. A ten percent deductible policy pays no indemnity for the first ten percent damage. In the above example the indemnity would be one hundred dollars, with a ten percent deductible policy. A twenty-five percent deductible policy pays no indemnity for the first twenty-five percent hail damage. Under this policy a crop damage of twenty percent would receive no indemnity.

The premium rates for a ten percent deductible policy are twenty-five percent less than the full coverage rates and

the rates for the twenty-five percent deductible policy are fifty percent less than the full coverage policy.

Deductible policies are particularly well adapted to areas in which hail risks and full cover premium rates are high.<sup>5</sup> For the same amount of premium a full coverage policy will pay the largest indemnity if the loss is forty percent or less. The ten percent deductible policy will pay the largest indemnity if the loss is between forty and fifty percent. If the loss is more than fifty percent, the twenty-five percent deductible policy will pay the largest indemnity.<sup>6</sup>

#### THE PROBLEM

The problem in this study arises from the differential in coverages by crop insurance and hail insurance, and the resulting differences in claiming for indemnities after crop damages from hail have occurred. Crop insurance in Manitoba is on an experimental basis and needs to be examined periodically as more experience is acquired in order to check the adequacy of coverage and fairness of the program. After

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<sup>5</sup>The Canadian Hail Underwriters Association; "How to Write Hail Insurance", p. 2.

<sup>6</sup>These losses are calculated on a township basis where the full cover rate is eight percent, the ten percent deductible rate is six percent and the twenty-five percent deductible rate is four percent.

five years of experience, sufficient data could be acquired to examine the adequacy of coverage by the Manitoba Crop Insurance program for specific hazards such as hail.

Hail insurance was available to farmers for a number of years and they became familiar with its policies. With crop insurance, however, unlike hail insurance, many farmers found that they would receive severe hail damages but would not be indemnified. The reason for this is that hail insurance pays indemnities on the percentage of damage basis whereas crop insurance pays indemnities on the amount the total yield is below their total coverage. Crops may survive a hail storm to the degree that they do not qualify for crop insurance indemnities. For example; a crop damaged twenty percent by hail and yielding twenty bushels per acre, would not qualify for crop insurance if the crop insurance coverage level was fourteen bushels per acre. However, the same crop, insured with hail insurance for ten dollars per acre would receive an indemnity of two dollars per acre or twenty percent of the coverage.

Another problem that arises with crop insurance is found in the method of adjustment where severe damages may not be indemnified. Adjustment for losses by crop insurance is done by measuring the total yield after harvest and subtracting this yield from the coverage yield. Hail damages unlike other

hazards such as drought which covers whole areas, are spotty, that is, a hail storm covers only a limited area and its boundaries are easily distinguished. Many cases arise, where one crop of an individual farm is severely damaged by hail while another field of the same crop from the particular farm is not. The portion of the crop not damaged by hail will raise the overall average yield of the crop above the qualifying coverage level for crop insurance indemnity. For example; a farm with two separate one hundred acre fields of wheat, insured with all-risk crop insurance at fourteen bushels per acre will have a total coverage of twenty-eight hundred bushels. Suppose one field is completely destroyed by hail while the other yields thirty bushels per acre. The total yield for the farm will be three thousand bushels which is above the coverage level. In this example the total loss is three thousand bushels but no indemnity may be received from crop insurance. The same farm, covered with ten dollars per acre hail insurance will receive an indemnity of one thousand dollars.

In essence, therefore, the problem is one with the adequacy of coverage for hail damages by all-risk crop insurance.

## CHAPTER II

### THEORETICAL CONSIDERATIONS IN THE ECONOMICS OF INSURANCE

The category of economics in which insurance falls is dynamics. Dynamics are involved in the sense that the element 'time' is necessarily present. In contrast to static situations, events must be dated in dynamics. The probability of an outcome is determined at one point in time for an outcome which will be forthcoming at some future point in time.

Formal insurance is "a device for the reduction of the uncertainty of one party, called the insured, through the transfer of particular risks to another party, called the insurer, who offers a restoration, at least in part, of economic losses suffered by the insured."<sup>7</sup> Formal insurance, therefore, involves two different principles. One set of principles are those of the insured, and the other set are those of the insurer. Usually, the risk is viewed as uncertainty by the insured and as a pure risk by the insurer.

In this chapter, an attempt will be made to discuss the principles of insurance from the standpoint of the insured and from the standpoint of the insurer. The discussion will centre

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<sup>7</sup> Pfeffer, Irving; Insurance and Economic Theory, Richard D. Irwin Inc., Homewood, Illinois; 1956, p. 53.

on crop production insurance.

### Agricultural Production and Insurance

The role of insurance in agricultural production is one of reducing uncertainty or transferring of risk to a second party. An example of a party accepting agricultural risks is the Manitoba Crop Insurance Corporation.

The meanings of the closely related words 'risk' and 'uncertainty' should be distinguished before a discussion of insurance is made. 'Risk' refers to outcomes which are measurable in an empirical sense. The probability of an event occurring may be established with certainty. 'Uncertainty', on the other hand, refers to outcomes which cannot be measured empirically. The probability of an uncertain outcome cannot be established but may only be guessed.

'Risk', is a combination of hazards and is measured by probability; uncertainty is measured by a degree of belief. Risk is a state of the world; uncertainty is a state of the mind.<sup>8</sup>

Uncertainty is characteristic of crop production on an individual farm. The farm manager must make decisions at one point in time for an output at another point in time. The individual farmer cannot predict his crop yields for any

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<sup>8</sup> Ibid., p. 42.

one particular year.

To illustrate the difference between risk and uncertainty, suppose a farm manager is faced with a production schedule as shown in Figure 1, for a ten year period. The

farm manager would know, with certainty, that in the next ten years he might have six years of normal crop yields, two years of below normal crop yields and two years of above normal crop yields.

Therefore, the crop yields in the ten year period confronting the manager would be classified as risk. He would know his total production for that period and be able to make decisions on that knowledge.

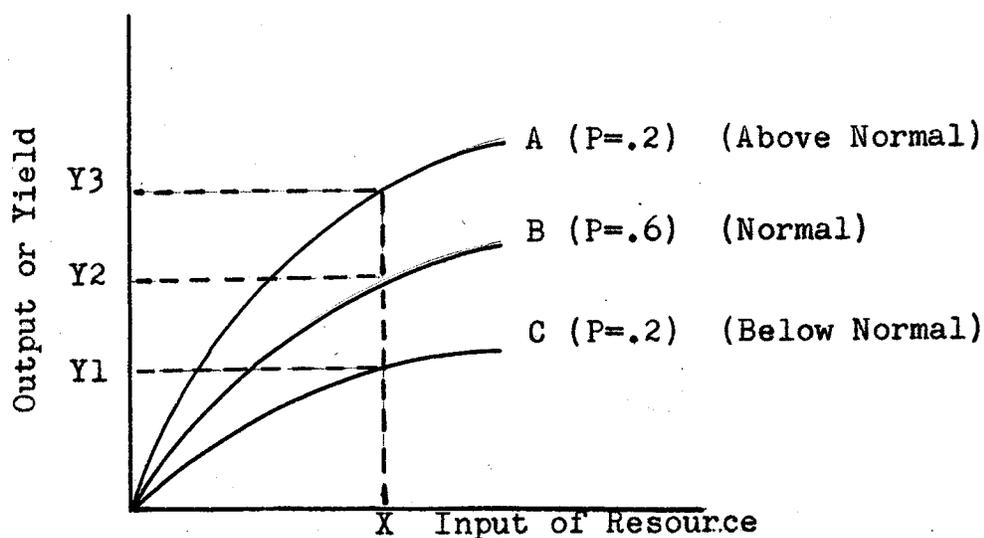


FIGURE I

Yield Variability

The farm manager would not, however, know which years would be normal and which would not be normal. For example; in the first of the ten years, the manager would not know whether his crop production decisions would be based on a normal, above or below normal year. Thus, for any particular year, decision-making would take place in an environment of uncertainty.

Insurance reduces the uncertainty in crop production in any one year. For a certain amount of premium, the farmer is guaranteed protection against an uncertain loss of income from crop production. To continue with the above example, the farm operator may pay a certain amount of premium and be guaranteed a normal crop income in every one of the ten years. The cost of the insurance may be incorporated into the decision-making.

### Risk and Insurance

Outcomes which fall into the category of risk are insurable. Outcomes which fall into the category of uncertainty are uninsurable.

The probability of an insurable outcome may be calculated empirically. Empirical probabilities of an outcome or loss can be established in the following manner.<sup>9</sup>

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<sup>9</sup>Heady, Earl O., Economics of Agricultural Production and Resource Use. Prentice-Hall, Inc. Englewood Cliffs, N.J., 1961; p. 440.

"The statistical probability of outcome can be established when (a) the sample of cases (observations) is large enough, (b) the observations are repeated in the population, and (c) the observations (cases) are independent (are randomly distributed in the manner of a stochastic variable)"

An individual farmer is uncertain as to whether his crops will be damaged by hail, for example; in any one year. A hail insurance company would be certain of the probability of an individual crop being damaged by hail when a large number of observations of the frequency of previous hail damages are available. The number of crops damaged by hail out of 100,000 crops, for example; may be determined empirically from previous hail experiences. " -- what is unpredictable and subject to chance for the individual is highly predictable and uniform in the mass."<sup>10</sup>

The theoretical structure of an insurance premium for a certain crop consists of a pure premium rate or loss cost, administration costs and a normal profit.

The pure premium rate or loss cost is the total loss caused by damage on insured crops. Two different methods may be used to establish the pure premium rate, according to the source of observations.

Historical crop yields may be used to establish the frequency of crop yields falling below a certain level. If the coverage level is "C" and the crop yields that are lower than

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<sup>10</sup> Samuelson, Paul A., Economics - An Introductory Analysis; McGraw-Hill Book Company, Inc., New York, Toronto, London, fifth edition, 1961, p. 512.

"C" are designated by  $Y_i$ , then the pure premium rate is determined by the frequency of  $Y_i$  and the amount  $Y_i$  is lower than  $C$  for each insurable crop area, or

(1)  $P = \sum f(Y_i) (C - Y_i)$ , where  $0 < Y_i < C$  and  $P$  is the pure premium rate

The second method of calculating the pure premium rate or loss cost may be used when sufficient insurance data is available. This loss cost is the ratio of the amount paid in losses or indemnities to the amount of insurance written or the liabilities in each area.

If the indemnity paid in an area is designated by  $I$  and the liabilities written by  $L$ , then the pure premium rate or loss cost ratio is the ratio of  $I$  to  $L$ , or

$$(2) P = \frac{\sum I_i}{\sum L_i}$$

In equation (1), the pure premium or risk increases if the frequency of losses,  $f(Y_i)$ , increases, if the coverage level,  $C$ , increases or if the crop yield,  $Y_i$ , decreases. In equation (2), the pure premium rate or risk increases if the indemnity,  $I$ , increases relative to the liability,  $L$ .

In an all-risk crop insurance program, the amount paid in indemnity is expected to equal the amount collected in total premiums. This will hold true over a number of years if;

- (1) one of the above methods to calculate the pure premium is used,
- (2) the sample of observations that the calculations are based on is large enough and
- (3) the observations are randomly and independently distributed.

## CHAPTER III

### THE METHOD OF THE STUDY

The problem of this study was described in the first chapter. To arrive at a valid conclusion, or solution to the problem, the proper method of analysis must be used. This chapter is thus devoted to stating the approach to solving the problem beginning with the hypotheses.

#### The Hypotheses

The following hypotheses are considered to guide the direction of the study;

- (1) The present coverage by all-risk crop insurance does not offer adequate protection for hail damages. This is due to the nature of hail damage and the system of adjustment under crop insurance.
- (2) Separate coverage for the risk, hail, under the all-risk crop insurance is feasible both from the stand-point of acceptance by the farmer and the acceptance by the Crop Insurance Corporation. One stipulation in a program of this type is that all other crop risks must be insured against before separate coverage for hail is granted to a farmer. Insurance against the single risk, hail, will not be feasible with the all-risk crop insurance. The

all-risk portion of the insurance must operate as it does now and the decisions for separate hail coverage must be made at the time the insurance is taken out by the farmer.

### The Data

The data for the study comes mainly from a field survey in the Russell and Silvercreek Municipalities of Manitoba. An important contribution of data and information came from the Manitoba Crop Insurance Corporation, and data relating to hail insurance rate making was acquired from the Canadian Hail Underwriters Association.

### The Field Survey

The area for the field survey was comprised of approximately nine townships, located on productivity index 'B' soil in the Russell and Silvercreek Municipalities of Manitoba.<sup>11</sup> This area was chosen for three reasons; (1) the area was part of the crop insurance test area for at least four years; (2) a large block of similar soil type was found here, thus easing the task of the actual survey since the data necessarily had to come from an area with the same soil

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<sup>11</sup>The soil productivity rating of the Manitoba Crop Insurance Corporation was used.

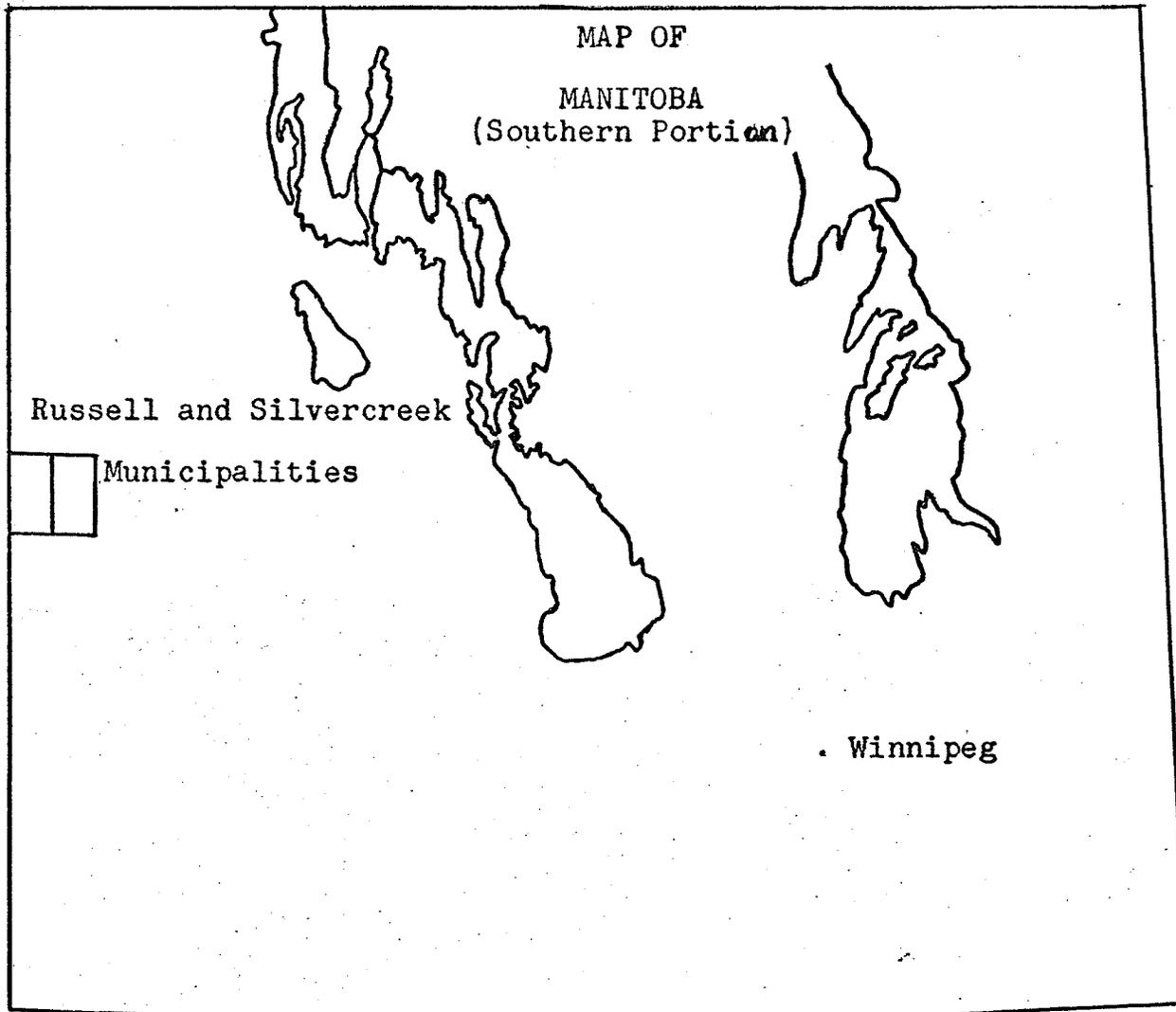


FIGURE II

Map Locating Survey Area

productivity rating, ensuring similar costs of production and yields among the individual farms; and (3) the frequency of hail in this area made the hail risk a concern of the individual farm business. Therefore, the relevant hail information could be obtained from the area studied.

Mixed-farming was found in the area, but the main source of income was from crop production. The major crops grown were wheat, oats, barley and flaxseed. There was some durum wheat, rapeseed, millet and mustard grown.

Eighty-nine farms, randomly selected from the population on productivity index 'B' soil were surveyed. The farmers situated wholly on the 'B' soil were determined from the land assessment records of the Manitoba Government.

The time period used in the questionnaires was five years, 1960-64 inclusive. This period was particularly useful to the study since it contained a great variation in weather conditions. The area experienced a severe drought in 1961 which resulted in large crop losses, and very favourable weather for crop production in the years following 1961, with crop losses attributable mainly to hail damages.

#### Physical Description of the Survey Area

The soil in the survey area is Newdale Clay Loam which has a high productivity rating. A large portion of the farm

income in that area is from crop production. In 1964, 69.1 percent of the surveyed farms' gross incomes came from crop production, 29.1 percent of the gross income was from livestock production and the remaining 1.8 percent was from off-farm sources.

With the income from crop production forming the largest portion of the total farm income, high participation in insurance on crops was expected. Over fifty percent of the farmers surveyed, had their crops insured. Table I gives a breakdown of the percentage participation in all-risk crop insurance, hail insurance and both insurances.

There was a great variation in weather conditions in the survey area for the years 1960-64. Crop losses were very small in some years and extremely large in other years. Monthly precipitations and temperatures are given in Table II from April to September for the years 1960 to 1964.

The year 1960, had below normal precipitation and above normal temperatures. Crop yields were generally good as there was sufficient reserve moisture and above normal or average precipitation in April and May. The survey area experienced a severe drought in the year 1961, with yields being lowered considerably. In some cases the crops were destroyed completely.

TABLE I

PERCENTAGE FARMS PARTICIPATING IN INSURANCE ON  
CROPS IN THE SURVEY AREA <sup>12</sup>

Year	Hail Insurance	Crop Insurance	Hail and Crop Insurance	Neither
1961	21	27	3	49
1962	20	39	9	32
1963	31	30	13	26
1964	30	26	9	35

<sup>12</sup>Records from 1960 were not included in this table because only a portion of the survey area was in the Manitoba Crop Insurance Test Area in that year.

TABLE II

MONTHLY MEAN TEMPERATURES, PRECIPITATIONS AND DIFFERENCES FROM NORMAL. RUSSELL, MANITOBA OBSERVATIONS.

Month and Year	TEMPERATURE		PRECIPITATION		NO. OF DAYS
	Mean Temp.	Difference from normal	Total Precipitation	Difference from normal	With .01 or more inches rainfall
<b>1960</b>					
April	33.8	-1.1	1.10	.20	7
May	52.3	2.7	2.90	1.36	10
June	58.4	.0	1.91	-1.33	13
July	67.5	3.0	1.13	-1.45	5
Aug.	64.9	3.4	.99	-1.15	10
Sept.	53.9	2.7	1.25	-.21	10
<b>1961</b>					
April	32.5	-2.4	.77	-.13	5
May	50.7	1.1	1.08	-0.46	5
June	64.5	6.1	.32	-2.92	4
July	66.1	1.6	.70	-1.88	4
Aug.	68.3	6.8	.03	-2.11	2
Sept.	46.7	-4.5	2.05	.59	8
<b>1962</b>					
April	32.7	-2.2	.82	-.08	4
May	47.7	-1.9	2.31	.77	11
June	61.4	3.0	.93	-2.31	8
July	61.5	-3.0	2.37	-.21	13
Aug.	62.8	1.3	2.98	.84	13
Sept.	49.3	-1.9	.59	-.87	6

Source: Department of Transport, Meteorological Branch; Monthly Record: Meteorological observations in Canada.

TABLE II (continued)

MONTHLY MEAN TEMPERATURES, PRECIPITATIONS AND DIFFERENCES  
FROM NORMAL. RUSSELL, MANITOBA OBSERVATIONS.

TEMPERATURE		PRECIPITATION		NO. OF DAYS	
Month and Year	Mean Temp.	Difference from normal	Total Precipitation	Difference from normal	With .01 or more inches rainfall
1963					
April	38.3	3.4	.99	.09	7
May	47.9	-1.7	2.62	1.08	13
June	59.5	1.1	4.10	.86	11
July	66.6	2.1	1.82	-.76	8
Aug.	64.0	2.5	4.99	2.85	10
Sept.	56.0	4.8	1.22	-.24	7
1964					
April	37.9	3.0			
May	51.8	2.2	2.78	1.24	11
June	59.4	1.0	1.30	-1.94	9
July	66.2	1.7	4.63	2.05	15
Aug.	58.3	-3.2	1.56	-.58	9
Sept.	48.0	-3.2	1.22	-.24	8

Source: Department of Transport, Meteorological Branch;  
Monthly Record: Meteorological observations in  
Canada.

The precipitation was considerably below normal during the growing season. This was accompanied by above normal temperatures. Reserve moisture was low as the precipitation in 1960 was below normal.

The year 1962 was a vast improvement over 1961. Precipitation in May and August was above normal. The years 1963 and 1964 were good for crop production with slightly above normal in the fall of 1963, with the first below freezing temperature reported at the twentieth of October.

Crop damages in the survey area during the five years studied were due mainly to two factors; drought and hail. In the year 1961, the crops were damaged by drought with a few reports of grasshopper damage. Hail was not reported in that year.

In 1962, hail was the biggest factor in causing crop damage. Twenty percent of the surveyed farms reported hail damage, which ranged from twenty to sixty percent. Less than ten percent of the farmers reported reduced yields due to grasshoppers and drought.

Again in 1963, hail was the chief factor causing crop losses with twenty-two percent of the surveyed farms being affected. Hail damages ranged from seven to eighty percent. One farm reported trouble with cutworms in that year and one farm had barley yields reduced because of a lack of moisture.

TABLE III

THE PERCENTAGE CLAIMS IN HAIL INSURANCE AND CROP INSURANCE  
OF THE NUMBER ELIGIBLE FOR EACH INSURANCE AND THE  
AVERAGE INDEMNITY PER CLAIM IN DOLLARS

Year	Percent Claims in Hail Insurance	Dollars per Claim	Percent Claims in Crop Insurance	Dollars per Claim
1961	-	-	92	\$911.73
1962	50	\$407.86	15	213.96
1963	22	863.75	3	454.00
1964	17	417.58	-	-

Source: From the Russell and Silvercreek Municipalities survey.

There was less hail damage reported in 1964, but it was the most important yield reducing factor. There was considerable frost damage reported with an early frost in September. The frost damages did not affect the crop yields but lowered the grades considerably in late crops.

The claims in hail insurance and crop insurance are shown in Table III. The only year P.F.A.A. payments were made was in 1961, when 63 percent of the eligible recipients received payment. The average amount per payment was \$315.95.

The average wheat yields on the surveyed farms were as follows: 1961 - 11.0 bushels per acre, 1962 - 31.4 bushels per acre, 1963 - 32.6 bushels per acre and 1964 - 30.1 bushels per acre. In 1964 the average wheat yields on hailed farms was 28.9 bushels per acre and the average wheat yield on farms that received no hail was 34.2 bushels per acre.

### The Analysis

The main line of attack at the problem is through a series of comparisons and case studies using the data from the Russell and Silvercreek Municipalities field survey.

In the following chapter, the protection by all-risk crop insurance for the single hazard 'hail' is examined. The adequacy of coverage for hail is examined from two points of view, the actual opinions of the farmers and from the actual records of the farm experiences with hail damage on crops.

A comparison is made of the wheat yields from hail damaged crops and the possibility of indemnification by all-risk crop insurance. In this chapter, the need for separate hail coverage with all-risk crop insurance is determined, that is, the adequacy or inadequacy of coverage for the hail risk by all-risk crop insurance is established.

Different alternatives to adjust the problem are presented in Chapter V. The costs to the insured are determined and compared for the alternatives, (1) of carrying both the present hail insurance and all-risk crop insurance, (2) raising the coverage level of the all-risk crop insurance and (3) providing separate hail coverage along with the all-risk crop insurance.

The loss cost ratio is used in Chapter VI in formulating premium rates for hail coverage with all-risk crop insurances. Other aspects of premium rate-making are examined in order to formulate a method for rate-making for the proposed crop-hail insurance program. Chapter VII brings the study to a close with a summary and implications.

## CHAPTER IV

### AN EVALUATION OF THE FARMERS' EXPERIENCE AND OPINIONS OBTAINED FROM THE SURVEY DATA, 1960-64.

Variation in crop yields does indeed add to the uncertainty of the income level in the agricultural industry. To help in reducing some of this uncertainty, farmers in Manitoba may insure their crops against economic losses due to weather, diseases, insects and pests.

All-risk crop insurance give protection against all unavoidable losses due to hail, drought, flooding, insects and diseases. The insurance does not cover to the full value of the crop, however, but only up to sixty percent of the long term average yield in each area. As a result, many farmers complain that all-risk crop insurance does not cover for hail losses. This chapter examines the extent of hail damages and the protection given against these damages by all-risk crop insurance.

#### 1. Farmers' Experience with Hail Damage and All-risk Crop Insurance.

Crop losses due to hail were reported in every year in the survey area of the Russell and Silvercreek Municipalities with the exception of 1961. Hail damages on wheat ranged from twenty to sixty percent in 1962, from seven to eighty percent in 1963, and from twenty-five to fifty percent in 1964. Table IV, gives the percentage of the total number of farms surveyed,

receiving hail damages in each of the years and Table V, gives the average wheat yields on these farms. The farms are grouped into four categories, according to the type of crop protection the farmers carried.

The coverage level of the Manitoba Crop Insurance for wheat in 1962-64 was 13.5 bushels per acre. There was not a single case where the average yield per acre on hailed farms was lower than the coverage level in these three years. The average yield of wheat on the hailed farms was considerably higher than the coverage level.

In the three-year period, 1962-64, a few farms carried both hail insurance and crop insurance protection. In all three years some of these farms had their crops damaged by hail and were only indemnified by hail insurance. In 1962, the average indemnity per claim from hail insurance was \$900.00; in 1963, \$1,418.00 and in 1964, \$238.22. The average wheat yields on the hailed farms were all above the Manitoba Crop Insurance coverage level.

TABLE IV

PERCENTAGE OF THE TOTAL FARMS SURVEYED RECEIVING  
HAIL DAMAGES IN EACH CATEGORY

Year	Hail Insurance	Crop Insurance	Both Insurances	Neither Insurances
1962	59	15	29	13
1963	22	19	20	29
1964	15	27	25	3

TABLE V  
 AVERAGE WHEAT YIELD, BUSHELS PER ACRE, ON  
 HAILED FARMS IN EACH CATEGORY

Year	Hail Insurance	Crop Insurance	Both Insurances	Neither Insurances
1962	33.4	38.2	37.7	23.8
1963	32.9	37.1	33.0	30.0
1964	29.4	28.6	46.8	17.8

2. Farmers' Opinions About Hail Damages and All-Risk Crop Insurance.

In the Russell and Silvercreek Municipalities field survey, the farmers were asked why they choose the type of insurance on crop production they did. They showed both resentment and satisfaction with the Manitoba Crop Insurance along with their reason for their choice of crop protection.

The opinions of the farmers are listed below in four categories: for those who had hail insurance, for those who had crop insurance, for those who had both hail and crop insurance and for those that did not insure their crops.

(a) With Hail Insurance

- (1) Thirty-one percent of the farmers in this category stated that hail is the major cause of crop damages, and hail insurance gives the best protection for hail. Some of these took hail insurance only when crop prospects were good.
- (2) Twenty-seven percent stated that crop insurance coverage level was too low.
- (3) Twenty-three percent stated that they can collect hail insurance but not crop insurance. This seems to imply that they are dissatisfied with crop insurance, when they receive hail damages but are not indemnified.
- (4) The remaining nineteen percent took out hail insurance simply for protection and to cover debts and expenses. These must also have felt that hail is the greatest threat in the area, since they protected themselves against the one risk only.

(b) With Crop Insurance

- (1) About 45 percent of the farmers in this category carried all-risk crop insurance to be assured of a

portion of their crop to cover expenses and meet debts.

- (2) About 23 percent carried crop insurance because it was a cheap form of insurance considering that they did not have to meet P.F.A.A. payments.
- (3) About 14 percent carried crop insurance because of the losses they experienced in the year 1961.
- (4) About 9 percent stated that crop insurance gave a broader coverage than hail insurance.
- (5) About 9 percent were dissatisfied with the level of coverage and the method of adjustment of crop insurance but were convinced that crop insurance was better than taking the chance of having no crop at all.

(c) With Both Crop Insurance and Hail Insurance

- (1) About 63 percent of the farmers were of the opinion that crop insurance does not cover for hail damages. Hail insurance protects the "top half" of the crops against hail losses while crop insurance covers the "bottom half" of the crops against all risks.
- (2) Twenty-five percent stated that they relied heavily on the income from crops and therefore needed both insurances to cover expenses and to meet debts.
- (3) About 13 percent had both insurances because hail

insurance covers for partial losses and it was easier for them to get loans when their crops were heavily insured.

(d) With Neither Insurance

- (1) Seventy-two percent of the farmers in this category were of the opinion that crop insurance is too expensive or has a too low level of coverage and hail insurance is not needed because hail is not too great of a risk.
- (2) About eleven percent had other forms of income protection such as livestock, off-farm employment or bank reserves.
- (3) About ten percent did not believe in insuring their crops.
- (4) Seven percent felt that they were better than average farmers and did not want to pay for other farmers' losses through crop insurance.

In general, the satisfactions expressed with the Manitoba Crop Insurance were that it is relatively an inexpensive form of insurance, and that it covers for losses attributable to all unavoidable causes and that it guarantees a minimum income from crop production. Some of the most common complaints with crop insurance were that the coverage level is too low and that adequate protection is not given against hail losses.

The implication of the preceding analysis that crop

insurance does not cover hail damage adequately. This is implied by the opinions of the farmers, by actual hail damages up to eighty percent where the crops did not qualify for Manitoba Crop Insurance coverage and by the case examples from those farms covered by both hail and crop insurance.

Hail damages may cause a good crop to become a below average crop, thus robbing the farmer of extra profits and a chance to progress further in his business. At the present moment, the Manitoba farmer may carry a heavy premium load and insure with both hail and crop insurance and be fairly certain of his profits from crop production or he may carry the risk of either hail or all other hazards by himself. In the following chapter, three different alternatives are examined to determine whether a program which offers better protection to the farmers may be established.

## CHAPTER V

### AN EXAMINATION OF THE FEASIBILITY OF A HAIL-CROP INSURANCE PROGRAM IN MANITOBA

Insurance to protect farm income from wide fluctuations due to variations in crop yields is important to a farm business. All-risk crop insurance is available to Manitoba farmers to guarantee them a minimum income from crop production in the event of crop failures due to any unavoidable causes. However, crop losses due to hail are seldom to the extent that the crop qualifies for crop insurance indemnification from the present Manitoba All-Risk Crop Insurance.

Three alternatives are considered in this chapter to determine the alternative which gives the farmer adequate protection against hail as well as all other losses. These are: (1) insuring the crops with both all-risk crop insurance and hail insurance, (2) raising the coverage level of the all-risk crop insurance to eighty percent of the long-term average yield, (3) and offering a separate hail coverage with all-risk crop insurance.

The composition of the three alternatives is as follows:

- Alternative 1 -- 60% coverage of all-risk crop insurance and hail insurance.
- Alternative 2 -- 80% coverage of all-risk crop insurance.
- Alternative 3 -- Crop-hail insurance - Option 1 and Option 2

The options of alternative 3 are defined as follows:

Option 1 - 60% coverage of all-risk crop insurance

Option 2 - 60% coverage of all-risk crop insurance  
plus separate coverage for crop damage  
due to hail.

In alternative 3, either option 1 or option 2 are taken out by the insured but not both. This is in contrast to alternative 1, where two separate crop insurance policies are taken out by the insured; all-risk crop insurance and hail insurance.

Alternative 1, 2 and option 2 of alternative 3 are compared to determine the most suitable form of crop protection with respect to the farmer. The most suitable alternative will be the alternative which (1) gives the best protection against all crop risks and (2) offers the best protection with the least cost in premiums.

Alternative 1: All-risk crop insurance and hail insurance

This alternative is at present available to the Manitoba farmer in the Manitoba Crop Insurance test areas. To have protection against all crop hazards and be guaranteed a minimum income from crop production, the farmer may insure his crops with all-risk crop insurance. The farmer, in addition, may insure his crops with hail insurance to cover losses due to hail irregardless of the total yield of the crop on the whole farm.

The cost to the farmer for this alternative is the amount paid in premiums for crop insurance plus the amount paid in premiums for hail insurance. With crop insurance as previously discussed, the farmer pays only eighty percent of the net premium rate and does not pay for administration costs. Up to now hail insurance is only available from a number of private hail insurance companies. The premium rates for hail insurance include the total loss cost, the administration costs and a profit level.

The hail rates are given by townships in table 6, for the Russell and Silvercreek Municipalities for the years 1961-64. In 1964, the rates ranged from four to eight percent, but for comparison of costs, a basic premium rate of six percent is used in all examples in this chapter.<sup>13</sup>

The crop insurance coverage level for wheat on the productivity index 'B' soil in 1964 was 13.5 bushels per acre, with a premium of \$1.02 per acre.

To determine the most suitable alternative, the costs in premiums and the coverages are calculated and applied to a one hundred acre field of wheat. The amount of hail insurance is ten dollars per acre. Higher or lower hail coverage would have proportionately higher or lower premiums.

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The six percent premium rate was arbitrarily chosen. Higher or lower premium rates will raise or reduce the costs in each example proportionately.

TABLE VI

BASIC HAIL RATES IN THE RUSSELL AND SILVERCREEK MUNICIPALITIES OF MANITOBA BY TOWNSHIPS: 1961-64.

Township and range	19-26	19-27	19-28	19-29	20-26	20-27	20-28	20-29	21-26	21-27	21-28	21-29
<u>Year</u>												
1961	8	7	7	6	7	6	6	5	6	7	6	4
1962	8	6	7	6	6	6	6	4	6	6	5	3
1963	8	6	7	6	6	6	6	4	6	6	5	3
1964	8	6	7	6	7	6	6	4	7	7	5	4

Source: Canadian Hail Underwriters' Association; Manitoba Hail Rates, 1961-64.

The coverage for hail on a one hundred acre field at ten dollars per acre is \$1,000.00. The premium at a basic rate of six percent is \$60.00. The total bushel coverage with crop insurance is 1,350 bushels and the total premium is \$102.00. The premium is \$162.00 for both hail insurance and crop insurance.

For the purpose of comparisons in this chapter, the value of wheat is assumed to be \$1.25 per bushel. Therefore, the total dollar coverage on the one hundred acres of wheat is \$2,687.50.

The average wheat yield in 1964, in the survey area, was 33.2 bushels per acre. A hundred acre field of wheat would have yielded 3,320 bushels of wheat valued at \$4,150. The amount of the dollar value of this crop covered with insurance was approximately sixty-five percent.

Alternative 2: Eighty percent coverage level of crop insurance.

The present all-risk crop insurance in Manitoba covers up to sixty percent of the long term average yield. As found in chapter four, hail damage usually does not bring the average yields below this level. Raising the coverage level to eighty percent of the long term average yield may bring the coverage up high enough to cover for more hail losses. The long term average wheat yield for the period 1930-64, for the survey area was 22.5

bushels per acre. Eighty percent coverage level would bring the coverage up to eighteen bushels per acre. Using the normal curve approach to determine premiums, the eighty percent premium rate is \$2.15 per acre. This figure has taken into consideration the twenty percent payment of premiums by the federal government.<sup>14</sup>

The cost of insuring one hundred acres of wheat with eighty percent coverage level of crop insurance is \$215.00. The total coverage is eighteen hundred bushels or \$2,250.00. The coverage is approximately fifty-four percent of the 1964 average wheat yield.

### Alternative 3: Crop-hail Insurance

The third alternative considered is to offer a separate hail coverage as an option with all-risk crop insurance. The essential difference of this alternative from an all-risk crop insurance program is that the adjustments for hail damages are made on the percentage damage basis, instead of on an average yield basis.

The method used in presenting this alternative is by (1) setting up a proposed plan, (2) illustrating the plan

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<sup>14</sup> B.E. Owen, "Crop Insurance and the alternative forms of Crop Income Protection". Unpublished Masters' Thesis, Dept. of Agric. Econ. and Farm Management, University of Manitoba, 1966.

with examples and (3) calculating the premiums and coverages of the plan for comparisons with alternatives 1 and 2.

(a) A Proposed Plan. To determine the costs and coverages of a crop-hail insurance program a proposed plan may be designed showing the basic principles of such a program.

The proposed plan is based on the present Manitoba Crop Insurance scheme. Two options are involved in the plan, with the first of these being identical to the present Manitoba crop insurance. Under the first option, indemnities on crops damaged by any risk including hail, are made on the difference in total yields from the total coverage.

Crop damages due to hail are considered separately from crop damages due to any other risk, under the second option. In the event of hail damage to a crop, adjustment is made shortly after the occurrence of the damage and the indemnity is paid to the farmer on the percentage damage basis. Adjustment on a crop damaged by any risk other than hail is made post-harvest. If the crop is totally destroyed adjustment is made pre-harvest. An indemnity is paid on the amount the yield is below the coverage level.

The differences in coverages by options 1 and 2 of the proposed crop-hail insurance plan are illustrated in Table VII.

The calculations are based on the following example;

Crop insured	----	100 acres of wheat
Coverage per acre	--	12bushels or \$15.00/acre.
Total coverage	-----	1200 bushels or \$1,500.00

TABLE VII

## NUMERICAL ILLUSTRATIONS OF OPTIONS 1 AND 2 OF THE PROPOSED CROP-HAIL INSURANCE

Physical Description			Option 1		Option 2			
Case No.	Damage	Final average yield (bus. per acre)	Value of Crop	Indemnity	Total Crop Receipt Including Indemnity	Indemnity based on percentage hail damage	Indemnity based on total value	Total Crop Receipt Including Indemnity
1	25% hail	22.5	\$2,812.50	-	\$2,812.50	\$ 375.00	-	\$3,187.50
2	50% hail	15	1,875.00	-	1,875.00	750.00	-	2,625.00
3	75% hail	7.5	937.50	\$562.50	1,500.00	1,125.00	-	2,062.50
4	100% hail	-	-	1,500.00	1,500.00	1,500.00	-	1,500.00
5	50% hail	10	1,250.00	250.00	1,500.00	750.00	-	2,000.00
6	50% hail plus excess fall rain	5	625.00	875.00	1,500.00	750.00	125.00	1,500.00
7	50% hail on 50 acres	10	625.00	-	1,875.00	375.00	-	2,250.00
	No damage on remaining 50 acres	20	1,250.00					

Cases 1 to 3 of Table VII illustrate the advantage of option 2 over option 1 with regard to hail damages. Case 4 illustrates that option 2 has no advantage over option 1, when crops are totally destroyed by hail.

Case 5 illustrates that indemnity may be received in either option. The difference in indemnities for the same crop damage in the two options lies in the difference in adjustment for losses.

Case 6 illustrates that indemnity is not paid in excess of the coverage level when the crop qualifies for indemnity based on the total value in option 2. Option 2 takes the total value received from the crop into consideration, including any indemnity that may have been received earlier in the year due to hail damages.

Case 7 illustrates how partial losses due to hail damages are indemnified under option 2, whereas no indemnity would result under option 1.

(b) Premiums and Coverages. The premiums and coverages discussed in this section are those calculated for option 2 of the proposed crop-hail insurance plan. The,problem again, is to offer the farmer adequate crop protection at the lowest cost. Option 1 of the proposed crop-hail insurance program is identical to the present Manitoba Crop Insurance program and is made available for those farmers who feel that the program

provides an adequate protection. The concern here is with option 2 which offers further coverage for hail damages.

The premium rate in option 2 is composed of two sets of rates, since actually two types of crop insurance are combined into one. The first set of rates is for the all-risk portion of the plan. This rate may be the same as the present Manitoba all-risk crop insurance rate. For example, \$1.02 per acre for wheat on the productivity index 'B' soil in 1964.

The second portion of the premium rate is that amount which just equals the amount of damage by hail on insured crops over a number of years, which is the loss cost ratio. In other words, this rate is the ratio of the losses paid on hail damages to the total liability or coverage on crops.

The premium rate of option 2 of the proposed crop-hail insurance program would be equal to the summation of the all-risk crop insurance rate and the loss-cost ratio for hail damages if the all-risk crop insurance rate incorporated no losses due to hail. On the average yield basis, it appears that no losses due to hail are incorporated into the all-risk crop insurance premium rate.

In the Russell crop reporting district for the ten year period, 1930-39 inclusive, average wheat yields below 13.5 bushels per acre were the result of a general drought. In the

period 1940-60, the average wheat yields in the Russell crop reporting district were all above the 13.5 bushel coverage level, the lowest average yield being 14.1 bushels per acre in 1954. The 1954 wheat yield was reduced by several factors including a wet spring with delayed seeding, rust and prolonged wet weather during harvest.<sup>15</sup>

In addition to the average yield for an area, the all-risk crop insurance premium rate takes into account the variability between farms and part of this variability may be due to hail damage.

The random sample survey in the Russell and Silvercreek Municipalities failed to reveal any individual farms with crop yields reduced by hail damage below the coverage level of 13.5 bushels per acre for wheat. However, the 1964 all-risk crop insurance premium rate is based on a thirty-five year period. The yield variability between farms may have been caused in part by hail damage in the area studied prior to the year 1960. A premium rate for the proposed crop-hail insurance program constructed by adding the all-risk crop insurance rate and the loss-cost ratio for hail damages may in effect be overcharging the farmer.

The risks responsible for the variability of yields between farms are undiscernible. Therefore, the portion of the

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<sup>15</sup>

The Department of Agriculture and Immigration, Queen's Printer, Winnipeg, Province of Manitoba, 1930-1959.

premium of all-risk crop insurance that may have been the result of hail damage on individual farms cannot be discovered from the present structure of the all-risk crop insurance rate.

The portion of the all-risk crop insurance premium rate attributable to the risk hail may, however, be estimated from actual experience with an insurance program of this type. The Manitoba Crop Insurance Corporation has had several years of experience with an all-risk crop insurance program and may be in a position to determine the ratio between indemnity paid on losses attributable to hail damage and indemnity paid on losses due to all other risks. The all-risk crop insurance premium rate may be adjusted to cover all risks except the risk hail by subtracting the percentage of the loss or indemnity attributable to hail damage.

In the proposed crop-hail insurance program, the added risk of separating hail coverage is expressed in the loss-cost ratio mentioned previously. Thus the structure of the premium rate of option 2 of the proposed crop-hail insurance program is equal to the summation of an adjusted all-risk crop insurance rate and the loss-cost ratio for hail damages.

The hail rates given in Table VI, are composed of a loss-cost ratio and administration expenses. Administration expenses are shared by the Provincial and Federal Governments. Only a slight increase in expenses is assumed for the proposed crop-hail insurance program since facilities exist for the present Manitoba

TABLE VIII

## PERCENT ADMINISTRATION COSTS INCLUDED IN HAIL PREMIUM RATES.

Year	Total Premiums	Total Administration costs	Administration costs as percent of premiums
1956	\$258,574.20	\$87,229.11	33.7%
1957	301,539.57	97,786.91	32.4
1958	216,260.08	64,471.00	29.8
1959	237,755.65	67,846.29	28.5
1960	263,291.13	68,147.46	25.8

Source: Report of the Superintendent of Insurance, Co-operative Hail Insurance Company Limited, 1957-61.

Crop Insurance. Therefore, only the loss-cost ratio for hail damages is added to the adjusted all-risk crop insurance premium rate for the total rate on the proposed crop-hail insurance program.

<sup>F</sup> From Table VIII, it may be determined that the average percentage administration costs included in the premium is 30 percent, leaving 70 percent of the basic hail rate to cover the indemnity paid for hail losses. In order to examine the feasibility of the proposed crop-hail insurance program, the example used in the discussion of alternatives 1 and 2 is continued here. To calculate the premium rate for alternative 3, the adjusted rate for the all-risk portion of the insurance is assumed to be \$1.02 per acre. This rate covers losses due to all risks except the risk hail. The costs to insure the one hundred acres of wheat are \$102. for the all-risk portion of the insurance and \$42. for the hail portion . The hail rate is 70% of the basic six percent rate. The level of coverage in alternative 3 is \$1,687.50 for all risks other than hail and \$1,000. for the risk hail.

TABLE IX  
A SUMMARY OF THE COSTS AND COVERAGES OF THE THREE ALTERNATIVES

<u>Alternative</u>	<u>Premium</u>	<u>Dollar Coverage</u>		<u>Total</u>
		<u>All-Risk</u>	<u>Hail</u>	
1	\$162.00	\$1,687.50	\$1,000.00	\$2,687.50
2	\$215.00	\$2,250.00	-	\$2,250.00
3	\$144.00	\$1,687.50	\$1,000.00	\$1,687.50

#### Comparison of Alternatives

The summary of the three alternatives considered is given in Table IX. Alternative 1 is composed of the present all-risk crop insurance and the present hail insurance. Alternative 2 is 80 percent coverage level all-risk crop insurance while alternative 3 is the proposed crop-hail insurance program.

The comparison of these alternatives is made to determine which alternative will give the farmer best crop protection with all risks, especially the risk hail, in consideration. The best alternative is determined for the five year period studied in the Russell and Silvercreek Municipalities.

Alternative 1 permits a higher total indemnity than Alternative 3, at a higher total premium. In the five year period studied, however, the indemnity that each damaged crop qualified for would have been the same with either Alternative 1 or Alternative 3. In the year 1961, the damaged crops would have qualified

for an indemnity from the all-risk portion of both alternatives. No hail damage was observed in the Russell and Silvercreek Municipalities in that year and thus no indemnity would have been paid on the hail insurance portion of the two alternatives. In the years 1962 to 1964 inclusive, all crops damaged by hail did not qualify for indemnity from the all-risk portion of the alternatives, but would have qualified for the same indemnity from the hail insurance portion of the alternatives. Therefore, it may be concluded that Alternative 3 would have been better suited to the farmers' needs than Alternative 1 in the Russell and Silvercreek Municipalities for the time period studied.

In circumstances other than those in the time period studied in the Russell and Silvercreek Municipalities, a possibility exists where hail damage may be to the extent that a crop is totally destroyed. In such a case, Alternative 1 would give a larger total indemnity than Alternative 3. In view of this possibility, Alternative 1 offers a better coverage if hail damage is to the extent that the average yield of a crop is brought below the coverage level of the all-risk crop insurance by more than the increase in the premium of Alternative 1 from that of Alternative 3. This possibility may be very unlikely in the Russell and Silvercreek Municipalities since cases were observed where crops were damaged by hail up to 80 percent but failed to bring the average yield of the crops below the all-risk

crop insurance coverage level.

Alternative 3 cannot be compared with alternative 2 directly from Table IX since a different coverage exists. Alternative 2 covers up to 80 percent of the long-term yield against all risks including hail. Alternative 3 covers up to 60 percent of the long-term average yield for all risks plus separate coverage for the risk hail.

Table IX reveals that the premium is lower for alternative 3 than in alternative 2. The total coverage is lower in alternative 3 than in alternative 2.

In order to evaluate the coverage of alternatives 2 and 3, reference is made to the Russell and Silvercreek Municipalities field survey data. The average wheat yields on hailed farms were above the eighteen bushel coverage level of alternative 2 in the years 1962-64, as shown in Table V, of chapter IV, with only one exception. Alternative 3, or the proposed crop-hail insurance plan would have indemnified the losses in all cases of hail damaged crops.

Therefore, it may be concluded that the proposed crop-hail insurance program is better suited to the farmers needs, with the risk hail in mind, than the 80 percent coverage crop insurance.

A separate coverage for the hail risk under the all-risk crop insurance program is feasible from the stand-point of

acceptance by the farmer in areas where the average yield of a crop is not brought substantially below the coverage level of the all-risk crop insurance by hail. An area such as this is the Russell and Silvercreek Municipalities of Manitoba.

## CHAPTER VI

### FURTHER CONSIDERATIONS ON A PROPOSED CROP-HAIL INSURANCE PROGRAM

A crop-hail insurance program, as outlined in the previous chapter, must be acceptable to both the insured or the farmer, and the insurer or, in this study, the Manitoba Crop Insurance Corporation, before it may become operational.

The proposed crop-hail insurance program is acceptable to the farmer in an area such as the Russell and Silvercreek Municipalities of Manitoba for the following reasons: (1) the program offers adequate protection against crop losses due to hail and other damages and (2) for such an area, the program gives adequate protection at a cost lower than any other alternative form of insurance.

The acceptability of the crop-hail insurance program by the Manitoba Crop Insurance Corporation is determined in this chapter. To be acceptable, the program must be in accord with the corporation's objective which is "to establish a voluntary crop insurance program which, while self-sustaining, will reduce the financial distress resulting from a loss of crops by insured farmers." <sup>16</sup>

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<sup>16</sup>Manitoba Crop Insurance Corporation; Annual Report, March, 1965.

The Acceptable Program. The crop-hail insurance program has two options. The first option is acceptable by the Manitoba Crop Insurance Corporation as it is identical with the present Manitoba crop insurance. The second option is composed of two parts, average yield adjustments on crops damaged by any risk other than hail and percentage damage adjustments on crops damaged by hail.

(1) The Coverage Level of Option Two;

The coverage level in the all-risk portion of option two of the proposed crop-hail insurance is 60% of the long-term average yields in each area. This level was chosen with the intention of covering the expenses of a farm in producing a crop, since the objective of the Manitoba Crop Insurance Corporation is to reduce the financial distress resulting from crop losses.

The coverage for hail damages may be in excess of the crop insurance objective. Therefore, the coverage for hail needs to be refined. A program which appears to suit the crop insurance coverage which may be examined is as follows:

Using the 1964 average wheat yield of 22.5 bushels per acre on the productivity index 'B' soil, the 60% coverage level under crop insurance is 13.5 bushels per acre.

A similar coverage for hail damages, adjusted for on

the percentage damage basis, is 22.5 bushels per acre, with a 40% deductible policy. In other words, the first forty percent hail damages would not be indemnified. A farm receiving 100% hail damages would be indemnified 60% of the coverage or an amount equal to the value of 13.5 bushels of wheat per acre.

The coverage statistics based on the year 1964 on the productivity index 'B' soil for option 2 of the proposed crop-hail insurance program then are:

35 year average wheat yield -- 22.5 bushels per acre

Assumed value of wheat -- \$1.25 per bushel

60% of the long-term average  
yield coverage for insured  
wheat crops against damages  
caused by any risks other  
than hail. 13.5 bushels or  
\$16.87½ per acre.

40% deductible hail clause -- 22.5 bushels or  
coverage \$28.12½ per acre.

(2) Application of the program to an actual case:

The revision of the coverage for hail damages to a 40% deductible clause means that the farmer is not indemnified for hail damages up to forty percent. An application of option 2 of the proposed crop-hail insurance program is made to an actual farm situation in the Russell and Silvercreek municipalities in 1964 to show that the proposed program covers against hail losses more adequately than the present

all-risk crop insurance.

The farm in question carried hail protection on 110 acres of wheat in 1964. The wheat crop was damaged 67% by hail and yielded 17.3 bushels per acre.

With a coverage level of 13.5 bushels per acre, the Manitoba crop insurance would not have indemnified the loss.

The crop-hail insurance would have indemnified the loss as follows:

Percent damage	67 %
Deductible	40%
Percent damage to indemnify	<u>27%</u>
Indemnity - 27% x \$28.12½ x 110 acres = \$835.31	

### (3) The premium rate

Part of the objective of the Manitoba Crop Insurance Corporation is that the program must be self-sustaining. By self-sustaining is meant that over a period of years the receipts in premiums must equal the amount paid out in indemnities.

Therefore, if the proposed crop-hail insurance program is to be accepted by the Corporation, it must not only have an acceptable coverage but must also be self-sustaining.

The proposed crop-hail insurance program is composed of two sets of premium rates. The premium rate for the all-risk portion of the program is calculated by the normal curve

approach as presently done by the Manitoba Crop Insurance Corporation. This approach shall not be enlarged upon in this study as other studies have been completed on the normal curve approach to premium rate making.<sup>17</sup>

The all-risk portion of the program covers for all risks other than hail. As discussed in chapter V, yield variability between farms may be caused in part by hail damage. The present all-risk crop insurance premium rate may be adjusted by estimating and deducting the amount of premium due to the risk hail. The yield variability caused by hail damage may be estimated from records of indemnities paid for crop losses. The percentage of indemnities paid for losses caused by hail damage as compared to the total indemnity paid for losses caused by all risks may be a close estimate of the yield variability between farms caused by hail damage. For example, if the all risk crop insurance premium rate is \$1.00 per acre and 5% of the indemnity paid was for losses caused by hail, then the premium rate for the all-risk portion of the proposed crop-hail insurance program becomes ( $\$1.00 - (5\% \times \$1.00)$ ) or 95 cents per acre.

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Botts, R.R. and Boles, J.N. "Use of Normal-curve Theory in Crop Insurance Rate Making," Journal of Farm Economics, Vol. XL, August, 1958.

Yeh, M.H. and Wu, R.Y. "Premium Ratemaking in All Risk Crop Insurance Program", Canadian Journal of Agricultural Economics, Vol. IX, Number 1, 1966.

The feasibility of the proposed crop-hail insurance program will be limited to the extent that an insurer such as the Manitoba Crop Insurance Corporation is able to estimate the yield variability caused by hail, in a manner as outlined above.

For the hail rates in the second option of the proposed crop-hail insurance program, a hail rate calculated by townships is suggested. There are two governing factors in rate making: (1) the frequency of hail and (2) the dollar coverage on insured crops.

The dollar coverage on insured crops simply increases or decreases the premium proportionately as the coverage increases or decreases. The frequency and extent of hail damages on crops determines the premium rate. A hail rate may be established only by using past records of hail damages, and forecasting these into the future.

A hail rate by townships may be formed by using two loss cost ratios. The first loss cost ratio is the ratio of the total indemnities paid to the total liability in a single township. The second loss-cost ratio is formed by grouping statistics from all townships which have the same soil productivity index and forming the ratio of the total indemnities paid to the total liability for each group. The final loss cost ratio or premium rate is formed by taking the arithmetic mean of the township loss cost and the group loss cost in

which the township lies.

For example, the premium rate for a township in the Russell and Silvercreek area would be the arithmetic mean of the loss cost ratio in that township and the loss cost ratio of all townships on the productivity index 'B' soil.

A hail rate formulated as above, involves an area small enough to give a fair rate to individual farms and by aggregating the data by soil productivity ensures that crops of equal value are being charged a proportionate rate. In the long-run, the program should prove self-sustaining since each year a new rate is formed as more records are available from past experiences with hail damages and the probabilities of hail damages are incorporated into the rates.

The hail rate formulated above is a basic rate. In the crop-hail insurance program, the rate charged for the forty percent deductible policy would be eighty percent less than the basic rate. <sup>18</sup> For example, the rate charged for the hail portion of the program is 1.2% of the coverage if the basic rate

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The charge for a ten percent deductible policy made by the Canadian Hail Underwriter's Association is twenty percent less than the full coverage hail premium rate and the charge for a twenty-five percent deductible policy is fifty percent less than the full coverage hail premium rate. This implies a linear relationship between the degree of hail damage and the frequency of its occurrence. Therefore, a reduction of eighty percent of the basic hail rate is made for the forty percent deductible policy.

is 6%.<sup>19</sup>

The premium rate for the proposed crop-hail insurance program would be the summation of the adjusted all-risk crop insurance rate and the hail-risk insurance rate.

#### IMPLICATIONS

The implication of this chapter is that the proposed crop-hail insurance program should be acceptable to the Manitoba Crop Insurance Corporation for the following reasons:

- (1) The program will reduce the financial distress resulting from a loss of crops by insured farmers. It will guarantee a minimum income from crop production as well as a coverage for hail losses from 40 to 100 percent, and
- (2) the program will be self-sustaining to the extent that the probabilities of crop losses due to hail or other causes are incorporated into the rates as outlined above.

The crop-hail insurance program is feasible both from the standpoint of acceptance by the farmer in an area such as the Russell and Silvercreek Municipalities and the acceptance by the Manitoba Crop Insurance Corporation.

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A basic hail rate of 6% was used here. This rate includes only the loss cost ratios and no administration expenses. It is then different from the basic hail rates given in Table VI of Chapter V, which do include administration expenses.

## CHAPTER VII

### SUMMARY AND CONCLUSIONS

The hypothesis set out at the beginning of the study were generally confirmed by the analysis.

The first hypothesis stated that the present coverage by all-risk crop insurance does not offer adequate protection for hail damage in the studied area. This is due to the nature of hail damage and the system of adjustment under crop insurance. This hypothesis was supported by evidence from the opinions of the farmers who were exposed to all-risk crop insurance and from the actual experiences of the farms with hail damages.

The second hypothesis was supported in general in Chapters V and VI. In Chapter V, it was evident that separate coverage for hail under the all-risk crop insurance program was feasible from the standpoint of acceptance by the farmer in an area such as the Russell and Silvercreek Municipalities. The proposed crop-hail insurance might provide the best protection against crop losses from hail and other damages at the lowest cost to the farmer.

The hail protection should be revised to a forty percent deductible policy under the all-risk crop insurance before the program could be acceptable to the crop insurance corporation. The objective of the Crop Insurance Corporation is to

provide financial relief in the event of crop losses. The all-risk crop insurance was designed to cover the expenses that are incurred in a year's crop production. Therefore, to keep the separate hail coverage in line with the all-risk portion of the program, a forty percent deductible hail coverage could be practical.

The forty percent hail coverage was applied to an actual farm case to determine whether the separate coverage would still be acceptable to the farmer and offer better protection against hail damages than the all-risk crop insurance.

The separate hail coverage is tied to the all-risk crop insurance and therefore, farm crops must be insured against all other risks before separate coverage for hail is granted to the farmer. Another reason for this is that insurance against the hail risk alone is available at the present moment. The problem was to determine whether the farm crops may be adequately protected against all risks including hail by one program or with a program in the least expensive form. Several conclusions may be drawn from the study. These are:

- (1) All-risk crop insurance does not apparently offer adequate protection against hail damages. This conclusion is important to farmers in areas where

hail is frequent, when they are making decisions whether to insure their crops with either hail insurance, crop insurance, both crop and hail insurance or neither insurance.

- (2) Separate coverage for hail under the all-risk crop insurance is feasible in an area where hail damage is to the extent that the average crop yield is not brought substantially below the all-risk crop insurance coverage level. A program of this type would be feasible in the Russell and Silvercreek Municipalities of Manitoba.
- (3) A feasible crop-hail insurance program is one which offers better protection to the farmers than any existing formal insurance or any conceivable alternative. It is also a self-sustaining program which may be put into operation by an insurer such as the Manitoba Crop Insurance Corporation, providing that the yield variability between farms caused by the risk hail may be estimated from past records of an all-risk crop insurance program.

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## APPENDIX I

The questionnaire used in the Russell and Silvercreek  
Municipalities Field Survey.\*

\* The questionnaire was designed to collect data for two studies. Some of the data collected was not used in this study.

NAME \_\_\_\_\_


INDICATE LEGAL DESCRIPTION, CROPS, ACRES, YIELDS AND LOSSES IN YEARS 1960-64,  
USING KEY PROVIDED.

<u>YEAR</u>	<u>CROP</u>	<u>ACRES</u>	<u>YIELD</u>
64-1964	W -Wheat	Numerical Size	Bu./Ac.
63-1963	O -Oats		Tons/Ac.
62-1962	B -Barley		Cattle/Ac.
61-1961	R -Rye		
60-1960	F -Flax	EG. 64-W-20a-18b, Stands	
	S -Summerfallow	FOR 18 bus./AC. on 20	
	T.H. -Tame Hay	Acres of Wheat in 1964.	
	W.H. -Wild Hay		
	P -Pasture		



(2)

YIELD RECORDS: 1960-64

YEAR	WHEAT		OATS		BARLEY		FLAX		HAY		PASTURE		OTHER (SPECIFY)						
	Ac.	Yd.	Ac.	Yd.	Ac.	Yd.	Ac.	Yd.	Ac.	Yd.	Ac.	cattle per.ac.	Ac.	Yd.	Ac.	Yd.	Ac.	Yd.	
1964																			
1963																			
1962																			
1961																			
1960																			

(3)

TYPE OF CROP PROTECTION CARRIED: 1960-1965

COVERAGE	YEAR	1960	1961	1962	1963	1964	1965
	I Hail Insurance						
II Crop Insurance							
III Neither							

(4) WHAT ARE YOUR REASONS FOR THE ABOVE CHOICES? \_\_\_\_\_

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(5)

COVERAGE FOR 1960-65

ITEM	HAIL INSURANCE					CROP INSURANCE				
	1960	61	62	63	64	1960	61	62	63	64
I ACRES INSURED										
(i) Wheat										
(ii) Oats										
(iii) Barley										
(iv) Flax										
(v) Other										
II COVERAGE										
(i) Amount of Coverage										
Wheat										
Oats										
Barley										
Flax										
Other										
(ii) Type of Policy										
(iii) Insured with										
III PREMIUM/ACRE										
(i) Wheat										
(ii) Oats										
(iii) Barley										
(iv) Flax										
(v) Other										

GIVE REASONS FOR CHOICE OF COVERAGE (i.e. CROPS INSURED, LEVEL OF COVERAGE) \_\_\_\_\_

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(9) HOW DO YOU FACE YOUR RISKS?

(a) INSURANCE:

- (i) Hail and Crop
- (ii) Life
- (iii) Car
- (iv) Truck
- (v) Tractor
- (vi) Livestock
- (vii) Fire

(b) SAVINGS

(c) TECHNOLOGY (FERTILIZER, ETC)

(d) NON-FARM INVESTMENTS

(e) DIVERSIFICATION

(f) SUPPLY INVENTORY

- (i) feed grain
- (ii) seed grain
- (iii) fertilizer



(c) Machinery & Equipment

Item:	Make & size	age	Insurance			Value (Dec.31,1964)	Depreciation (1964)
			coverage	premium	source		
Car							
Truck							
Tractor							
combine							
swather							
plow							
one-way disc.							
Discer.							
disk harrow							
cultivator							
deep tillage cultivator							
Drag harrows							
Packer							
Rod weeder							
Grain drill							
fert. attachments							
sprayer							
grain cleaner							
grain auger							
Seed treater							
Baler							
forage harvester							
Mower							
Rake							
fuel tank							
harness							
Bee equipt.							

Machinery & Equipment (cont'd.)

Item:	Make & size	age	Insurance			Value (Dec.31,1964)	Depreciation (1964)
			coverage	premium	source		
Hay loader							
Trailers							
racks							
stack mover							
planters							
tillers & thinners							
diggers & pickers							
Irrigation eqpt:							
cattle feeders							
cream separators							
milking machine							
coolers							
bulk tank							
Hog feeders & waterers							
Hog Bræding eqpt.							
Hog shelters							
poultry feeders & waterers							
poultry brooders							
Range shelters							
Egg cases & crates							
Feed mixer							
feed grinder							
Electric fencer							
water barrels & tanks							
Scales							
front end loader							
manure spreader							
Electric motors							
farm tools							
shop eqpt.							
garden tools							

## (d) LIVESTOCK

ITEM	Number (Dec. 31, 1964)	Age	Value (Dec. 31, 1964)	Number Sold During 1964
Bulls				
Dairy Cows				
Heifers				
Calves				
Stockers				
Feeders				
Boars				
Sows				
Gilts				
Feeder Pigs				
Suckling Pigs				
Rams				
Ewes				
Lambs				
Hens				
Pullets				
Chicks				
Capons				
Broilers				

(e) FARM ACCOUNTS RECEIVABLE

ITEM	AMOUNT (Dec. 31, 1964)
Mortgage	
Notes	
Personal Notes	
Payment for Custom Work	
Others	

(f) PERSONAL ASSETS

ITEM	VALUE (Dec. 31, 1964)
Bank Deposits	
Credit Union Deposits	
Stocks	
Bonds	
Mutual Investments (e.g. Inv. syndicate Western Savings and Loans)	
Life Insurance*	
(a) Term	

## (11) Farm Expenses:

Item	Amount (1964)	Method of payment (cash or charge)	when payment made	usual or not
I License (a) car				
(b) truck				
II Fuel				
III Repairs (including tires)				
(a) Machinery				
(b) Buildings				
IV Crop				
(a) Seed				
(i) imputed value				
(ii) purchase price				
(b) fertilizer				
(c) Herbicides				
(d) Insecticides				
(e) Fuel				
(f) Crop or hail insurance				
(g) Custom work				
(h) Cash rent				
V Hired Help				
(a) field work				
(i) spring				
(ii) fall				
(b) Other				
VI Property Taxes				

(12) FARM RECEIPTS (SOURCES OF INCOME) --1964

ITEM	VALUE--1964 (\$)	% OF TOTAL (%)
A. Crops		
(i) Wheat		
(ii) Oats		
(iii) Barley		
(iv) Flax		
(v) Other		
B. Livestock		
(i) Cattle		
(ii) Hogs		
(iii) Poultry and Eggs		
(iv) Dairy		
C. Non-Farm Income		
(i) Custom Work		
(ii) Non-farm Job		
(iii) Deficiency Payments		
(iv) Interest on Outside Investment		
(v) Family Allowance		

(13) PERSONAL EXPENSES—1964

ITEM	AMOUNT (\$)
Food	
Personal (Recr., Charity, Etc.)	
Health	
Clothing	
House and Furnishings	
Fuel, Hydro, Telephone	

