DETERMINATION OF THE OPTIMUM LOCATION OF GRADING AND PACKAGING OF MANITOBA POTATOES

A Thesis

Presented to

The Faculty of Graduate Studies and Research

University of Manitoba

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

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by

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May 1963

ABSTRACT

DETERMINATION OF THE OPTIMUM LOCATION
OF GRADING AND PACKAGING OF
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The main objective of this study was to estimate the grading and packaging costs both at the farm and the wholesale levels and to determine, on the basis of these costs, the optimum location of the grading process. In addition, an attempt was made to evaluate the economics of hand grading versus machine grading at the farm level and, in the light of this comparison, to determine the size of the potato crop necessary to justify the purchase of a grading and packing machine.

First, some major aspects of the production and marketing of potatoes, such as acreage, yield, varieties, harvesting, handling, utilization, method of sale and shipment, were described. Grading and packaging costs were then estimated, followed by conclusions, and some policy implications of the conclusions. Finally, some important related issues were discussed and suggestions were made for further research.

Items included in the grading and packaging costs (excluding the cost of bags) were the costs of labour, power, interest, and depreciation, insurance and repairs on the grading machine and on the building area used for grading and packaging purposes.

Cost estimates for these items were based on information collected from 38 potato farms situated in the Winnipeg, Red River, and Springfield crop districts, and from seven wholesalers in the Winnipeg market. These estimates were developed for the 1961-62 potato crop.

On the basis of the information collected, the simple average grading cost by hand for a volume group up to 6,000 hundredweights was 26.5 cents per hundredweight as against 13.6 cents by machine for the same volume range. The difference of 12.9 cents per hundredweight between these two methods of grading was tested and found significant at both 5% level and at 1% level. It was also estimated that about 1,967 hundredweights of potatoes (approximately 24 acres) were necessary to justify the purchase of a grading and packaging machine, costing $1,650.

The simple average grading cost by machine for a volume ranging from 675 to 105,600 hundredweights at the farm level was estimated as 14.4 cents (including scale loss) per hundredweight as compared to 17.8 cents at the wholesale level. The difference in the two costs was significant at 5% level. On the basis of this analysis and in view of the fact that opportunities to use culls are better on the farm than at the wholesale level, it was concluded that the optimum location of grading potatoes is at the farm level rather than at the wholesale level.

Three other situations of the grading cost structure, viz., (1) hauling ungraded potatoes direct from the field in bulk, (2) hauling ungraded potatoes from storage, packed in 75-pound bags, and (3) hauling partially graded potatoes from the field in bulk to the wholesale market, were also analyzed. The grading cost at the farm level was found lower than the grading costs for any of these three alternative situations.

The studies suggested for further research with a view to either testing and improving the validity of the conclusions reached here, or to

examine some related cost and profit determining factors in regard to potato cultivation are:

(1) Determination of the optimum location of "Registered Grading Stations" and the feasibility of integrating grading activities with production of potato starch.

(2) Determination of the various methods of culling potatoes and the optimum cost-volume relationship from the standpoint of economic efficiency.

(3) Determination of the efficiency of various potato-harvesters in relation to volume of injured potatoes and the rate of output.

(4) Improvement in the methods of transportation of potatoes from farm to wholesale market.

(5) Determination of the optimum potato enterprise under different soil, variety, fertilizer, and irrigation conditions.

(6) Implications of contract farming for potato growers.

ACKNOWLEDGMENTS

The author wishes to acknowledge the assistance of those who aided in the preparation of this manuscript:

The author is deeply indebted to Professor Om P. Tangri, under whose supervision this thesis was written, for his continuous guidance, advice and encouragement. He is also grateful to Professor A. W. Wood for his constructive criticisms and helpful comments on the manuscript, and to Professor M. H. Yeh for his generous assistance in the statistical analysis. The author also wishes to acknowledge with thanks the helpful comments and criticisms made by Professor J. D. Campbell, which not only removed any errors of technical nature in the discussion of soils and potato production, but also improved the readability of the thesis.

Thanks are due to the Department of Agricultural Economics and Farm Management, University of Manitoba, for providing the necessary research facilities for conducting the field work in connection with this project, and above all, for providing the necessary academic training which is so vital to any meaningful exercise in research.

The co-operation of the farmers, wholesalers, and officials of the Manitoba Department of Agriculture in conducting the survey is gratefully acknowledged.

The assistance rendered by Mr. Bruno Tonn who worked as an investigator for the survey is very much appreciated.

The author is thankful to Lockwood Grader Corporation, Nebraska, U.S.A., for providing photographs of potato harvesting, hauling, and

grading machines, which were found very valuable in the descriptive aspects of the study. The author is indeed grateful to the External Aid Office of the Government of Canada for awarding the "Colombo Plan Scholarship" which made it possible to undertake graduate work in agricultural economics and research on this thesis at the University of Manitoba.

Finally, the author wishes to acknowledge his sincere gratitude to Mr. Gordon Alvare, who undertook and performed the arduous task of typing the manuscript. Perhaps he is as happy as I am at the completion of this thesis!

TABLE OF CONTENTS

LIST OF TABLES

TABLE NO. PAGE

LIST OF FIGURES

FIGURE NO. PAGE

CHAPTER I

INTRODUCTION

The purpose of this chapter is to give an historical sketch of the importance of the grading function of potatoes in Manitoba, and to discuss the problematic situation, the importance of the problem, the objective, scope and research methodology of this study.

A comprehensive study on the subject of marketing of fresh fruits and vegetables was conducted by the Economics Division of the Canada Department of Agriculture in co-operation with the Provincial Department in 1945-46. The results of the study were reported in "The Marketing of Fresh Fruits and Vegetables in Greater Winnipeg," published in the year 1946. [1/] This report was the first to deal with the marketing aspect of fruits and vegetables in Manitoba in considerable detail. It revealed convincing evidence of poorly organized and uneconomic marketing procedures characterized by the lack of standard packing and grading regulations. Producers, dealers and consumers were reported to have expressed dissatisfaction with the then-existing situation characterized by unregulated and uncontrolled packs and grades. Because of this deficiency, producers were not rewarded with higher

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[1/] R. S. Elliot, et al., The Marketing of Fresh Fruits and Vegetables in Greater Winnipeg (King's Printer, Winnipeg, 1946).

prices for better grade produce. Wholesalers and retailers were discouraged from handling domestic produce, and consumers did not have the advantage of established grades as a guide to buying. Among other recommendations for orderly marketing, the report commended:

> That under the authority of "The Manitoba Vegetable Sales Act" (Chapter 64, Statutes of Manitoba, 1941-42), specific regulations providing for standards of packaging and grading be established for all Manitoba small fruits, vegetables and potatoes. 2/

Since then, considerable improvements in packing and grading regulations have been made and grading has been recognized as one of the basic prerequisites of an efficient marketing system. It has assumed great importance in the general complex of modern marketing practices, and description of produce by grade names has contributed to efficiency in production and marketing.

Statement of the Problem

Potatoes in the Province of Manitoba are graded both at the farm and the wholesale levels. At the farm level, they are generally graded "dry" by hand or with the aid of mechanical graders and are mostly packed into 75-pound bags for shipment to the wholesale market. These potatoes sometimes have to be regraded and washed at the wholesale point as they pass through the line for packing into smaller consumer packages. The wholesaler has to regrade these because:

(1) Some potatoes have not been properly graded by the farmers according to the standards laid down in the Act 3/ and must be graded

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2/ Ibid., p. 92.

3/ Enforcement of The Manitoba Fruit and Vegetable Sale Act with regard to size, quality and grade is mainly made at the retail level, seldom at the farm level. A. G. Wilson, Primary Aspects of Potato Marketing in Manitoba (Department of Agricultural Economics, University of Manitoba, Winnipeg, March, 1961), p. 4.

by the wholesaler before he can release them into the retail market.

(2) Potatoes often suffer some weight and quality losses during storage. In such cases, regrading and repackaging becomes necessary for the wholesaler.

(3) Sometimes potatoes have to be washed and packed in different types of containers on the basis of quality and variety according to consumer demand.

Thus, it seems that due to legal requirements, potatoes have to be graded at some point or other and in many cases, as remarked above, duplication of grading is involved when the farm-graded potatoes are not graded satisfactorily enough to meet the requirements laid down in the Act. But a variation is presently developing whereby potatoes, without being previously graded (or "partially graded" at best) at the farm, are being shipped to the wholesaler and the entire grading is done by the wholesaler. The term "partial grading" means that the potatoes are graded on a "field run" basis. In this type of operation, picking and culling by hand are carried out simultaneously in the field. Even though this practice of shipping entirely ungraded or partially graded potatoes has been under way for some time now, the farmers are not sure where they should grade their potatoes in order to minimize their grading costs. It is also not known whether it is more economical to grade at the farm level (by hand or with the aid of mechanical graders) and thereafter haul only those potatoes which have a high economic value, or ship all potatoes ungraded to the wholesale market and pay the wholesaler charges for grading [4/] and also incur the extra

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[4/] Clause (a) of Sec. 2 of The Manitoba Fruit and Vegetable Sales Act requires that edible potatoes must be graded before any sale is effected.

cost of transportation of culls which have a negligible market value.

Importance of the Problem

Income from potatoes exceeds half a million dollars annually in Manitoba. During the last five years, potatoes contributed between 30 and 40 percent of total income from vegetables (Table 1.1). In 1961, for example, sales of vegetables in Manitoba amounted to approximately 1.9 million dollars, of which $579,000 (approximately 30%) was from potatoes.

TABLE 1.1

FARM CASH INCOME FROM POTATOES AND OTHER VEGETABLES IN MANITOBA *

Year	Potatoes	All Vegetables Including Potatoes	Proportion of Vegetable Cash Income from Potatoes (percentage)
	(thousand dollars)		
1957	569	1,584	35.9
1958	721	1,841	39.2
1959	534	1,741	30.7
1960	703	1,757	40.0
1961	579	1,906	30.4

*Dominion Bureau of Statistics, Farm Cash Income, Ottawa, Canada, 1960 and 1961.

The production of potatoes in Manitoba is rapidly moving from hand operation to machine operation, thereby making heavy investment in machinery necessary. On the other hand, the competitive forces of market demand and supply continually tend to exert downward pressures on potato prices. This phenomenon of rising costs of machinery and downward pressures on prices is creating a difficult economic situation

for the producer as far as his net returns are concerned. The potato producer in Manitoba is also faced with market competition from neighboring provinces in Canada as well as producers south of the border. About 40% of potatoes consumed in the province come from outside the province. In order to stay in business, therefore, a Manitoba potato producer must try to minimize his production and marketing costs, and grading constitutes an important part of marketing costs. A study of marketing costs of Manitoba potatoes made by E. N. Afful [5/] in 1958 showed that grading and sacks for packaging constituted 48.9% of the total primary marketing costs and 20.1% of the selling price. The primary costs included grading, sacks, freight and storage.

Although Afful (and a few others) have done some work on the marketing costs of potatoes, little attention has been focused on the question of optimum location of the grading and packaging of Manitoba potatoes. In view of the importance of the grading and packaging cost in the total primary costs, it is necessary to examine the present situation with a view to determining whether the existing arrangement with respect to grading is the most economical or whether some alternative system would be more efficient and reduce the cost of grading. Any device which reduces the grading and packaging costs will benefit both producers and sellers, and eventually probably the consumers, too.

Objective of the Study

In the context of the above problematic situation, the main objective of this study is to investigate the optimum location of the

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[5/] E. N. Afful, "A Study of Primary Marketing Costs for Manitoba Potatoes" (unpublished Master's Thesis, Department of Agricultural Economics and Farm Management, University of Manitoba, Winnipeg, 1960), p. 58.

grading function of Manitoba potatoes. In addition, an attempt is made to evaluate the economics of hand grading vis-a-vis machine grading at the farm level. In order to pursue these objectives, two hypotheses will be tested during the investigation:

Major hypothesis: Grading costs for the potato producer will be minimized if he grades his potatoes fully at the farm level rather than transporting them ungraded or unsatisfactorily graded to the wholesaler.

Minor hypothesis: On-farm grading with the aid of mechanical graders is more economical than hand grading.

In testing the above hypotheses, the following conditions are assumed to prevail:

(a) Non-availability of a subsidiary occupation to farmers during the winter is a constraint common to all or most of the potato growers.

(b) The farmer uses only family labour in the operation of his grading equipment.

(c) Culls have little or no economic value at the wholesale point.

(d) Pre-packaging into appropriate consumer bags is a function of the wholesalers.

(e) Farmers sell most of their potatoes through wholesalers for disposal in, as well as outside of, Manitoba.

Farmers growing field crops, including potatoes, have practically no farm work to do during the winter. It is, therefore, assumed that they utilize most of their idle time in grading potatoes and performing other activities in connection with the storage of the crop. Moreover,

because of the scarcity of labour in the farming areas, they cannot get the help of hired labour as and when they require it for the grading operation, especially during fall. Coupled with this problem is the lack of a subsidiary occupation available to farmers. The most profitable situation for them seems, therefore, to be one of using their own labour resource to grade potatoes. If grading is done at the wholesale level, this will tend to increase grading costs due to payment of high labour wages and other incidental charges.

Haulage of ungraded potatoes will also increase the total cost of transportation from the farm to the market, because of the culls included in the ungraded potatoes. Furthermore, the culls left after grading at the wholesale level may not be utilized because:

First, there are no industries which are engaged in the manufacture of potato by-products from cull potatoes.

Second, the culls cannot be sold to consumers for edible purposes under the provisions of the Manitoba Fruit and Vegetable Sales Act.

On the other hand, these culls can be utilized at the farm level. For instance, farmers may use them for family consumption and also as seed and stock feed on their own farms. They might also be able to sell them to neighbouring farmers as seed or stock feed at discount prices.

With regard to the last two assumptions, potatoes are generally graded "dry" and packed into 75-pound bags at the farm level. The function of pre-packaging into small consumers' bags is left to the wholesalers who are in a better position than the farmers to gauge the market and the consumers' tastes and preferences. With the technological developments in recent years, the system of potato farming has changed,

and in the present market set-up, the average producer peddles a rather insignificant amount of his total produce directly to consumers. Instead, he endeavours to keep himself abreast of the latest developments in production techniques. He delivers his produce for fresh consumption to wholesalers or other intermediaries between himself and the consumer. Thus, consumers' tastes and preferences are not directly conveyed to the producer. Consequently, the wholesaler is in a much better position to gauge the market and convey market information to the producer.

The issue that emerges from our minor hypothesis is the question of method of grading at the farm level. The question is whether it is more economical to grade by hand or with the aid of mechanical graders. A mechanical grader involves a large capital investment. There is also a considerable annual fixed cost from depreciation (including obsolescence), interest and repairs. The farmer must decide what size of crop or output will justify the purchase of a machine. Will a machine reduce the grading costs and perform a better-quality job than grading by hand? An attempt is made to solve this question in Chapter 3 of this report.

Scope and Research Methodology

The scope of this study will be limited primarily to the development and examination of the cost functions for grading and packaging the 1961 potato crop at the farm and at the wholesale levels. Both hand grading and machine grading operations with varying levels of outputs at the farm level will be taken into account. Grading costs will be taken to include costs incurred from the time potatoes are taken from the storage bin till they are packed and moved back to temporary storage or hauled to the point of shipment. The cost of bags for

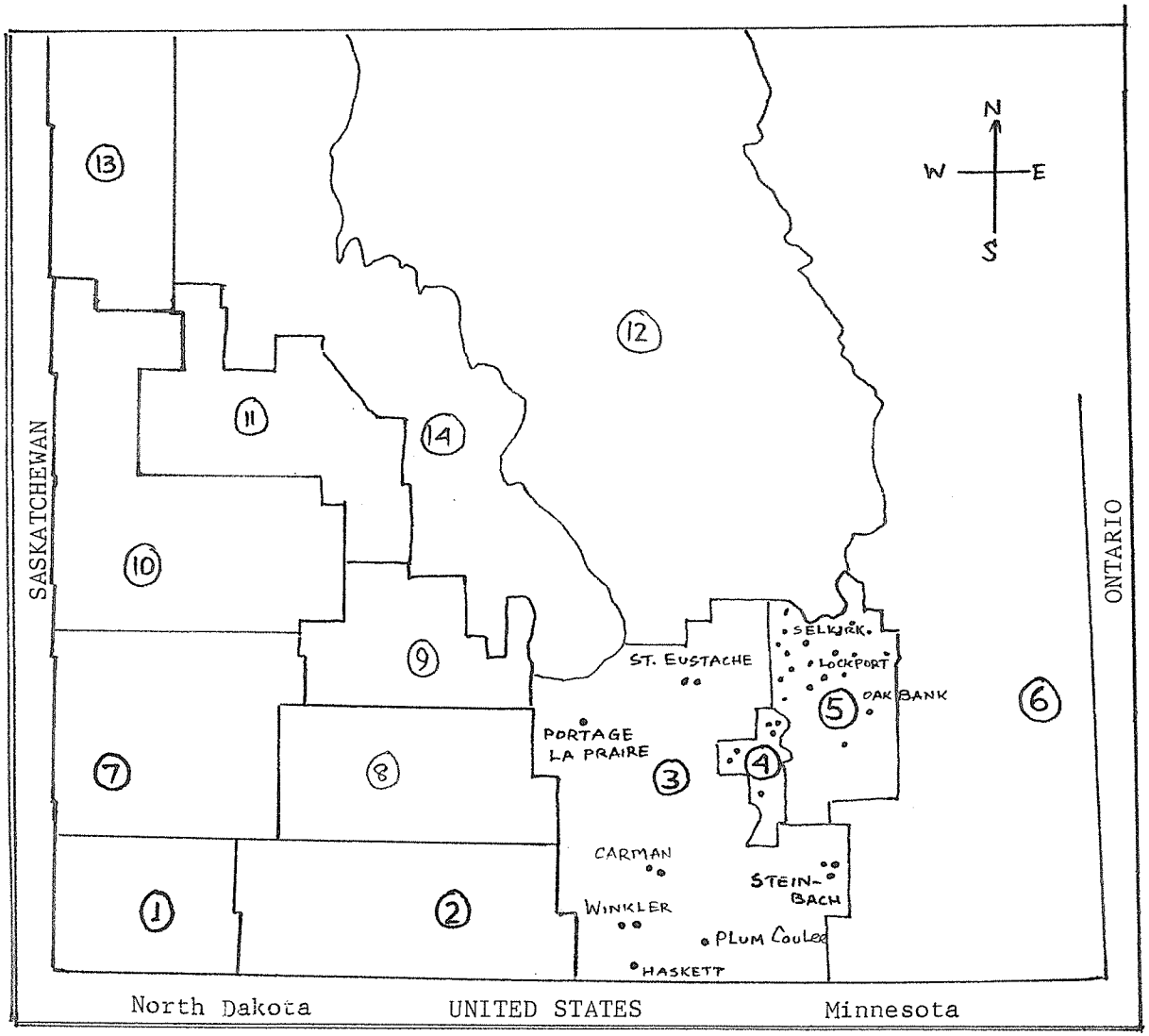
packaging has not been included in the cost study because under the "Act" different kinds of bags are required to pack Canada No. 1 and No. 2; for example, potatoes marked Canada No. 1 can not be sold or transported unless they are packed in new bags. Further, this study is limited to growers in three crop districts around Winnipeg who use Winnipeg as their central market. These are the Winnipeg, Springfield, and Red River crop districts. All the important potato grading and packaging firms in the City of Winnipeg are also covered.

Thirty-eight growers out of one hundred growers in the three crop districts including small home gardeners were selected and interviewed for purposes of this study. Though accurate figures are not available on the total number of home gardeners, it is estimated by the officials of the Department of Agriculture, Manitoba, that there are about 20 such farmers who do not offer for sale any part of their potato crop. The selection of 38 farmers was made with the help of officials of the Manitoba Department of Agriculture. The selections of necessity had to be based on the farmers' willingness and ability to give information, and their experience with grading costs and allied problems relating to this study. An attempt was also made to include growers with and without grading equipment and with different scales of operation. Other considerations, like the cost of travel and the time required, also influenced the selection of the sample.

A map showing the location of farmers interviewed is provided (Figure 1.1). The growers were located mostly in Lockport, Selkirk, East Selkirk, Kirkness and Oakbank in the Springfield crop region; St. Eustache, Portage la Prairie, Carman, Winkler, Plum Coulee, Haskett and Steinbach in the Red River crop region; and Pacific Junction and

FIGURE 1.1

MAP
SHOWING THE CROP DISTRICTS OF MANITOBA
AND SOME OF THE IMPORTANT PLACES COVERED IN THE SURVEY IN THE THREE CROP DISTRICTS
(Each dot represents a farmer interviewed)



KEY TO NUMBER AND NAMES OF CROP DISTRICTS

1. MELITA
2. KILLARNEY
3. RED RIVER
4. WINNIPEG
5. SPRINGFIELD
6. EASTERN
7. VIRDEN
8. CARBERRY
9. NEEPAWA
10. RUSSEL
11. DAUPHIN
12. MID-LAKE
13. SWAN RIVER
14. WEST SHORE

Fort Garry in the Winnipeg crop region. Growers were interviewed during June and July of 1962 as they were completing their seeding and planting. In most cases, between one and two hours' time was spent with each grower for collection of the required data and information. Wherever possible, records were consulted, but in most cases the information was based on the farmers' memory and estimates.

With regard to grading and packaging costs at the wholesale level, information was obtained from seven wholesalers in the Winnipeg market, out of which four performed the operations of grading, washing and packaging. The remaining three performed grading and packaging services, but did not wash. Only two wholesalers were able to produce their records; on the remaining cases, the investigator relied on the wholesalers' estimates.

A set of questionnaires, one for farmers and one for wholesalers, was prepared to secure information needed to calculate grading and packaging cost. From both levels, information on types of grading equipment used, volume graded per hour, cost of depreciation, insurance, repairs on the building area used for grading and packaging as well as on grading equipment, cost of power and water, packing materials, labour charges per hour, annual turnover of different grades, etc., were collected. Apart from these, information on acreage of potatoes and other crops, varieties of potatoes grown, methods and equipment used for harvesting and grading, mode of transportation, method of sale, etc., were obtained from farmers. An attempt was made to gather as much data as possible to help in studying the grading cost, and marketing and production of the potato crop in general. A copy of both questionnaires is included in Appendix M.

The cost data are mainly classified into two categories: (1) direct costs, and (2) overhead costs. Under direct costs are included labour, power and light. The costs of depreciation, interest, insurance, repairs and maintenance are included in the overhead cost. We have not included the cost of bags and stitching materials in the total grading and packaging costs, since these types of expenditure are quite similar at the farm and wholesale levels. This assumes that the bag seller does not discriminate between small- or large-scale purchases. Moreover, the study would have been unnecessarily complicated if bag costs were included in the grading and packaging costs because new bags must be used for Canada No. 1's according to Section 12 of the Manitoba Fruit and Vegetable Sales Act, 1960, and old bags may be used for grades lower than Canada No. 1. Further, we have already pointed out that packaging is not an important function from the standpoint of growers as wholesalers repack into consumer packages practically all potatoes received from the growers.

Direct Costs

Labour costs for grading and packaging comprise different items of work which may be classified into the following categories:

(a) Receiving--the process of hauling potatoes from the storage bin and feeding them to the grading machine;

(b) Grading--the process of sorting and culling at the grading tables;

(c) Packing--the process of packing potatoes, stitching bags and weighing;

(d) Transportation--the process of hauling the graded produce from the packaging shed either to storage or to the point of transportation for sale.

All persons working on these operations are called the "crew" for grading and packaging. The costs of grading and packaging are charged directly to the total turnover. For example, assume that five persons in a crew can pack, grade and haul one hundred 75-pound bags per hour. With the wage of $1.00 per hour per person, the labour cost for this operation will be $5.00. The grading and packaging cost per bag of 75-pounds excluding the cost of the bag would be $\frac{\$5.00}{100} = \$0.05$.

However, there are certain difficulties in computing the cost of grading and packaging when grading is done on a field run basis. In this type of operation, picking and grading by hand are performed simultaneously. Hence, it is difficult to isolate the grading cost as no empirical data are available. However, on the basis of experience, it seems that grading cost on a field run basis amounts to approximately 20 to 50% of the total cost of picking and grading.

It may also be pointed out that grading and packaging operations in most cases are carried on simultaneously, and it is rather difficult to isolate the two operations. Volume graded and packed per hour will depend upon the size of bag used in packaging and many other variables which will be discussed in greater detail in the next chapter. Suffice it to mention at this point that the size of bag influences the grading rate. The grading rate, measured in terms of bags per hour, decreases as the size of bag increases, because of increasing capacity. At the growers' level, almost all the growers used 75-pound bags and the rate of grading obtained was in terms of the number of 75-pound bags graded per man-hour. In cases where some packaging has been done in smaller bags or delivery has been made in bulk, the volume handled was converted to the original grading rate based on 75-pound bags, and then the unit

cost of grading and packaging was changed to a hundredweight basis.

The problem becomes more complex when we try to estimate the grading cost at the wholesale level. Most big wholesalers wash, brush, and pack the potatoes into small consumer packages of five, ten, twenty-five, and sometimes into 75-pound bags for sale to small wholesalers. To arrive at a calculation comparable to the grading cost at the farm level, the cost of washing was not taken into account and all the produce received by each wholesaler was assumed to be regraded and packed into 75-pound bags. Actual grading rates of 75-pound bags per man-hour were obtained from some wholesalers and estimated rates were used where such figures were not available. The grading rate based on the unit of 75-pound bags per man-hour of ungraded potatoes coming from the farm has been evaluated on the basis of regression analysis. This aspect of calculation will be presented in Chapter 3 of this report.

With regard to the cost of power and light, grouped under direct cost, some difficulty was encountered in estimating these costs as there was no separate meter for them. Some estimate had to be framed according to the number of hours the plant operated for grading and packaging. The cost was calculated on the amount of electrical energy consumed per hour.

As to the labour cost, there were some special problems, especially with regard to grading at the farm level. Most of the small farmers do not hire any outside labour and they think that grading should be done at leisure after all the farm operations are over in the fall. They use their own family labour. In such cases, labour costs were imputed on the basis of prevailing rates for hired labour in the farming area.

Overhead Cost

The costs of depreciation, interest, insurance, repairs and maintenance are grouped under overhead costs. The operations of grading, packaging and storage of potatoes are mostly carried out under the roof of one building. It is, therefore, necessary to allot a certain portion of the fixed or overhead cost like depreciation, insurance, etc., of the whole building to the grading and packaging cost which are entirely different cost items than storage cost. The costs are charged to grading and packaging in proportion to the floor area used for these purposes. For example, assume a building has 4,000 square feet of floor area with $100 as depreciation, $20 as repairs and maintenance, and $10 as insurance (i.e., a total of $130) per annum. If the grading equipment and packaging area occupy 100 square feet (2.5% of the whole building area), 2.5% of these costs, i.e., $3.25, is charged to the volume graded annually by a farm or firm. The individual calculations on depreciation, insurance, interest, repairs and maintenance, are done as follows.

As to depreciation on the area used for grading and packaging purposes, records were consulted, and the rate prescribed for income tax calculation, which is 5% of the total cost of building, is used for calculating depreciation. Where such records were not available, the same flat rate of 5% of the total cost of building is charged to depreciation.

Some difficulty was encountered in charging depreciation to grading and packaging equipment. Obsolescence was the main factor. Grading machines of some of the farmers were already fully depreciated for tax purposes. Some growers constructed their own grading machines, and this cost them much less than the new ones would cost in the market.

Most growers thought that depreciation on the machines should be calculated at 10%, and some regarded 20% as a more reasonable figure. On the basis of the general observation, 10% of the original cost of the machinery was charged towards grading cost both at the farm and the wholesale levels. It is recognized that the 10% figure assumed regarding depreciation may not accurately reflect capital costs. But, due to data and time difficulties, it was decided that the most generally used depreciation rate (10%) may not be altogether unrealistic or off the mark. Besides, as long as the same depreciation rate is used consistently for the comparable equipment used by the farmers as well as wholesalers, the possible error in cost estimates may not be very high.

Similar difficulties existed in calculating the cost of insurance on buildings and machinery. Wherever figures on insurance of the total building were available, allocation of cost of insurance to the grading and packaging operations was made on the basis of the proportion of total floor space they occupied. But in cases where insurance covered the building and machinery, the values of the grading area and machinery were taken into account in estimating the insurance cost.

Interest on machinery was calculated by the depreciated value method. 6/ Interest was charged on the net value after deducting accumulated depreciation for the years in use from the total initial investment.

Some big wholesalers in Winnipeg suggested that common costs like supervision, foreman, bookkeeping and storage should be apportioned to grading and packaging cost, since they contribute to the total selling cost. As these cost items were peculiar to only a few firms, enough

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6/ For details, refer to p.55

data were not available to study this aspect.

Out of some 100 growers (including very small vegetable gardeners) in the three crop districts, 38 (i.e., a little over one-third) were selected for this study. These growers accounted for a total production of 473,981 hundredweights out of the 799,800 hundredweights of potatoes produced in the province during the year, 1961. The production by these 38 farmers, therefore, represents 59.3% of the total production in the province, and for that reason it may be said that the sample selected was reasonably adequate in terms of size and structure.

The accuracy of research results, to be sure, depends upon the nature and size of the sample and the reliability and adequacy of the data. The area of the three crop districts in the survey, no doubt, forms a very small section of the total area in Manitoba in which potatoes are grown. But it includes the largest commercial potato-growing regions in the province. With due recognition of the limitations posed by the small absolute size of the sample, therefore, it is hoped that the conclusions drawn from this study will throw some light on the cost aspects relating to the grading and packaging of potatoes.

CHAPTER 2

PRODUCTION AND MARKETING OF MANITOBA POTATOES

This chapter describes, in general, the acreage, yield, and varieties of potatoes grown, and other important aspects of potato production, such as methods of harvesting, picking, crop handling, sale, shipment and utilization. In addition, economic analysis wherever possible has been made in certain fields in this study.

Total Acreage and Production

A review of total potato acreage and production in Manitoba shows that during the past ten years production and acreage have remained fairly stable. The average annual acreage in the province was around 17,300 acres with a production of 2,350,000 bushels. However, the data reveal a trend towards cyclic variation between production and prices, as may be observed from Table 2.1 and Figure 2.1.

These data also reveal that even though acreage planted was highest in the year 1961, it yielded the lowest yield of 63 bushels per acre with the resultant lowest production of 1.3 million bushels in the ten-year period. Extremely dry weather that prevailed throughout the year was the main cause of this exceptionally low average yield.

Factors Affecting the Size of Potato Farms

Factors that influence the potato acreage per farm are mainly soil types, technology, weather, production costs, storage facilities, financial resources, distance from central market, marketing costs,

TABLE 2.1

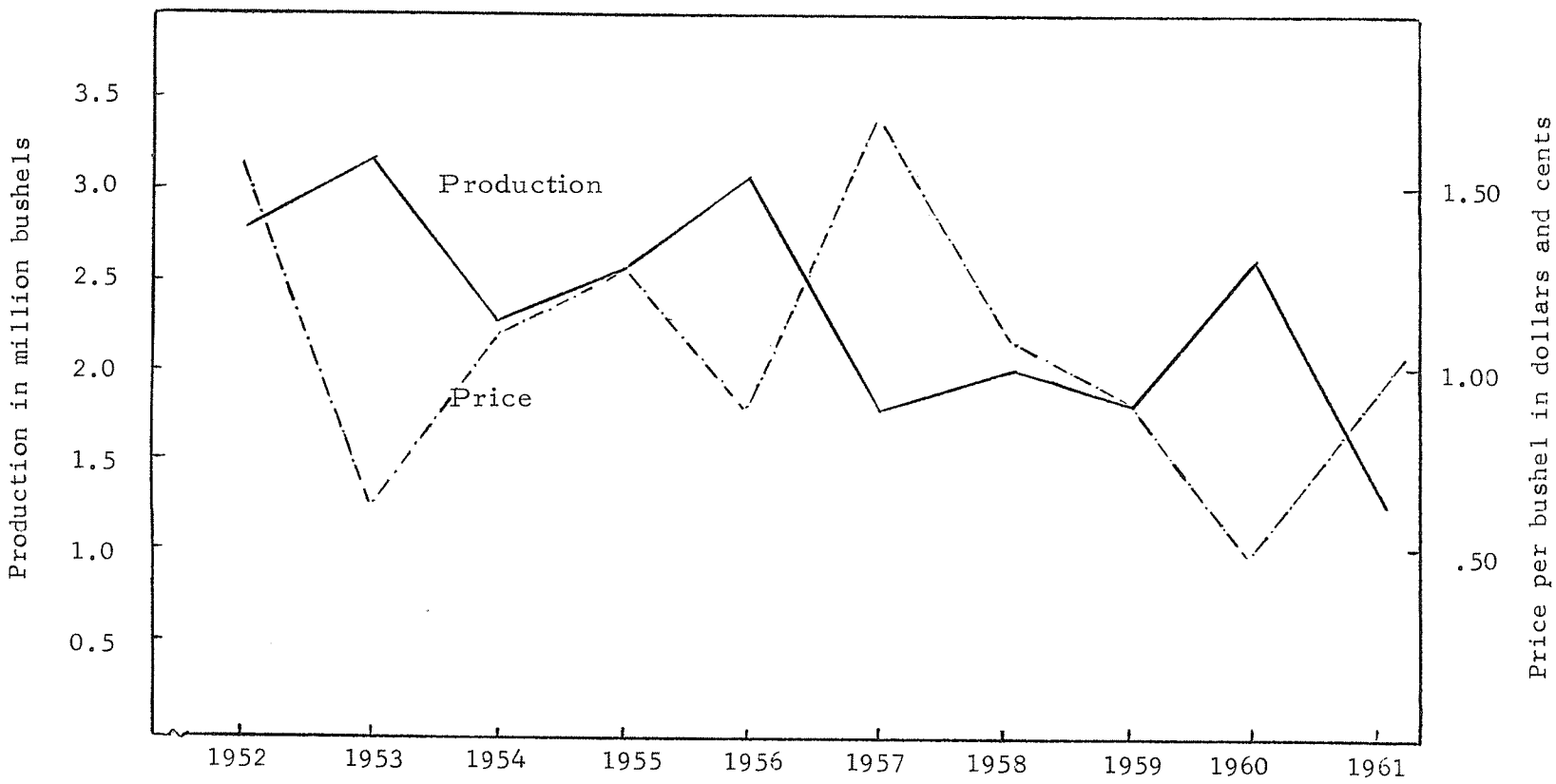
ACREAGE, YIELD AND PRODUCTION OF MANITOBA POTATOES FROM 1952 TO 1961*

Year	Acreage (Thousand acres)	Yield (Bushels per acre)	Production (Million bushels)	Average price (per bushel)
1952	17.3	159.0	2.8	$ 1.60
1953	18.8	170.0	3.2	.63
1954	17.1	135.0	2.3	1.10
1955	19.0	135.0	2.6	1.30
1956	16.5	185.0	3.1	.90
1957	15.3	115.0	1.8	1.70
1958	15.6	128.0	2.0	1.11
1959	15.5	114.0	1.8	.90
1960	17.0	150.0	2.6	.48
1961	21.2	63.0	1.3	.96
AVERAGE:	17.3	135.4	2.3	$ 1.07

*Department of Agriculture and Soil Conservation, Manitoba, Report on Crops, Livestock, etc., Crop Bulletin No. 140 (Queen's Printer, Winnipeg, 1962), p. 40.

FIGURE 2.1

CYCLIC VARIATION BETWEEN PRODUCTION AND PRICES OF POTATOES
MANITOBA, 1952 TO 1961*



*Source: Table 2.1

price differentials and incentives associated with alternative crops, etc. It is beyond the scope of the present study, however, to assess the impact of each one of these numerous factors on the size of the potato operation. Instead, attention has been focused on only two factors: (1) soil types, and (2) distance from the central market, because information on these two factors could be obtained from the survey questionnaire more readily.

Soil influences the size of potato farms in two ways: (1) through its suitability to the crop; (2) through its degree of adaptability to the use of heavy machinery on the land. For instance, much of the land adjacent to the City of Winnipeg has clay soil. This soil does not lend itself to mechanical harvesting due to its lumpy characteristics when dry and its stickiness when wet. In addition, clay soils tend to adhere to the tubers in the harvest, particularly under wet conditions, giving rise to an unattractive product, unless washed. These factors ultimately inhibit the expansion of potato production in the vicinity of Winnipeg. On the other hand, the best fine loam soil, which is found in the southern part of Manitoba, is quite suitable for using heavy machinery, and this encourages the farmers in that area to devote more acreage to potato cultivation and less to other crops. This is probably one of the reasons why large potato farms are located in the Morden-Winkler-Haskett area in southern Manitoba.

The survey data also reveal some interesting features regarding the effect that distance from the Winnipeg market has on the farm size. Our survey included eight farms in the Winnipeg crop district, eighteen in the Springfield district, and twelve in the Red River district. Table 2.2 below shows the distance-size relationship in terms of averages.

From the data (Table 2.2), it follows that as the distance of the

TABLE 2.2

EFFECT OF DISTANCE ON THE SIZE OF POTATO FARMS*

Crop district	Average distance from Winnipeg market (miles)	Average potato acreage (acres)
Winnipeg	18.6	31.4
Springfield	26.1	54.3
Red River	58.1	316.8

*Source: Appendix A.

farm from the market increases, the acreage allotted to potato cultivation also increases. The same conclusion emerges if the data are grouped in mileage class intervals. This is done in Table 2.3.

TABLE 2.3

RELATIONSHIP BETWEEN DISTANCE FROM WINNIPEG MARKET AND ACREAGE OF POTATOES PER GROWER

Distance from Winnipeg (miles)	Total acreage	No. of growers	Average acreage per grower
0 - 20	365	10	36.5
21 - 40	1,219	19	64.2
41 - 60	1,222	4	305.5
61 - 80	1,010	3	336.7
81 and over	1,215	2	607.5

There are several factors that influence the size of potato farms with increasing distance from the Winnipeg market. For example, the smallness in size of potato farms near Winnipeg is due to the following factors:

First: The family holdings are more concentrated near Winnipeg. The farms are small-sized (see Table 2.4) and the farmers allot relatively small proportions of their farms to a cash crop like potatoes in order to supplement their main income from other crops.

Second: The opportunity of getting employment in the City is much greater than for the farmers situated at a distance from Winnipeg. The farmers will have little time to look after large acreages if part-time employment is available. They depend more on other sources of income than on potato farming which involves a risk factor in production.

Third: The value of land near Winnipeg is comparatively higher than in the rural areas. This factor also puts a limit on expansion of potato acreage.

Fourth: The attitude of farmers also plays an important role in deciding the acreage to be devoted to potato cultivation. They may grow potatoes primarily for family consumption. They may seek to avoid price risk, the hard labour involved in potato production, and the heavy investment required for storage and grading operations. Rather, they appear to prefer growing more grain which requires less labour in production, involves smaller storage costs, and they reap the benefit of an assured market through the Wheat Board.

As distance from the City increases, however, most of the conditions cited above are just reversed and potato farms located at greater distances from the City tend to increase in size. Lack of alternative

employment for farmers, associated with less demand for land and shortage of hired labour which often leads to mechanization of farming, are some of the major influencing factors contributing to large-scale farming.

However, from the data presented in Appendix A, it would be noticed that there are variations in the correlation of the size of potato farms with distance. The correlation of increasing distance with increasing farm size is not perfect. For example, a farm (Schedule No. 31) at a distance of 10 miles (see Appendix A) from the market in the Winnipeg crop district has 20 acres of potatoes, but another farmer (Schedule No. 34) in the same district at a distance of six miles has 24 acres. This sort of variation was also observed in other crop districts. Proximity to the highways which affects the transportation cost, difference in soil type and production techniques, are some of the factors, in addition to those mentioned earlier, that seem to govern the size of individual farms located at the same distance from the central market.

The effects of increasing distance from the Winnipeg market are twofold. Not only does the scale of operations of potato farms increase, but also the proportion of potato acreage to the total of all crops grown increases. This may be due to an effort to minimize the cost of production and to reduce marketing costs for storage, grading and transportation. In addition, potatoes being a more valuable crop than grains, farmers find it more profitable to allot a greater proportion of their farms to potatoes.

The proportion of potato acreage relative to the area in the Winnipeg crop district was 20.0%; in the Springfield district, 30.8%; and in the Red River district, 55.1% (Table 2.4). The survey data also reveal that only seven farmers out of thirty-eight allotted more than

50% of their total acreage to potatoes. So, in about 82% of these cases, potatoes were grown only as a supplement to the main crop, which was grain.

TABLE 2.4

PROPORTION OF POTATO ACREAGE TO TOTAL OF ALL CROPS IN THREE CROP DISTRICTS*

Crop district	No. of farms	Total Acreage of all crops	Acreage of potatoes	% of Acreage in potatoes	No. of farms growing more than 50% of the total acreage under potatoes
Winnipeg	8	1,254	251	20.0	-
Springfield	18	3,174	978	30.8	2
Red River	12	6,896	3,802	55.1	5
Grand Total:	38	11,324	5,031	-	7
Average:	-	298	132	44.4	-

*Source: Appendix A.

Yield

Yield of potatoes, as in the case of other crops, is a function of several factors. Some of the more important ones are the type of soil, production practices and weather conditions. Since the dry weather condition for the year under study was common to all growers, the difference in yields for purposes of this study may be considered largely attributable to the difference in soil type and production techniques.

As mentioned earlier, the soils in the Winnipeg region are generally high in clay content and are unsuitable for potato cultivation;

whereas, the fine loamy soils in the Red River region, particularly in the Winkler-Morden-Haskett area, are best suited for this crop.

This point was discussed in a recent study made by Wilson. According to his study:

> The decline in production in division 2 has been at a slower rate than for the province as a whole. This has been due to an increase in production in the Stanley sub-division which contains the Winkler-Morden-Haskett area. This is an extension of one of the major potato producing areas of North Dakota. Factors which encouraged this extension included the influence of American production techniques and a soil type suitable for their adoption and a gregarious farm population with a predilection for intensive agriculture. 1/

A broad comparison of yields under dry farming conditions on the basis of soil types in the three crop districts is shown in Table 2.5.

The average yield per acre in the Winnipeg crop district was 74.17 cwts. per acre; in the Springfield district, 82.13 cwts., and in the Red River district, 92.06 cwts. per acre. However, no similar conclusion could be drawn for irrigated farms, because the number of such farms in the survey was not large enough to permit a meaningful observation.

The pattern of yields in these crop districts during 1961 is also supported by the findings of the Department of Agriculture and Conservation, Province of Manitoba. 2/ The district-wise yield was highest in Red River, with an average of 89.4 bushels per acre. In the Springfield and Winnipeg crop districts, the yields were almost equal, with an average of 70.0 and 71.8 bushels per acre respectively.

The effect of irrigation on the yield of potato crop was also studied. Out of 38 farmers in the survey, five irrigated their crops.

1/ A. G. Wilson, Primary Aspects of Potato Marketing in Manitoba (Department of Agricultural Economics and Farm Management, University of Manitoba, Winnipeg, 1961), p. 19.

2/ Department of Agriculture and Conservation, op. cit., p. 35.

TABLE 2.5

SOIL TYPES AND YIELD OF POTATO CROP

Crop District	Soil Zone	Main Soil Type	Yield per Acre (cwts.)
Winnipeg	Black fine textured	Clay	74.17
Springfield	Black grey wooded	Sandy clay-loam & sandy-loam	82.13
Red River	Black fine textured & black medium textured	Fine loam, clay	92.06

TABLE 2.6

YIELD OF POTATO CROP WITH AND WITHOUT IRRIGATION

	POTATO ACREAGE (acres)		TOTAL PRODUCTION (cwts.)		YIELD PER ACRE (cwts.)	
Crop Region	Irrigated	Non-Irrigated	Irrigated	Non-Irrigated	Irrigated	Non-Irrigated
Winnipeg	20	20	3,300.0	750.0	165.0	37.5
Springfield	36	33	6,918.6	2,193.6	192.2	66.5
"	37	40	4,491.0	2,625.0	121.4	65.6
"	40	40	6,000.0	2,040.0	150.0	51.0
Red River	215	245	34,965.0	20,699.0	162.6	84.5
Total:	348	378	55,674.6	28,307.6	791.2	305.1
Simple Average:	69.6	75.6	11,134.9	5,661.5	158.2	61.0
Weighted Average:	-	-	-	-	160.0	74.9

A comparison of the yield per acre between irrigated and non-irrigated crops on farms having approximately the same acreage and within the same crop region is made in Table 2.6.

These figures show that the yield of potatoes was increased by irrigation in all the crop regions. For the entire area under survey, the weighted average yields, in round figures, from irrigated and non-irrigated farms were 160.0 and 75.0 hundredweights per acre respectively.

From the data available for this study, an attempt was made to ascertain the relationship between yield per acre and size of operation of the non-irrigated potato crop. There were 33 farmers in this (non-irrigated) category. The potato acreage of individual farmers together with production and yield per acre are shown in Table 2.7.

From the data (Table 2.7), it is difficult to draw any clear conclusion regarding the optimum size of potato farm, because with the increase in farm size, variation in yield does not show any consistent pattern. The least square regression fitted to the data yielded the regression coefficient of 0.04, and the equation for regression line was $Y = 70.6 + .04X$. The correlation between the acreage and yield per acre was found to be +.47. These data, therefore, indicate that with the increase in farm size, the yield increased, but at a very moderate rate. Hence, this statement should not be interpreted to imply that an optimum scale of production in potato farming does not exist. Rather, it suggests the need for conducting a separate and more comprehensive study to analyze the size-yield relationship. Such a study would have to analyze and isolate the effects of many other important factors, such as: (1) the local climatic conditions; (2) the incidence of pests and diseases; (3) quantity of fertilizers; (4) the type, variety and quantity

TABLE 2.7

POTATO ACREAGE, PRODUCTION AND YIELD PER ACRE

Schedule No.	Potato Acreage	Production (cwts.)	Yield per Acre (cwts.)
1	10	750.0	75.00
13	14	1,012.8	72.34
17	15	1,162.8	77.52
10	19	1,143.6	60.19
31	20	750.0	37.50
34	24	907.8	37.82
38	24	2,156.4	89.85
8	25	1,950.0	78.00
36	26	1,950.0	75.00
16	33	2,193.6	66.47
6	40	2,625.0	65.62
26	40	2,040.0	51.00
32	40	3,000.0	75.00
4	46	2,760.0	60.00
9	53	3,206.4	60.50
14	55	2,962.8	53.87
15	55	2,062.8	37.50
5	60	4,050.0	67.50
12	60	3,375.0	56.25
39	60	5,625.0	93.75
3	65	6,960.0	107.08
19	65	5,479.8	84.30
21	65	6,263.2	96.36
7	95	7,125.0	75.00
30	110	12,187.8	110.80
2	115	10,780.8	93.75
33	182	23,250.0	127.75
18	245	20,699.0	84.50
27	445	31,387.5	70.53
24	502	43,680.0	87.01
28	525	44,460.0	84.69
23	550	54,750.0	99.54
22	1,000	105,600.0	105.60
Grand Total:	4,683	410,307.1	2,517.39
Simple Average:	142.0	12,676.0	76.28
Weighted Average:	-	-	89.32

of seed; (5) the timeliness and method of planting which affect the yield in different degrees.

Varieties of Potatoes Grown

Our survey reveals that 12 varieties of potatoes were grown by 38 Manitoba growers (Table 2.8). Norland was the most popular variety, followed by Pontiac. Of the total potato crop, 39.1% was seeded to Norland, and 21.6% to Pontiac. Predominance of these two varieties was also found in all three crop districts.

The importance of the Norland variety may be attributed to characteristics such as pleasing red colour and uniformity in size of tubers. The tubers are smooth, shallow-eyed and very attractive. 3/

However, all these varieties may be classified into three main types: Red, White, and Russet, from the standpoint of marketing. Red potatoes are desired by the retail trade because of their attractive appearance in consumer packages. On the other hand, since white potatoes lack this attribute, production of this type is discouraged except for varieties having high quality for processing. Russet potatoes, especially the "Netted Gem," are associated with high quality at all levels of the trade and tend to command a premium in the market. Despite the premium, however, acreage under this type, as will be noticed from Table 2.8, is relatively low. The association of high premium with low acreage is perhaps due to low average yields, and more particularly, lower average marketable yields due to predilection of this variety to knobbiness under adverse growing conditions. The variety is also

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3/ J. A. Menzies, "Potato Variety Trials," Proceedings of Fifth Annual Convention, Vegetable Growers' Association of Manitoba, Winnipeg, 1958, p. 17.

TABLE 2.8

POTATO ACREAGE ACCORDING TO VARIETY IN THREE CROP DISTRICTS

Name of Variety	Winnipeg	Springfield	Red River	Total Acreage	% of Total Acreage
Norland	113.5	388.0	1,464.0	1,965.5	39.1
Pontiac	49.0	147.0	888.0	1,084.0	21.6
Waseca	26.5	54.0	390.0	470.5	9.3
Netted Gem	35.0	255.0	165.0	455.0	9.0
Kennebec	4.0	50.0	350.0	404.0	8.0
Irish Cobbler	15.0	62.0	180.0	257.0	5.1
Red Warba	-	-	150.0	150.0	3.0
White Warba	-	-	135.0	135.0	2.7
Snowflake	-	-	50.0	50.0	1.0
Manota	-	17.0	10.0	27.0	0.5
Cherokee	5.0	-	20.0	25.0	0.5
Osseo	3.0	5.0	-	8.0	0.2
Total:	251.0	978.0	3,802.0	5,031.0	100.0

susceptible to certain tuber diseases, such as "net necrosis." Therefore, as a rule, Netted Gems have higher production costs per bushel in comparison to other varieties.

Under the red types of potatoes are included Norland, Wasseca, Pontiac, and Red Warba; under White the varieties are Osseo, Kennebec, Cobblers, Manota, Snowflake, Cherokee, and White Warba; under Russet, the only variety grown was Gems. The data in Table 2.8, when grouped on a colour basis, show that 73.0% of the total crop under survey was under Red varieties, 17.9% under White varieties, and 9.1% under the Russet type.

Practices and Methods of Handling Potatoes

There are various alternative methods and equipment in use for harvesting, receiving and placing potatoes into storage, and for hauling

to the grading and packing line. The methods employed have considerable effects on marketing costs. Mechanical injuries and other types of damages which occur during these operations not only affect appearance, but also cause waste, increase paring losses, and often pave the way for decay. Major injuries may be scored as grade defects which, in turn, increase the culling rate For these reasons, it is desirable to describe the methods and equipment used before discussing the composition of grading and packaging costs both at the farm and the wholesale level. The methods and equipment most common in use for performing these operations are briefly described below.

(a) Harvesting

Systems for harvesting and handling potatoes in the field in Manitoba may be classified into three groups: (1) conventional system; (2) completely mechanical system; (3) partially mechanized system.

In the conventional system of harvesting, a one- or two-row tractor-drawn digger is used to dig potatoes (Fig. 2.2, 2.3), and drop them back on the ground. They are then picked up by hand and placed in the field container-boxes or bags. The potatoes are then hauled from the field to the storage bin on flat-bed trucks. They are loaded and unloaded manually.

In the completely mechanized operation, both the harvesting and handling operations are mechanized. Mechanical equipment is used to dig the potatoes and load them in bulk in special bodies called bulk boxes, which are mounted on trucks or trailers. In direct harvesting, digging and loading are accomplished with a machine in one operation (Fig. 2.4, 2,5, 2.6). In indirect harvesting, the potatoes are first dug with a conventional digger and placed in a windrow by means of a windrowing

attachment (Fig. 2.7). A machine is then used to pick them up out of the windrow and load them in bulk.

Partial mechanization involves the use of mechanical equipment for only a part of the harvesting operation, and the use of conventional methods for the remainder. That is, the potatoes may be dug with a harvester that places them in the field containers, which are then handled manually in the field and at the storage houses. On the other hand, the potatoes may be dug and picked up in the conventional way. They may then be loaded in bulk in the field by means of a field loader (Fig. 2.8) to be hauled to the storage bin.

With the above descriptions of the equipment and methods used for harvesting potatoes, we may now examine the relative number of injuries to potatoes which occurred in each of these operations. In our survey, all the farmers were asked about their percentage of cut or mechanically injured potatoes in total production. These data have been arranged in Table 2.9 .

Use of the mechanical harvester resulted in the highest proportion (26.3%) of cut and damaged potatoes; whereas, the percentage was comparatively low by the use of diggers in general. Higher percentage of cut or injured potatoes through harvesting naturally leads to greater cull losses and higher labour cost in grading, thereby increasing the total grading cost, but this increase in grading cost may be offset by the saving of labour through increased output per man-hour in harvesting and picking. In other words, if the rate of output per unit of time by use of harvesters is greater than the output rate of diggers, this will tend to offset the higher labour cost through grading, particularly if the wage rate and the labour cost for grading is less than labour cost for harvesting. Further, high percentage of culls or damaged potatoes

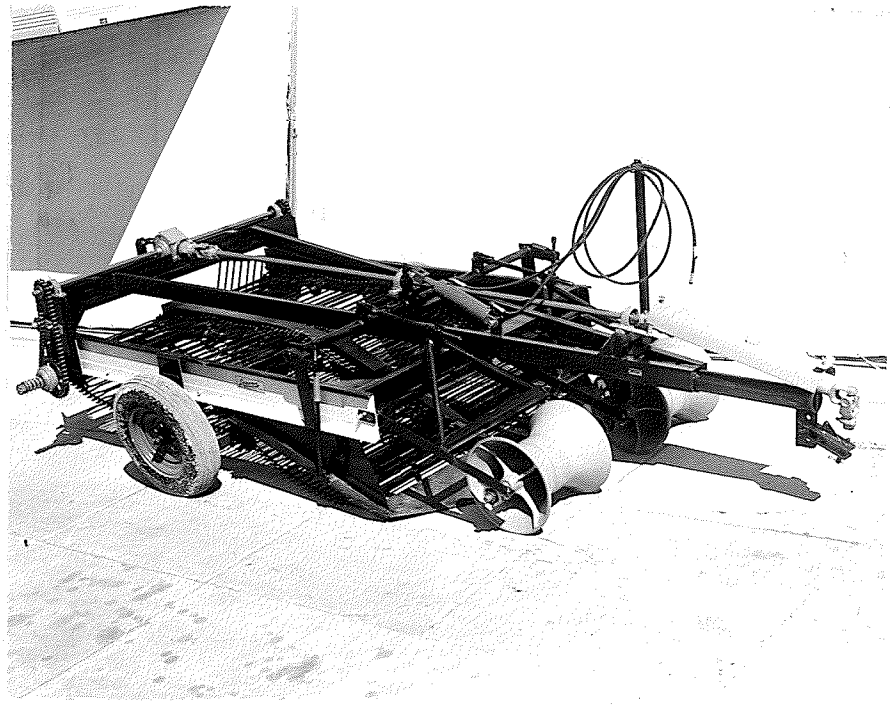

Fig.2.2
A two-row tractor-drawn potato digger.

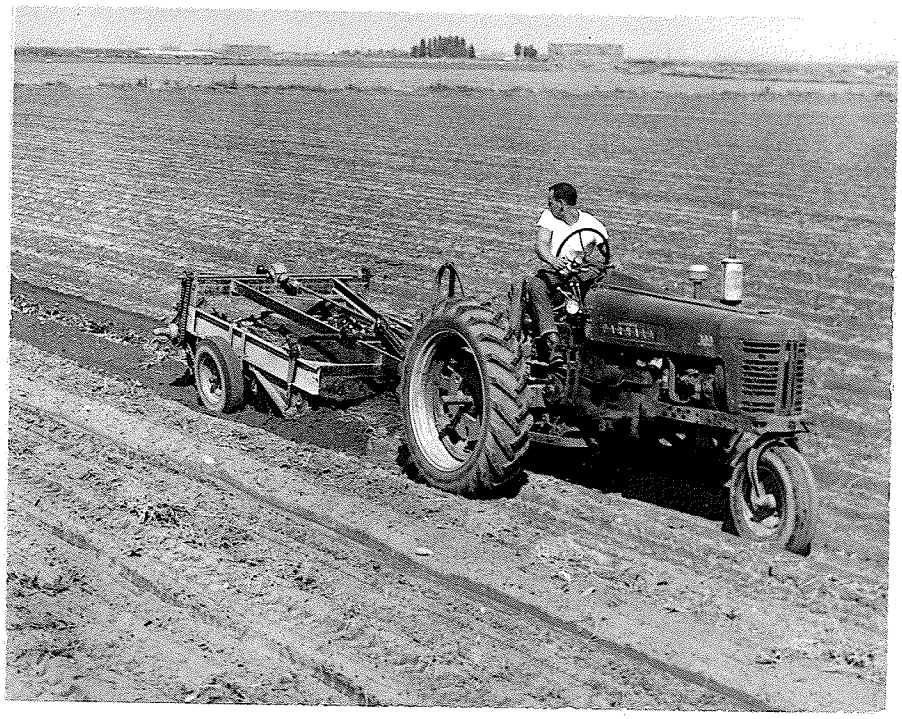

Fig.2.3

A two-row tractor-drawn potato digger in action (Conventional type of harvesting)

Fig.2.4
A two-row potato harvestor digs and bulk loads two rows of potatoes. (Complete mechanised harvesting)

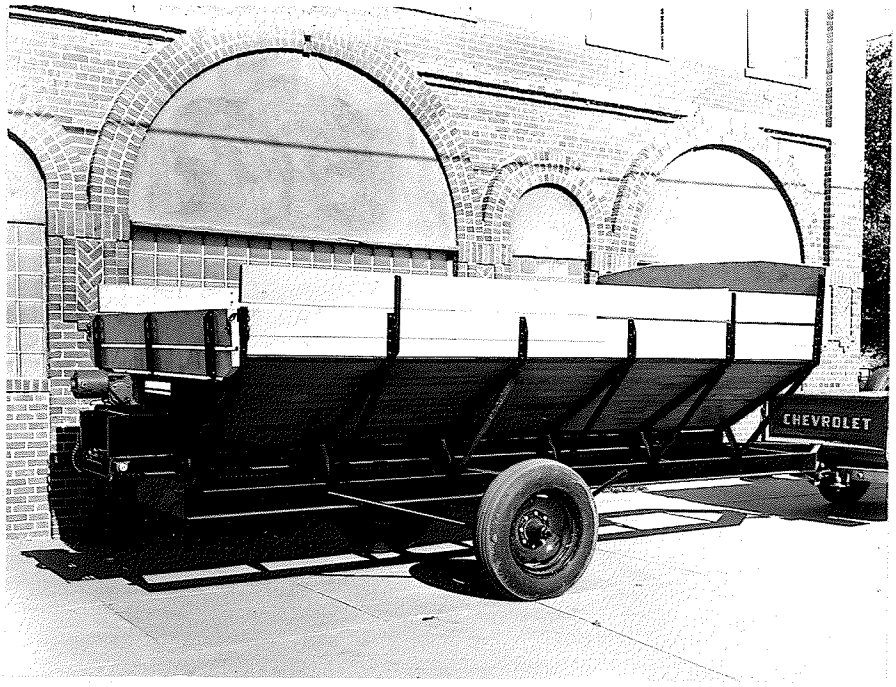

Fig.2.5.
A bulk box used for hauling potatoes.

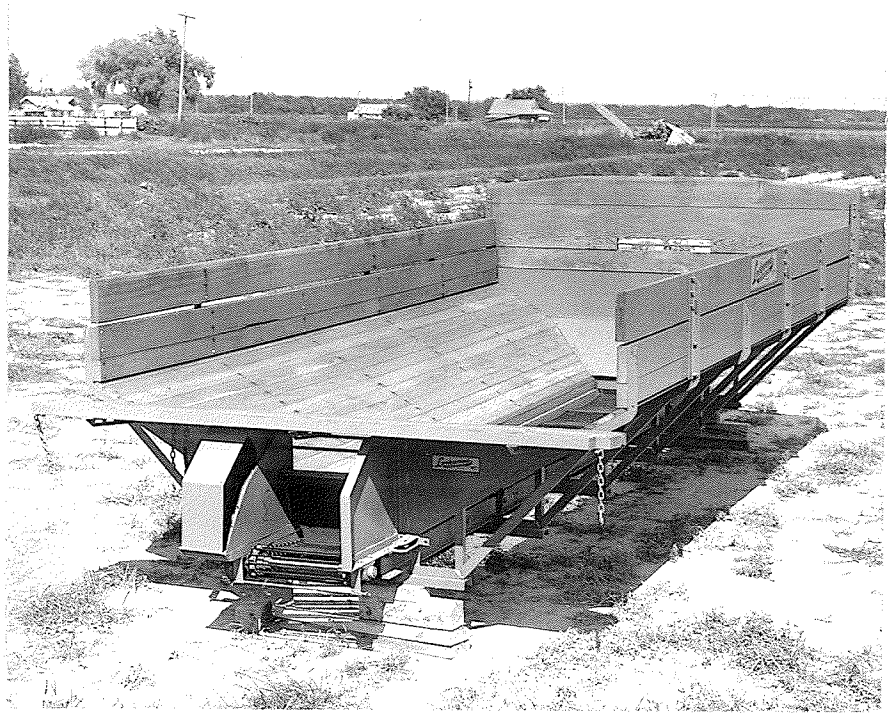

Fig.2.6.

Inside view of a bulk box.

Fig.2.7.

Potatoes are loaded into the truck mounted bulk box by conveyor after windrowing.(Indirect harvesting)

TABLE 2.9

PROPORTION OF INJURED POTATOES ASSOCIATED WITH THE USE OF MECHANICAL EQUIPMENT

Method	Harvesting Equipment	No. of Growers using the equipment	% of injured potatoes in the total yield
Conventional	(i) 1-row digger	6	17.2
	(ii) 2-row digger	24	11.0
Complete Mechanization	2-row harvester	6	26.3
Partial Mechanization	1-row harvester	2	6.0

in the total yield which affects grading cost will tend to be offset by the use of large and efficient grading machines which increase output in grading per unit of time.

The relation between the amount of injured potatoes and the rate of output in harvesting and picking by different equipment needs a separate study, but the other aspect of the study relating labour cost to the percentage of culls in grading has been developed in greater detail at a later stage. 4/

Many factors seem to affect the amount of injuries in potatoes harvested by different equipment. Some of the more important are variety, maturity of the crop, condition of the field, type of equipment, care with which equipment is operated, control of depth of operation for minimum damage and maximum recovery of potatoes, regulation of travel

4/ Pages 56-62

speed, etc. 5/

(b) Principal Type of Equipment used for Receiving Potatoes at the Storage Bins

Potatoes hauled in bulk boxes from the field are unloaded by means of a draper chain conveyor. As potatoes are being unloaded, boards that support the load over the chain are pulled out to permit potatoes to flow on the draper chain and be carried out to the storage bin. Potatoes received in bags or boxes are generally handled manually and sometimes a conveyor is used to move the potatoes to storage bins. Often potatoes are stored, especially at the wholesale level, in pallet boxes. A fork-lift truck is used for removing the pallet box from the loading area, transporting and stacking it in storage.

(c) Hauling Potatoes from Storage to the Grading and Packing Line

In most cases, small farmers and wholesalers haul the potatoes kept in sacks or boxes from the storage bin by hand trucks to the grading and packing line. They have, generally, no facility for washing and, therefore, the potatoes are dry graded at stationary grading and packing machines. In some cases, when potatoes are not washed, small portable graders are moved to the storage bins. Here the potatoes are fed into the grading equipment by hand forking them into a hopper and short conveyor (Fig. 2.9). The potatoes not requiring regrading at wholesale levels are also bagged into consumer packages at the storage bin. A small, double-head unit bagger (Fig. 2.10) is used for the purpose.

5/ For an excellent and complete discussion on this point, see A. H. Glaves, et. al., Increasing Potato-Harvester Efficiency, United States Department of Agriculture, Agriculture Handbook No. 171 (Washington: Government Printing Office, December, 1959); and also R. E. L. Greene, et. al., An Analysis of Quality and Cost of Harvesting and Handling Potatoes with Mechanical Equipment, Agricultural Experiment Station, Gainesville, Florida, Bulletin 612, October, 1959.

Fig.2.8.
A sack loader

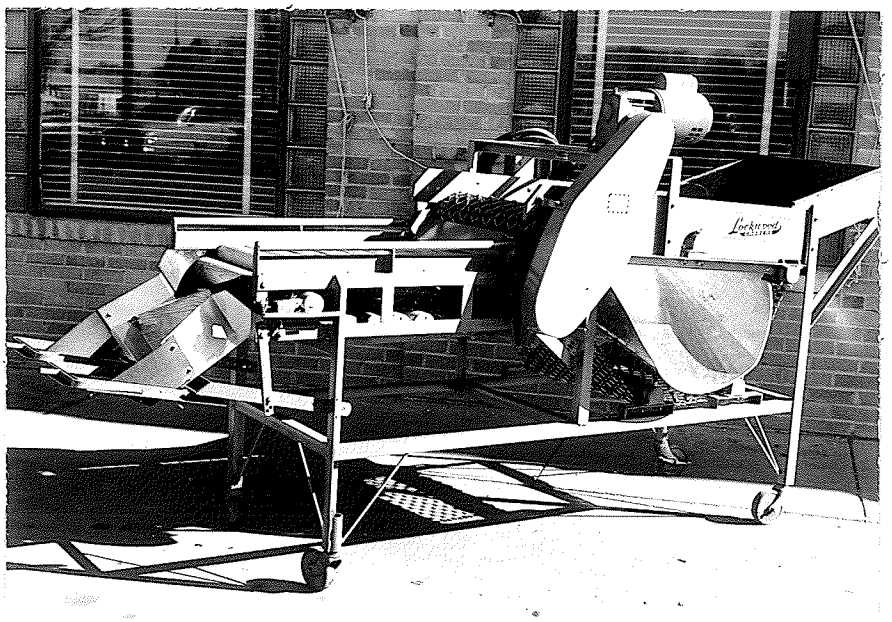

Fig.2.9.
A motor driven grader,
moving type.

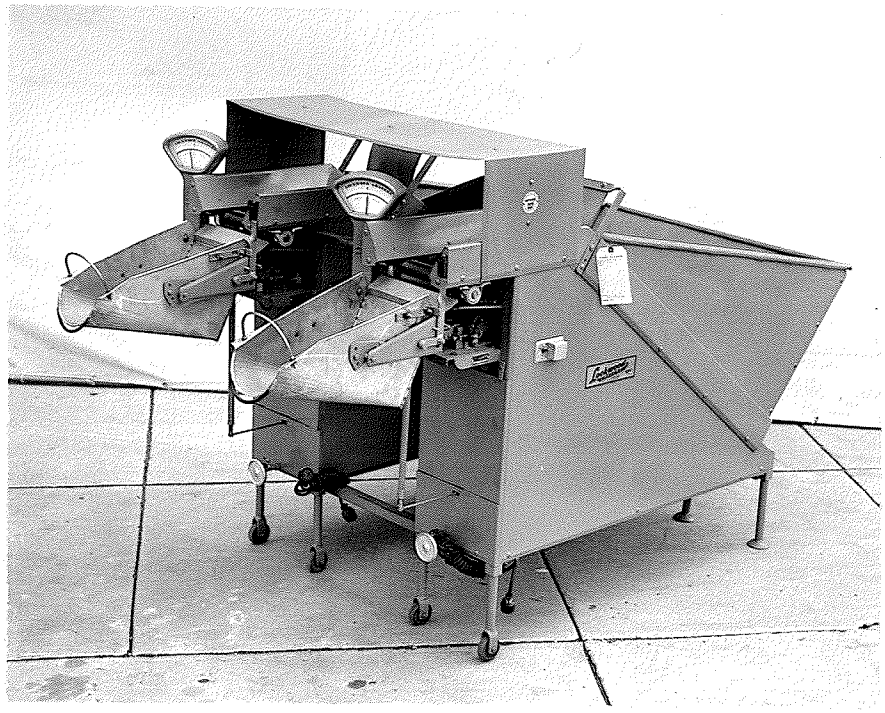

Fig.2.IO

A double-head unit bagger
with attached weighing scale.

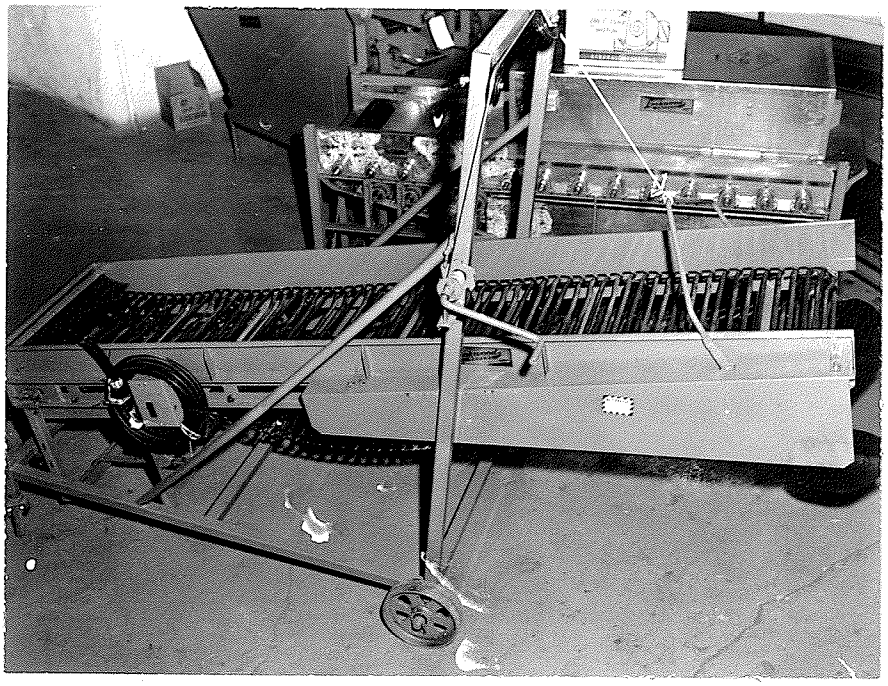

Fig.2.II

A bulk box unloading conveyor.

Many big farmers and wholesalers use the "flume system" for moving potatoes from the storage bin to the grading premises. "Potato fluming is the conveying of potatoes from one point to another by means of water flowing through a sluice or flume that connects the two points." 6/ The flume system should be designed so that the desired quantities of water and potatoes can be put into the flume at the receiving end, and the potatoes taken out and the water disposed of at the other end. A typical procedure and the stages involved in handling potatoes from storage until they are packed under the flume system is described below. The procedure has been followed by one of the big wholesalers in Winnipeg.

Potatoes generally come to the plant in 75-pound jute bags. Twenty-five bags are then packed on a 40" x 48" x 34" pallet box and moved by fork lift truck to the flume area ahead of the soak tank. The bags are opened and discharged by conveyor (Fig. 2.11) into the flume and carried by water to the soak tank. An elevator operating within the soak tank conveys the potatoes into the transverse brush washer. The potatoes are run over rubber pintle rollers and thence over nylon brush rollers, all an integral part of the washer (Figs. 2.12, 2.13, 2.14 shown as separate units).

After passing through the sizer (Fig. 2.15), the potatoes then travel over sponge rollers to remove excess moisture (some use dryers after washing) and are then discharged onto the roller-picking or grading table (Fig. 2.16). At this stage, the potatoes move along the roller picking table, being turned over and over, so that all defective specimens may be culled out prior to entry on to a rubber belt conveyor. The

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6/ A. D. Edgar, et. al., Flume Systems for Handling Bulk-Stored Potatoes, United States Department of Agriculture, Marketing Research Report No. 177 (Washington: Government Printing Office, June, 1957), p. 1.

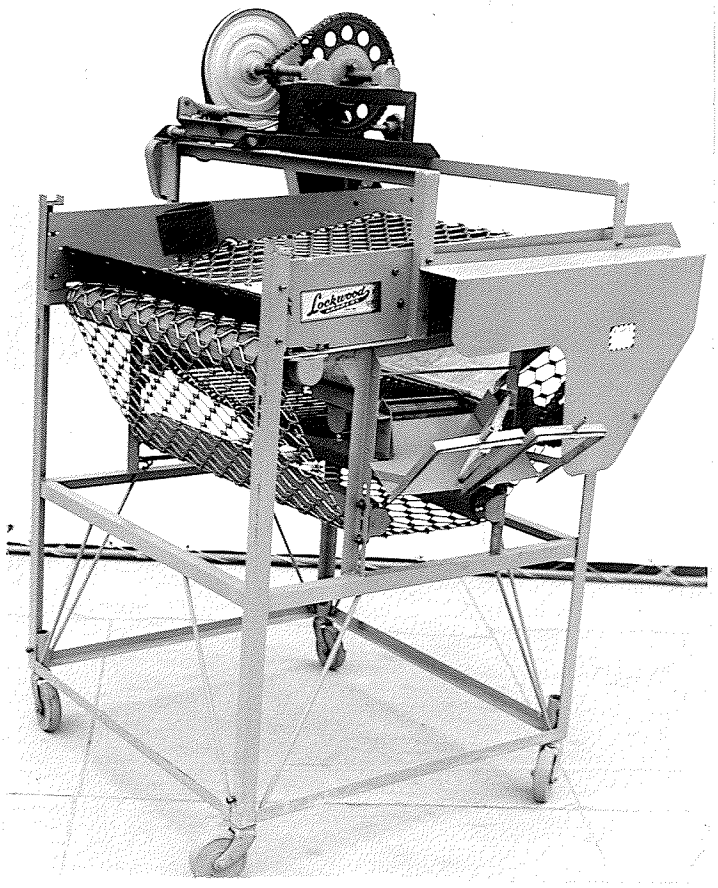


Fig.2.I3

A single screen sizer

Fig.2.I2

A brusher type washer.

Fig.2.I4

A table washer.

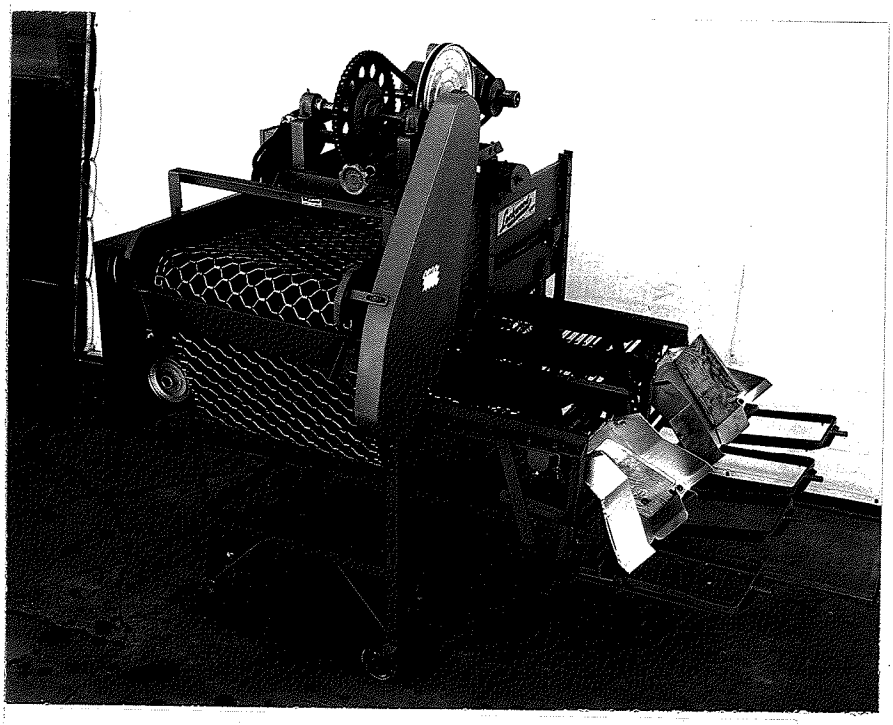


Fig.2.I5

A double screen sizer

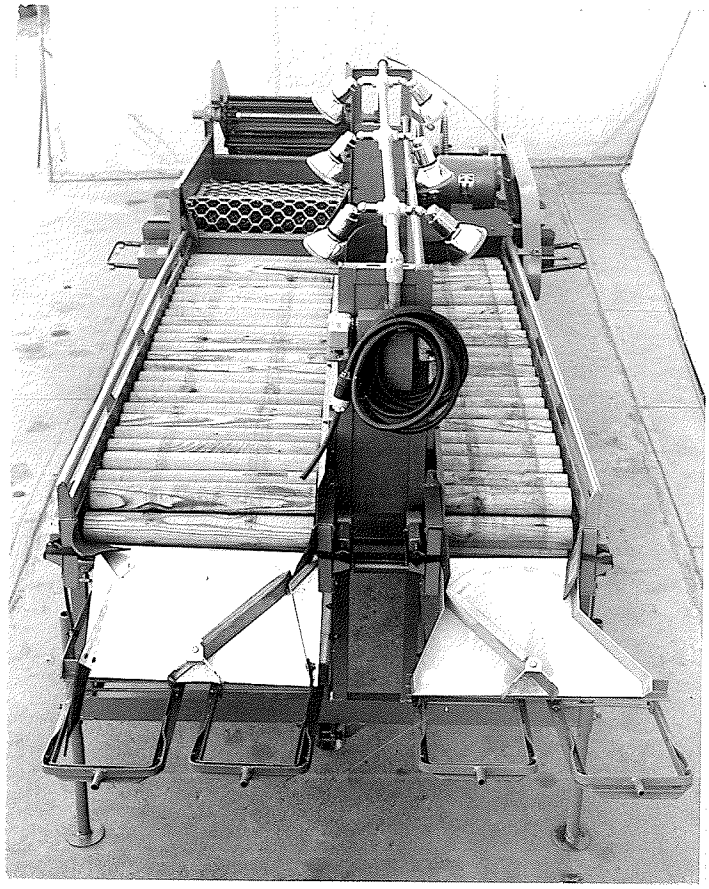


Fig.2.I6
A picking and grading table.

Fig.2.I7

A general view of washing, brushing, grading and packing line.

potatoes now may be channelized off one side of the rubber belt conveyor and directly into 75-pound bags or may continue on into bulk pallet boxes. For purposes of pre-packaging, the latter procedure is followed exclusively. The pallet boxes of washed potatoes are transported to the pre-packaging area by fork lift truck, where they are dumped by electrically-powered hydraulic dumpers into the packaging machine. The pre-packaging operation consists of a rotary bagger packing the potatoes into bags of 5, 10, and 25 pounds each. The 5- and 10-pound units are packed ten and five units to a master container.

With more modern type of machinery, potatoes are washed, sized, brushed and bagged in almost any way desired in one line (Fig. 2.17).

Utilization and Method of Transportation

The utilization of the potato crop and the kind of transport used have a bearing on the grading cost function. Detailed analysis of these points will follow later. At this point it may be sufficient to indicate utilization at the farm level and the various methods used for shipment.

Potato growers dispose of their produce through various channels. In the aggregate, the highest proportion of total production in the three crop districts was sold to wholesalers as table stock. The next highest percentage went to processors where the farmers were required to do little or no grading at all as per agreement with the processors. Growers also sold a fair portion of their crop as seed to other farmers. The complete utilization of the potato crop in the three crop districts is shown in Table 2.10.

TABLE 2.10

UTILIZATION OF POTATO CROP IN THE WINNIPEG, RED RIVER AND SPRINGFIELD CROP DISTRICTS*

	(PERCENTAGES OF TOTAL PRODUCTION)			
Items	Winnipeg	Springfield	Red River	Weighted Average of all Districts
Own seed	6.9	9.4	4.6	5.6
Sold as seed	14.5	19.1	5.6	8.4
Wholesalers	55.2	48.5	47.7	48.2
Retailers	16.8	3.3	4.4	4.8
Institutions	-	0.7	0.7	0.7
Consumers	-	0.08	0.7	0.6
Processors	1.0	11.9	20.0	17.7
Farm consumption	0.4	0.2	0.05	0.09
Waste and culls	5.2	6.7	16.2	14.0
Total:	100.0	100.0	100.0	100.0

*Source: Appendix B.

Method of Transport

Four methods of transporting potatoes were used by growers. They were (1) own truck; (2) buyer's truck; (3) public service vehicle truck; (4) rail. Rail transport was used solely by big farmers in the Red River region to markets in the provinces of Ontario, Alberta, Saskatchewan, and British Columbia. The proportion of total shipment by these modes of transport is recorded in Table 2.11.

These data reveal that by far the largest volume, 65.7% of total production, is hauled by the farmer's own truck. This method is dominant in all the crop districts. In the Winnipeg and Springfield crop district, however, the farmers never hired public service vehicle trucks nor used rail to haul their produce to market. Probably this was due to nearness

TABLE 2.11

VOLUME OF POTATOES SHIPPED BY DIFFERENT TYPES OF TRANSPORT

Crop District	Total Volume Delivered (cwts.)	PERCENTAGE OF THE TOTAL VOLUME DELIVERED BY			
		Own Truck	Buyer's Truck	P.S.V. Truck	Rail
Winnipeg	19,497.5	97.5	2.5	-	-
Springfield	70,706.8	97.0	3.0	-	-
Red River	291,127.0	55.9	22.8	11.8	9.5
Weighted average of the three Districts:	-	65.7	18.1	9.0	7.2

of the market and a desire to make economical use of their own trucks. In the Red River crop district, all four methods were used, with the least use made of rail. The growing importance of truck haulage is due to the fact that handling charges are lower and faster movement cuts down spoilage. Reduced handling and spoilage means reduction in marketing costs. Moreover, greater speed gives the shipper or grower an opportunity to take advantage of a favourable market.

CHAPTER 3

GRADING AND PACKAGING COSTS

An attempt is made in this chapter to estimate the grading and packaging costs both at the farm and the wholesale level and to determine, on the basis of these costs, the optimum location of the grading process. Costs and benefits of hand and machine grading at the farm level are also assessed and compared with each other and, in the light of this comparison, an attempt is also made to determine the size of the potato crop a farmer must grow in order to justify the purchase of a grading and packaging machine.

Potatoes are graded on the basis of maturity, quality, size, and physical appearance. Specifications required by the Provincial Government for sale of potatoes, as stated in "The Fruit and Vegetable Sales Act," 1/ are listed in Appendix C. According to the provisions of the Act, the grades of table potatoes are:

(a) Canada Fancy;

(b) Canada No. 1;

(c) Canada No. 1 Large;

(d) Canada No. 1 Small, that shall be used only for shipment out of Canada;

(e) Canada No. 2.

1/ The Fruit and Vegetable Sales Act, July 5, 1960 (Manitoba Regulation 38/60), Section 38, p. 24.

There is a great deal of overlapping in the specifications between these grades. Size is probably the best example of this overlapping, as can be observed from Table 3.1.

TABLE 3.1

RELATIONSHIP BETWEEN SIZE AND GRADE OF POTATOES

Grade	Diameter range and qualification
Canada Fancy	Not less than 2-1/4" in diameter, or more than 3-1/4" in diameter.
Canada No. 1	Not less than 2-1/4" in diameter, or more than 4" in diameter, except in cases of long-shaped varieties the minimum diameter may be 2".
Canada No. 1 (large)	Not less than 3-1/4" in diameter.
Canada No. 1 (small)	Not less than 1-1/2" in diameter, and not more than 2-1/4" in diameter.
Canada No. 2	Not less than 1-3/4" in diameter, with not less than 75% by weight of the potatoes in the lot of a diameter not less than 2".

It is evident from the above table that grade specifications with regard to the diameter between Canada Fancy and Canada No. 1 are almost the same. With the introduction of grading machines, farmers as well as wholesalers have adopted two grades for the trade, viz., Canada No. 1 and Canada No. 2, in order to standardize and speed up the operation. Of the entire potato crop surveyed under this study, 64.7% was Canada No. 1, and 35.3% was Canada No. 2 (see Appendix D).

Two methods of grading were used by the farmers:

(1) Hand grading (a) on the field run basis;

(b) in the storage bin.

(2) Machine grading--in the storage bin.

FACTORS AFFECTING METHODS OF GRADING

(a) Grading on field run

A sample of 38 potato growers in our survey revealed that two farmers with a production of about 6,000 hundredweights each graded their entire produce by hand in the field while harvesting the crop, while 36 graded at their storage bins--11 by hand, and 25 by machine. In regard to the first two farmers, lack of storage facilities, high cost of grading machinery, shortage of family labour, and lack of knowledge of the grading cost by hand or machine were given as some of the reasons for their practice of grading and selling the entire crop on the field run basis. Sale by contract to processors was another contributing factor in the case of one of these two farmers in disposing of the crop directly from the field.

Also, among the 25 machine-grading farmers, three farmers used a combination of both hand grading on the field run basis and machine grading at their storage bins. These three farmers were all located in the Steinbach area. The reasons for sale direct from the field in the case of these three farmers were that they planted both early and late varieties and did not have enough storage space to accommodate the total production. Some part of the early crop was sold under contract to processors, and the farmers had a better price advantage over the late crop prices prevailing during the second and third quarters of the potato marketing season (see Table 3.2).

This, however, does not necessarily mean that selling the potato crop on the field run basis without proper grading is the most profitable

TABLE 3.2

AVERAGE QUARTERLY PRICES OF POTATOES RECEIVED BY THREE STEINBACH POTATO GROWERS DURING 1961-62 (PER BAG OF 75 POUNDS)

Farm No.	Prices of potatoes (graded on field run) during 1st Qr. ending Aug., 1961	PRICES OF POTATOES GRADED IN THE STORAGE BIN DURING THE FALL		
		2nd Qr. ending Nov., 1961	3rd Qr. ending Feb., 1962	4th Qr. ending May, 1962
21	$2.30	$1.75	$1.75	$2.50
30	2.00	1.85	2.00	2.50
26	2.00	1.80	1.80	2.10

course of action for the producer, because production costs for raising early varieties were not examined in the present study. Moreover, the sales of these three farmers, as mentioned above, were confined mainly to the processors under contract farming, and to the retailers in the Steinbach area, rather than to the normal trade channel. Also, the last column of Table 3.2 shows that prices in the fourth quarter were higher than prices in the second and third quarters. This, perhaps, explains why storage was used as a technique to take advantage of better prices prevalent in the fourth quarter by those farmers who had some waiting capacity.

(b) Grading by hand

Of the 38 farmers, 11 graded their produce by hand in the storage bin, mostly during the winter. Some of the factors which seem to account for the choice of hand grading are related to the volume of operation, the cost of grading machinery, availability of family labour, and the extent to which subsidiary work is available to the farmer. Most of these 11 farmers have small-sized operations, with the volume of business ranging from 750 to 6,000 hundredweights. These farmers were not sure whether the use of machine grading equipment would be an economical proposition. Also, since most of these farmers are only field-crop growers, they do not have much farm work during the winter, or any other off-farm work. Therefore, they find it economical to utilize their own as well as their family's labour in grading potatoes.

(c) Grading by machine

One of the most important factors that emerges out of the survey in this context is the adequacy or inadequacy of family labour that decides the issue of hand-grading versus machine grading within a certain

volume group. In contrast to hand grading, where the volume of business ranged up to 5,625 hundredweights, there were also 13 farmers within this volume group who graded their produce by machine. The reasons cited by these farmers were opposite to those for hand grading (noted earlier). These farmers faced the problem of insufficient labour, but were financially better off. In order to reduce grading costs and to receive a better premium (to make a higher net profit) for their product over hand grading, these farmers used machines for grading.

Differences between hand and machine grading costs are analyzed later in this chapter, but it is sufficient to point out here that these differences are considerable. Furthermore, most of the hand graded potatoes were passed as No. 2's in the wholesale market. Consequently, farmers within this category could sell, on an average, only 35.7% of their total production as Canada No. 1, and 64.3% as Canada No. 2. Farmers in the machine grading group, on the other hand, could sell as much as 54.1% of their potatoes as Canada No. 1, and 45.9% as Canada No. 2 (see Appendix E). Since the price for Canada No. 1 is usually 15 to 25 cents higher than the price for Canada No. 2 (75-pound bag), and since machine grading, as mentioned above, results in higher percentages of Canada No. 1 potatoes, it seems reasonable to infer that the prospect of higher net returns associated with machine grading acts as an important motivating factor in choosing this over the hand grading alternative.

We have so far discussed only the considerations relevant to the problem of choosing between hand and machine grading on different bases, viz., the field run basis, and the storage bin basis. We have not, however, analyzed the cost-volume relationships for these two broad alternatives, i.e., hand grading versus machine grading method. This is done in the following section.

A. GRADING COST AT THE FARM LEVEL

Items included in the grading and packaging costs, as listed earlier in Chapter 1, are the costs of labour, power, depreciation, insurance, interest, repairs and maintenance. Since these costs were not directly available, in the form required for our analysis from the survey data, certain transformations and calculations had to be made. A typical example, illustrating how grading cost per hundredweight has been calculated in this study is given below.

Assume from the survey questionnaire that we get the following information about a farmer's grading expenses:

1. Total production of potatoes: 8,000 bags (75 pounds each);
2. Cost of grading machine: $600.00;
3. Year of purchase of the machine: 1958;
4. Cost of the storage bin: $1,000.00;
5. Light and power charges: $15.00 per annum;
6. Repairs and maintenance:
   (a) Storage bin: $100.00 per annum;
   (b) Grading machine: $10.00 per annum;
7. Insurance:
   (a) Storage bin: $20.00 per annum;
   (b) Grading machine: $2.00 per annum;
8. Floor area of the storage bin used for grading and packaging: 10% of total floor area;
9. Volume graded per hour: 10 bags (75 pounds each);
10. Labour rate per man-hour: $0.75.

The grading cost from the above data is calculated below.

Items	Rate	Cost
DIRECT COSTS 2/		
1. Labour (including cost on haulage from the bin, grading, packaging and transportation to shipping or temporary storage point)	10 bags per hour @ 75¢ for 8,000 bags	$600.
2. Light and power	based on estimates of working hours	15.
TOTAL DIRECT COST:		$615.
OVERHEAD COSTS 2/		
3. Depreciation		
(a) On building area used for packaging and grading	10% of the total depreciation on building 3/	5.
(b) On grading machine	10% of total cost	60.
4. Repairs and maintenance		
(a) On building area used for grading and packaging	10% of the total repairs & maintenance on building	10.
(b) On grading machine		10.
5. Insurance		
(a) On building area used for grading and packaging	10% of total insurance on building	2.
(b) On grading machine		2.
6. Interest on machine	5% of the depreciated value of the machine 4/	21.
TOTAL OVERHEAD COST:		$110.
Total Direct and Overhead Costs:		$725.

Grading cost per 75-pound bag = $\frac{\$725.}{8,000}$ = 9¢ or 12¢ per cwt.

2/ See manuscript, pp. 12-16 for a discussion and explanation of costs.

3/ The depreciation of the storage bin costing $1,000 calculated at 5% comes to $50. Ten percent of this amount allotted toward grading cost is $5. per annum.

4/ Figuring depreciation at 10% per year, the value of the machine three years after the date of purchase is $420 (year of purchase was 1958, and the survey relates to 1961). Interest at 5% (based on Government maturity bonds) on $420 comes to $21.

Using the above procedure, the grading and packaging costs by hand as well as by machine have been calculated and arranged according to certain volume groups (see Appendix F). It should be pointed out here that the cost of labour has been calculated in terms of a 75-pound bag per hour excluding the washing operation, because packing in 75-pound jute bags was most common among farmers (see Appendix D), and most of them had no washing and brushing facilities. However, there were eight farmers in the survey who not only packed in 75-pound bags, but also sold a certain portion of their produce in 100-, 25-, 10- and 5-pound bags, and in bulk boxes (see Appendix D). A few in this group also washed their potatoes. However, to simplify calculations, these exceptions to the general practice of using 75-pound bags were ignored, and it was assumed that every farmer used 75-pound bags. The effect of this simplifying assumption is not considered to be too damaging, because approximately no more than 8% of the total volume is packed in 100-pound bags, and roughly 11% in bags of lesser quantities than 75 pounds or in bulk boxes. Using a 75-pound bag as the unit of measurement of grading rate per hour, we may now examine the factors that influence the rate of grading.

Factors Affecting Grading Rate

The factors influencing the rate of grading are the stage of maturity, and variety of potatoes, ability of the work crew, type of grading machine, percentage of culls, and the degree to which the grading work is done in conformity with standards specified by law. If the potatoes are not properly matured, the grading rate will decrease, because the grader will have to be careful not to bruise the skins. Certain varieties like "Netted Gem" also require careful grading because they fetch a higher premium than other varieties. Similarly, the output of

a skilled worker conversant with the grading and packaging operation would be more than that of an unskilled worker. The type and make of the grading machine also affects the grading rate. A small, old grading machine will grade comparatively less volume than a modern machine.

Due to the inadequacy of data, it is rather difficult to assess the impact of each one of these factors on the rate of grading. Instead, two factors on which information was available from the survey questionnaires were considered. These are:

(1) the percentage of culls in the yield, and

(2) the size of the grading machine.

Data showing the effect of percentage of culls on volume graded per hour is shown in Table 3.3. These figures reveal that the average grading rate by hand for potatoes containing an average of 12.5% culls is five bags an hour; whereas, in the case of machine grading, the average rate is 12.8 bags an hour with 16% culls. These data are plotted in Figure 3.1 in the form of a scatter diagram, and a trend line is fitted to each set of data in terms of the Cobb-Douglas function. The negative slope of each curve shows that as the percentage of culls increases, the volume graded per hour decreases.

The analysis also shows the following relationship for each set of data in Table 3.3:

(1) Hand grading (a) $\hat{Y} = 7.38X^{-.19}$

(b) $r^2 = 0.13$

(2) Machine grading (S) (a) $\hat{Y} = 20.0X^{-.31}$

(b) $r^2 = 0.32$

(3) Machine grading (L) (a) $\hat{Y} = 110.5X^{-.69}$

(b) $r^2 = 0.42$

TABLE 3.3

EFFECT OF PERCENTAGE OF CULLS ON VOLUME GRADED PER HOUR

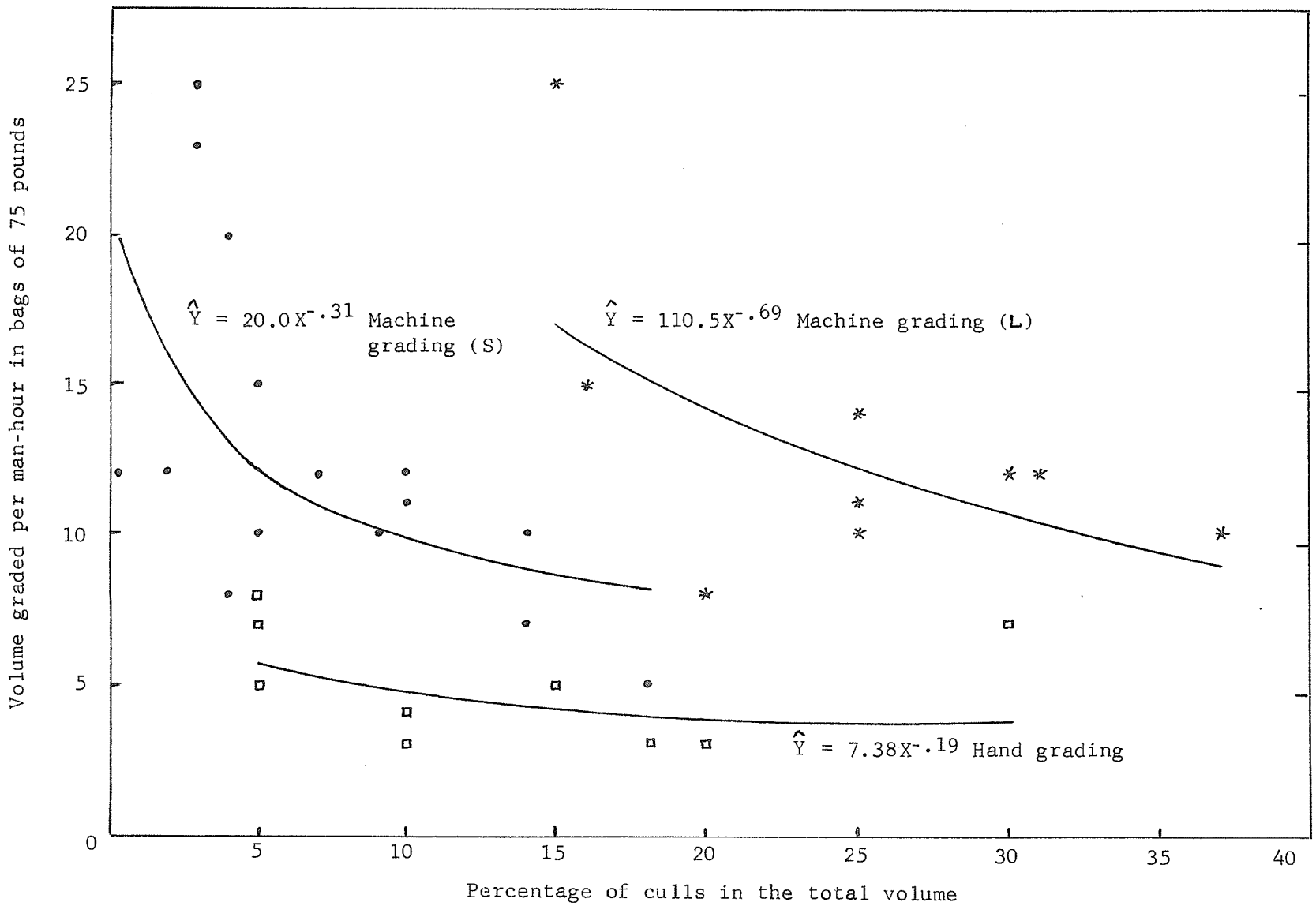
Farm No.	Percent of culls	No. of bags graded per man-hour (75 pounds each)
HAND GRADING		
8	5	5
4	5	8
36	5	5
15	5	7
38	10	4
31	10	3
1	15	5
39	15	5
17	18	3
10	20	3
13	30	7
Average:	12.5	5
MACHINE GRADING (S)		
Length of the machine less than 20'-- designated hereafter as (S), i.e., Small Machine.		
12	.2	12
5	2	12
3	3	23
37	3	25
35	4	20
6	4	8
7	5	10
11	5	15
32	7	12
9	9	10
33	10	11
18	10	12
34	14	10
26	14	7
16	18	5
Average:	7.2	12.8

TABLE 3.3--Continued

Farm No.	Percent of culls	No. of bags graded per man-hour (75 pounds each)
MACHINE GRADING (L)		
Length of the machine greater than 20'--designated hereafter as (L), i.e., Large Machine.		
30	15	25
24	16	16
21	20	8
22	25	10
29	25	14
14	25	11
27	25	10
23	30	12
2	31	12
28	37	10
Average:	24.9	12.8
Average of Machines S and L:	16.0	12.8

FIGURE 3.1

RELATIONSHIP BETWEEN PERCENTAGE OF CULLS IN THE YIELD AND VOLUME GRADED PER MAN-HOUR



$\hat{Y}$ refers to the expected volume graded per man-hour, X refers to the percentage of culls in the yield of potatoes. The exponent in each of the equations (a) is the elasticity of grading, expressing a relationship between the dependent variable (volume graded per hour) and the independent variable (percentage of culls). "Elasticity of grading" (E_g) may be defined as the percentage change in the volume graded per hour associated with a one percent change in the volume of culls. The coefficient of determination is represented by r^2, which indicates the proportion of variance in the values of the dependent variable (Y) that can be explained by or estimated from the independent variable (X).

In the case of hand grading, the elasticity of grading is -.19, which indicates that with one percent increase in the percentage of culls, there will be a decrease in the rate of grading by .19 bags per hour, i.e., .19 x 75 lbs. = 14 lbs. The simple coefficient of determination, r^2 value of 0.13, indicates that 13 percent of the variation in the volume graded per hour can be explained by the percentage of culls present in the lot. Both these values of E_g and r^2 were found not to be significant at 5 percent level. 5/

5/ The survey sample was not drawn with the use of random sampling techniques. In consequence, some statisticians might question the validity of the use of the test of significance. In answer, it can be argued, however, that the sample is quite adequate, since it was selected with the help of officials in the Manitoba Department of Agriculture who have pretty good first-hand knowledge of the area. Also, the sample included about 50% of the population (38 farmers out of 80). The selection of the respondents was of necessity based on farmers' willingness and ability to give accurate information. The sample included farmers with and without grading equipment, and with different scales of operations. Almost all types of potato operations were represented. Thus our sample, even though it is not randomly drawn, is quite representative of the population. It was apprehended that if a random sample had been drawn, there would have been difficulty in obtaining the co-operation of all the selected growers. Finally, there would have been the risk of getting incorrect information from some of the farmers who would have been included in a randomly drawn sample but did not keep good accounts of their enterprise. And this could have become a serious limitation of the project.

In the case of machine grading (S), the elasticity of grading is -.31, meaning that with one percent increase in the percentage of culls, the volume graded per man-hour decreases by (.31 x 75 lbs.) 23 pounds. The coefficient of determination is .32. The values of E_g and r^2 were found to be significant at 5% level of significance.

In the case of Machine (L), the elasticity of grading, E_g is -.69, indicating that with one percent increase in the percentage of culls, there will be a decrease of (.69 x 75 lbs.) 52 pounds in the rate of grading per man-hour. The coefficient of determination is .42. Both the values of E_g and r^2 were significant at 5% level.

This analysis reveals that in the case of hand grading, percentage of culls in the yield of potatoes does not significantly affect the rate of grading; whereas, there appears to be a significant effect of culls on the grading rate when machines are used for grading. One thing that must be noted from Figure 3.1 is that the effect of higher percentage of culls on the rate of grading is offset by the use of large grading machines, i.e., Machine (L). Probably this is one of the reasons why big farmers and wholesalers use big grading machines to economize their labour costs by realizing a greater turnover per man-hour.

(1) Cost of grading by hand

Appendix F shows the cost of hand grading for varying outputs by 11 farmers, excluding the two who graded their entire crop on a field run basis. The volume graded by this method ranged from 750 to 5,625 hundredweights, and the grading costs varied from a high of 44.5 cents to a low of 13.9 cents per hundredweight, with a weighted average of 23.0 cents. So, the range between the lowest and the highest grading cost was 30.6 cents per hundredweight. The largest producer in the hand

grading group graded 5,625 hundredweights with a unit cost of 19.1 cents. The next two largest, grading 2,760 and 2,156.4 hundredweights, had costs of 13.9 and 27.1 cents per hundredweight respectively. Grading costs were higher for the first and third largest producers because these two farmers had to pay high wage rates, resulting in higher labour costs per hundredweight.

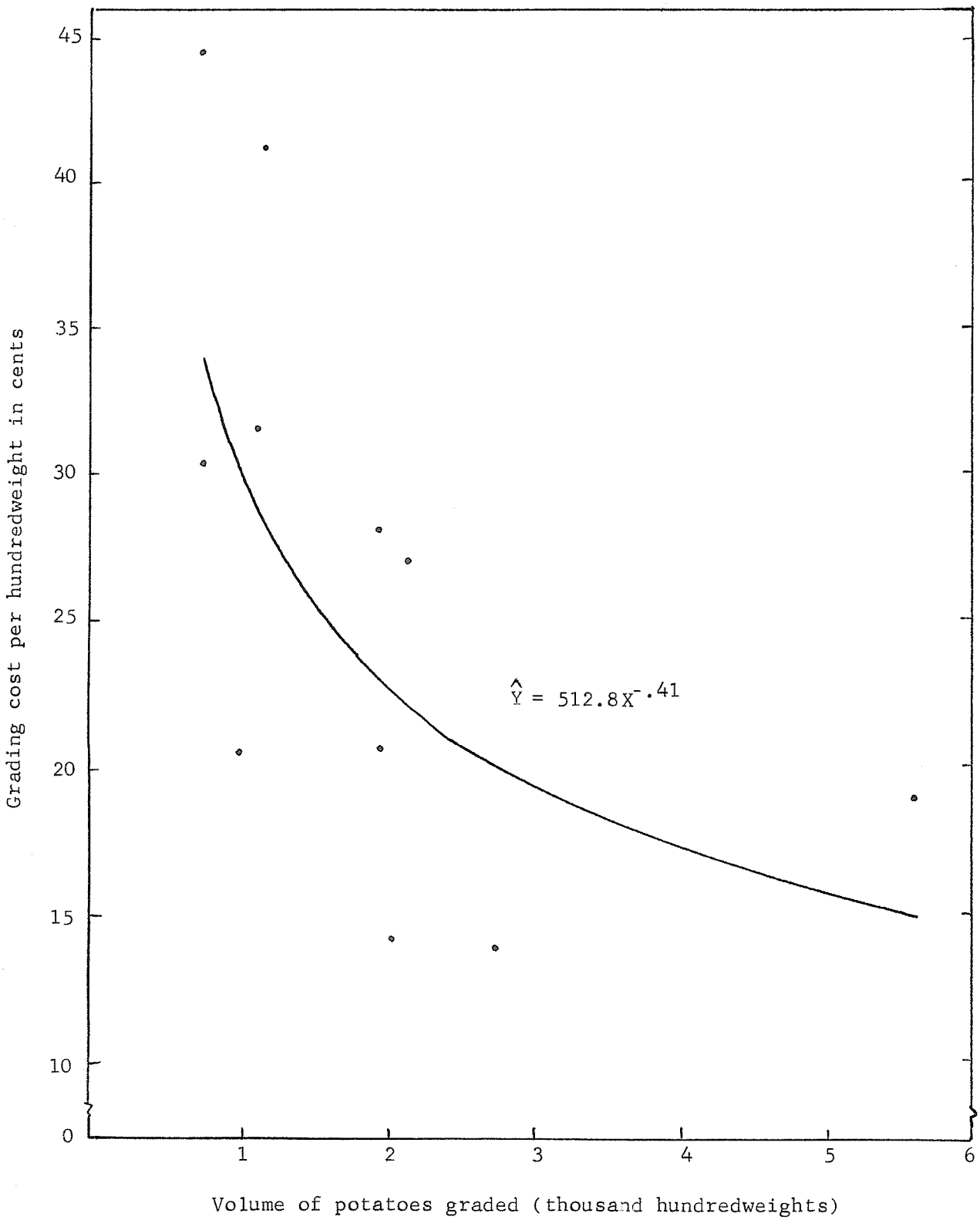
On the lower side, the two smallest volume graders with 750 hundredweights each, had unit costs of 44.5 and 30.3 cents. In this case, the one with lower cost paid $120 less than the other for labour due to higher rate of output per hour, though they paid the same wage rate. The grading rate of the farmer with 30.3 cents as grading cost was five bags an hour as compared with three bags an hour for the farmer whose cost was 44.5 cents per hundredweight. The next two smallest graders with 1,013 and 1,144 hundredweights had costs of 20.6 and 31.6 cents respectively. With a few exceptions in this group, there is some evidence of economies of scale. The larger graders, on an average, had lower unit costs compared with the small graders. The data on the cost of grading as related to volume graded has been plotted in Figure 3.2, and a curvilinear trend line has been fitted to the data by the use of a Cobb-Douglas equation. The curve fitted was of the form:

$$\hat{Y} = 512.8X^{-.41}$$

where $\hat{Y}$ represents the expected grading cost per hundredweight in cents, and X is the volume of potatoes graded. The average elasticity of the curve over the range of the data was -.41, and was significant at 5% level of significance. The value of the coefficient of determination was .42, and was also significant at 5% level. Even though this suggests that grading cost per unit reduces with increase in the volume graded, due

FIGURE 3.2

RELATIONSHIP BETWEEN VOLUME GRADED AND GRADING COST BY HAND



to limited data available for the study, it was not possible to determine the optimum cost-volume relationship.

(2) Cost of grading by machine

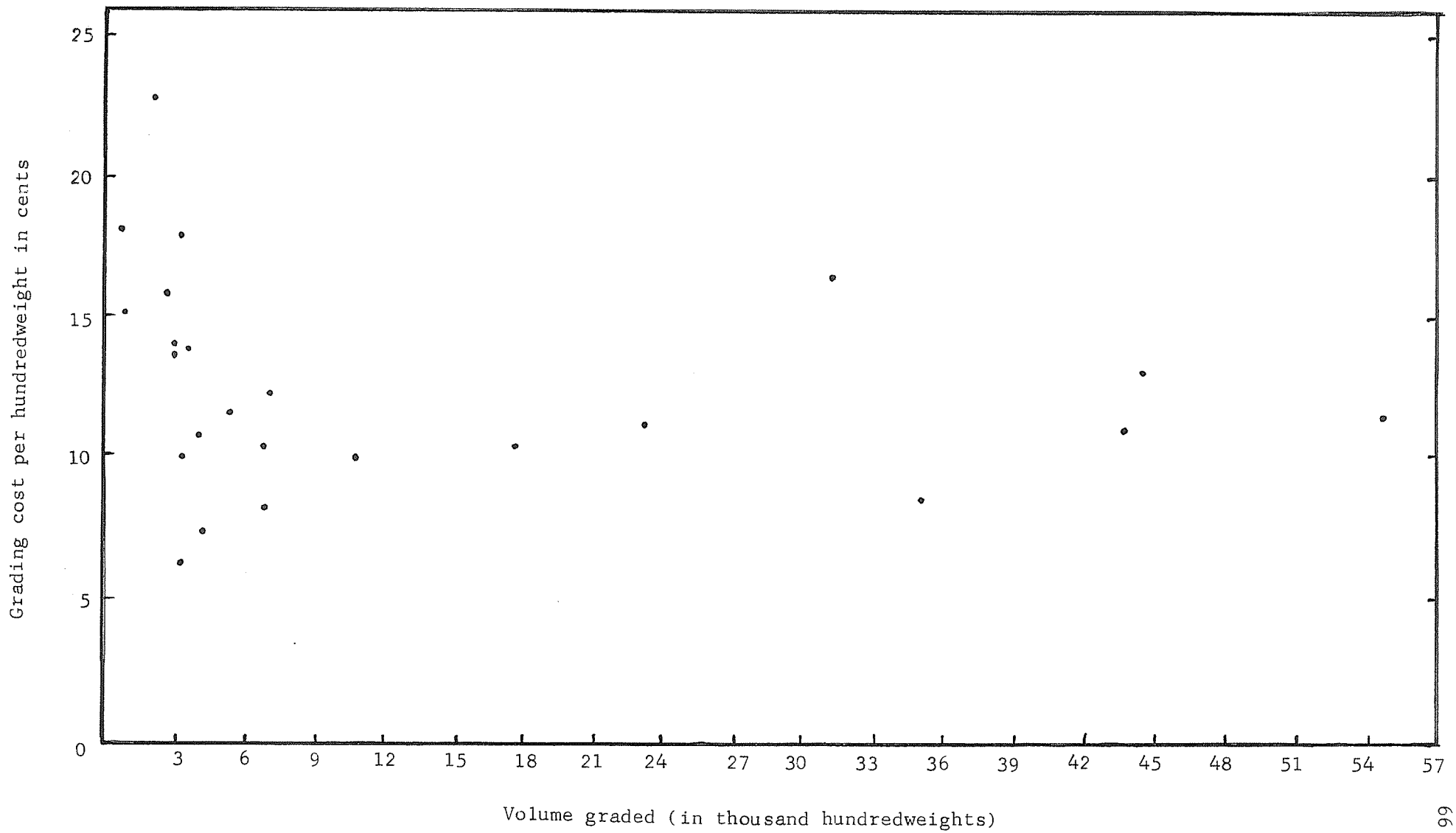
The volume graded under this group varied from 675 to 105,600 hundredweights (see Appendix F), and the grading costs ranged from 6.2 to 22.7 cents, with a weighted average of 11.8 cents per hundredweight. The farmer grading the largest volume of 105,600 hundredweights had a unit grading cost of 12.4 cents per hundredweight, while the smallest with 675 hundredweights had a unit cost of 18.2 cents (per hundredweight). The highest unit cost of 22.7 cents was found on a farm where 2,194 hundredweights were graded, and the lowest unit cost of 6.2 cents was observed on a farm where 3,300 hundredweights were graded. The second lowest cost of 7.4 cents was on a volume of 4,491 hundredweights. These two farmers seem to be the most efficient in the group, because they harvested and handled the crop carefully. Their crops had, on the average, 3.5% culls, and even with their second-hand grading machine they graded at the rate of 22 bags per hour. They also had low overhead costs. One of these two farmers also used his grading machine for grading onions, thereby spreading the fixed costs of the machine over two crops.

The wide dispersion in the grading costs by machine (Fig. 3.3) was caused by peculiarities on the individual farms. With increase in the volume graded, variation in the grading cost did not show any consistent pattern. Some of the important factors responsible for this wide dispersion are:

First, there were between-farm differences in the percentage of culls in the total yield of potatoes. These differences were due to harvesting and handling methods, and type and condition of soil. With

FIGURE 3.3

RELATIONSHIP BETWEEN VOLUME GRADED AND GRADING COST PER HUNDREDWEIGHT BY MACHINE



increase in the percentage of culls, as noted earlier, the volume graded per hour decreases, both in the case of small and big machines, resulting in higher labour costs of grading.

Second, variety and quality of potatoes affect the grading cost. Long-shaped types and the varieties prized for quality, such as "Netted Gem," are carefully graded, which result in low output per hour.

Third, there were differences in the quality of job done. For example, some farms may have graded the potatoes more carefully than others, with the expectation of receiving higher prices.

Fourth, there were differences between farmers with respect to their managerial abilities. It seems as if the skill of the farmers and the workers employed by them has an important effect on the extent of volume graded and packed per hour.

Fifth, farm wages differed from region to region, and also within the same region, ranging from 75 cents to one dollar per hour.

Sixth, the age of the facilities in use affected costs. New machinery, while it may be efficient in the use of labour, may have higher depreciation costs. Old and home-made machines generally had lower depreciation costs. Portion of the building used for grading and packaging or equipment may have been fully depreciatd. Cost of repairs was also affected by the age of the facilities.

The effect of these six factors, and perhaps many others (differences in the use of conveyors, hand and forklift trucks, fluming equipment, etc.), among different farmers account for the lack of any clear and precise consistent relationship between the volume graded and costs per hour. Due to these peculiarities it was difficult to analyze the data statistically and to fit any trend line to the scatter diagram

(Fig. 3.3).

Despite the dispersion, however, when the volumes were grouped into certain class intervals, the data revealed a tendency toward first a decreasing average cost and then an increasing average cost relationship (see Table 3.4). Though the grading cost is at a minimum within the 9,001-12,000 hundredweights volume group, it can not be said definitely or exactly where the optimum volume lies in this group, or whether the optimum lies in this volume range at all, because the cost relates to only one farm and enough data are not available for other farms between 11,000 and 20,000 hundredweights to study their grading costs.

(3) Hand-grading versus machine-grading

A comparison between hand grading and machine grading shows that machine grading is not only more economical, but twice as fast as hand grading. An average of 12.8 bags (75 pounds) is graded per man-hour by machine operation, as against five (75 pounds) bags by hand (see Table 3.3). Table 3.5 below shows the frequency distribution of grading cost by these two methods of grading. The Table 3.5 shows that 13 farmers out of 25 in the machine grading category had grading costs ranging from six to 12 cents per hundredweight, but not a single farmer in the hand grading group was within this cost range.

Data on comparative costs for hand and machine grading are available only for two volume groups, 0-3,000 and 3,001-6,000 hundredweights, and calculations for these two groups show that simple average grading cost by machine is significantly lower than the simple average grading cost by hand. Specifically, the simple average grading cost per hundredweight by hand grading for a volume range up to 6,000 hundredweights was 26.5 against 13.6 by machine for the same volume range.

TABLE 3.4

AVERAGE GRADING COST BY MACHINE IN VOLUME GROUPS*

Volume groups (cwts.)	No. of firms within group	Weighted average grading cost per cwt. (cents)
0 - 3,000	6	16.1
3,001 - 6,000	7	10.9
6,001 - 9,000	3	10.2
9,001 -12,000	1	10.0
12,001 and over	8	11.8

*Source: Appendix F.

TABLE 3.5

COMPARISON OF GRADING COST BY HAND AND MACHINE*

Grading cost per cwt. (cents)	NUMBER OF FARMS	
	Hand grading	Machine grading
6.0 - 9.0	-	4
9.1 - 12.0	-	9
12.1 - 15.0	2	6
15.1 - 18.0	-	4
18.1 - 21.0	3	1
21.1 - 24.0	-	1
24.1 - 27.0	-	-
27.1 - 30.0	2	-
30.1 - 33.0	2	-
33.1 - 36.0	-	-
36.1 - 39.0	-	-
39.1 - 42.0	1	-
42.1 - 45.0	1	-
Total:	11	25

*Source: Appendix F.

In other words, there was a difference of 12.9 cents per hundredweight. To test the significance of the difference between these two means, the following formula was used:

$$t = \frac{\bar{Y}_1 - \bar{Y}_2}{S_{\bar{Y}_1 - \bar{Y}_2}}$$

where $\bar{Y}_1$ = 26.5 cents, the simple average cost of grading by hand;

$\bar{Y}_2$ = 13.6 cents, the simple average cost of grading by machine;

$S_{\bar{Y}_1 - \bar{Y}_2}$ = standard error of difference between means $\bar{Y}_1$ and $\bar{Y}_2$.

$S_{\bar{Y}_1 - \bar{Y}_2}$ was calculated as follows:

$$S^2 = \frac{\Sigma\ y_1^2 + \Sigma\ y_2^2}{n_1 + n_2 - 2} \quad \text{where } n_1 = 11,\ n_2 = 13,\ y_1 = Y_1 - \bar{Y}_1,\ y_2 = Y_2 - \bar{Y}_2$$

$$= \frac{1014.60 + 248.56}{11 + 13 - 2}$$

$$= 57.42$$

$$S^2_{\bar{Y}_1 - \bar{Y}_2} = \frac{57.42}{11} + \frac{57.42}{13}$$

$$= 9.63$$

$$S_{\bar{Y}_1 - \bar{Y}_2} = \sqrt{9.63} = 3.1$$

$$t = \frac{26.5 - 13.6}{3.1} = 4.16$$

At 5% level of significance, the table value of t = 2.07, which is less than our calculated t value of 4.16 means our calculated t = 4.16 is significant at 5% level. This suggests that the difference of 12.9 cents per hundredweight between hand and machine grading is quite significant. If the differences in the costs for these volume ranges in the sample are any indication of the differences for the population, it would seem that machine grading is more economical than hand grading.

Also, as remarked earlier, grading by machine is twice as fast as that by hand in terms of volume graded per hour (see Table 3.3) and the output of higher grades by machine is more by than that obtained by hand grading (see Appendix E). With this information, we accept our minor hypothesis, viz: on-farm grading with the aid of mechanical graders is more economical than hand grading.

Having accepted our minor hypothesis, we are now in a position to analyze another related question, viz., How much crop will justify the purchase of a grading machine?

The size of crop necessary to justify the purchase of a grading machine

A mechanical grader has a high initial purchasing cost. There is a considerable annual fixed cost involved due to depreciation (including obsolescence), interest and repairs, no matter how large or small the crop is. According to the information collected from the growers included in the study, the annual fixed cost of a grading machine is about 15% of the original purchasing cost. The average original cost of a machine estimated from the costs of machines used by growers in the study comes to $1,650 (see Appendix G). Thus the annual fixed cost at 15% would be $247.50. Since the weighted average grading cost by hand according to calculations shown earlier is 23 cents per hundredweight (see Appendix F), obviously a farmer considering the purchase of a grading machine will have to have a sizeable volume of crop in order to spread the annual fixed cost of the machine for an economical use. The formula suggested given below [6/] may be helpful in estimating the minimum volume of crop which a

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[6/] The formula was used by Downing, et. al., in a study on potato harvesting costs to estimate the size of crop necessary to make an economical use of a harvesting machine. For details, see L. J. Downing, et. al., Potato Harvesting Cost by Hand and by Machine in the Red River Valley, Agricultural Economics Report No. 7; North Dakota Agricultural College Agricultural Experiment Station, Fargo, North Dakota, April, 1953, pp. 12-14.

farmer must have for grading in order to justify the purchase of a grading and packaging machine.

$$X = \frac{\alpha \ M}{H - D}$$

X = hundredweights of crop necessary to justify machine grading

α = estimated coefficient for annual fixed cost

H = cost by hand grading per hundredweight

D = direct cost per hundredweight with machine

According to the formula, X, i.e., the number of hundredweights per year necessary to justify the purchase of a grading machine, equals α times the original cost of the machine, M, i.e., .15 x $1,650, divided by cost of hand grading per hundredweight minus the direct cost per hundredweight by machine, i.e., H - D. The rationale involved in the formula is that if the annual fixed cost of the grading equipment is less than the annual saving realized through the difference in direct cost between hand grading and machine grading, machine grading will prove more profitable. Since by definition the total direct costs would vary with the variation in the volume graded, while fixed cost would not, there must be some volume of potatoes below which hand grading is cheaper and above machine grading is cheaper. The formula given above can be helpful in roughly estimating where the optimum volume is likely to lie. In the following paragraph, an example is given to illustrate the use of the formula.

The average cost of the machine for our sample is $1,650, and α is .15. The weighted average grading cost by machine is 11.80 cents per hundredweight (see Appendix F). Since this figure includes both direct and fixed costs, a sum of 1.38 cents per hundredweight was deducted as a fixed cost (see Appendix G) in order to get the direct cost of machine which comes to 10.42 cents per hundredweight. The weighted average

grading cost by hand, H, is 23 cents per hundredweight (see Appendix F). Substituting these figures in the formula,

$$X = \frac{0.15\ M}{H - D}$$

$$= \frac{0.15 \times \$1,650}{23¢ - 10.42¢}$$

$$= 1,967 \text{ hundredweights.}$$

With an average yield of 81 hundredweights per acre (see Table 2.1, p.19), the minimum number of acres of potatoes justifying machine grading would be $\frac{1,967}{81}$ = 24 acres (approximately).

It should be kept in mind that the optimum volume of X estimated above is based on the use of averages for the entire study. For any individual farmer, therefore, the figure will necessarily differ depending upon the annual average fixed cost of machine, and the acreage yield for the individual farm under consideration.

B. GRADING COST AT WHOLESALE LEVEL

With our earlier assumption that all the wholesalers grade their potatoes at the rate of 75-pound bags per hour, the grading cost per hundredweight has been worked out and shown in Appendix H. These calculations are for potatoes which require regrading at the wholesale level. A great variation in wholesale grading cost is exhibited within the various volume groups. The volume graded varied from 27,500 to 335,610 hundredweights and the grading cost ranged from 8.6 to 17.1 cents per hundredweight with an average of 13.3 cents. The largest grader of 335,610 hundredweights had a unit grading cost of 11.4 cents, while the smallest, with 27,500 hundredweights, had a unit cost of 13.8 cents. The highest single unit cost of 17.1 cents was found in the case of a

firm grading 83,696 hundredweights and the lowest unit cost of 8.6 cents was associated with a volume of 94,900 hundredweights.

The variations in grading costs between firms are largely attributable to some of the factors already discussed 7/ (i.e., difference in rate of grading, depreciation, repair cost, management and quality of potatoes, etc.). However, it may be pointed out here that the firm with the lowest grading cost had the lowest total fixed costs, and its grading rate was higher in comparison to others. On the other hand, the firm with the highest unit grading cost had the highest total overhead costs. In addition to the factors discussed earlier, the following factors also seem to affect the grading and packaging cost at the wholesale level:

First, the capacity at which the plants were operating had an effect upon costs. Firms operating for short seasons had higher average grading costs than those which operated for longer seasons. The effect of this factor was observed especially in the case of fixed-cost items, such as repairs, depreciation and interest. Firm number 46, for example, with very high repairs and depreciation costs, operated below capacity during the major part of the year. This resulted in high grading costs as compared with the other wholesale firms.

Second, the cost of grading was affected by the shape and quality of potatoes the firm received from the growers. Exact statistics are not available on this point, but on the basis of personal interviews with some of the wholesalers, the general observation is that firms receiving potatoes with higher percentage of grade defects and long-shaped varieties had higher labour costs in grading, which resulted in

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7/ See manuscript, pp. 65-67

higher total grading costs.

Third, some firms in our sample followed the policy of grading the potatoes more accurately than others in relation to the legal requirements.

Finally, firms supplying several grades and types of packaging had higher handling costs than those supplying potatoes in fewer grades and types of packages.

Comparison of grading costs between farm and wholesale levels

The simple average grading cost at the wholesale level comes to 13.3 cents per hundredweight (see Appendix H). This unit cost has been derived for re-grading those potatoes which have been previously graded at the farm level. Hence this figure cannot be compared with the grading cost at the farm level. The central question involved in obtaining a comparable measure is: What would be the grading costs at the wholesale level were the wholesalers to receive absolutely ungraded potatoes from the farmers? The procedure used in answering this question is outlined below.

It was assumed that the wholesalers receive only ungraded potatoes. An allowance was then made for the fact that the percentage of culls in the ungraded potatoes received by the wholesalers would be higher than would be the case had the wholesalers received potatoes which had been partially graded at the farm. From Table 3.3., the average percentage of culls in the total yield of potatoes graded by machine at the farm level was calculated, which came to 16%. Accordingly, it was assumed that the potatoes received by the wholesalers contained 16% culls. For purposes of initial calculations, it was also assumed that the grading machines used by the wholesalers were comparable to the grading machine (L),

for which the elasticity of grading (E_g) has been calculated earlier in this chapter. It would be recalled that E_g for machine L is equal to -.69 (see p.62), meaning that for every one percent increase in culls, the grading rate per man-hour falls by 52 pounds (i.e., .69 x a 75-pound bag).

In the second step of our calculations, the above figures had to be adjusted to allow for the fact that the grading machines used by most of the wholesalers were slightly larger than machine (L), and that their labour-use and general layout of the grading units were, generally speaking, more efficient than those of the farmers. To make some allowance for this efficiency differential, the value of E_g used for our cost calculations was -.60 instead of -.69, i.e., a 45-pound decrease (.60 x a 75-pound bag) rather than a 52-pound decrease in the grading rate per man-hour for every one percent increase in the culls.

On this basis, the rate of grading per man-hour for every wholesaler was reduced according to the difference in the percentage of culls (between previously graded and ungraded potatoes) as shown in Table 3.6.

Grading at the rates shown in Table 3.6 will increase not only the labour costs, but also the consumption of light and power. Accordingly, even though the overhead costs would remain the same, direct costs will increase. The grading cost structure of each firm resulting under the new situation is shown in Appendix I. According to this, the simple average grading cost (by machine) for a wholesale firm comes to 17.8 cents per hundredweight, compared to an average grading cost of 12.4 cents per hundredweight (by machine) at the farm level. The weighted average grading cost per hundredweight of salable graded potatoes comes to 19.0 cents at the wholesale level (see Appendix I), compared to 14.1 cents per hundredweight at the farm level (see Appendix F).

TABLE 3.6

GRADING RATE AT THE WHOLESALE LEVEL

Firm No.	% of defects in farmers' grading received by wholesaler	Volume re-graded per man-hour (bags of 75 pounds)	Volume graded per man-hour at 16% culls in the total volume received (bags of 75 pounds)
43	3	16.5	8.8
45	6	16.7	10.7
44	2	20.7	12.3
47	10	16.7	13.1
40	1	20.7	11.6
46	5	20.5	14.0
42	7	16.5	11.2
Average:	5	18.3	11.7

At this point, another adjustment to these cost comparisons is in order. Every farmer, while packing 75-pound bags, adds a few extra pounds of potatoes towards scale loss (which is a trade practice) in order to compensate for weight losses due to shrinkage. Consequently, the scale loss must be added to the grading costs of the farmers in order to get valid cost comparisons. The value of the extra quantity of potatoes added to compensate for scale losses has been calculated at two cents per pounds, and the total cost, viz., grading cost plus the cost of scale loss, is shown in Appendix J. The scale loss on an average comes to two cents per hundredweight. On the basis of this calculation, the average grading cost at the farm level amounts to 14.4 cents (12.4 plus 2 cents) per hundredweight as against 17.8 cents per hundredweight at the wholesale level. 8/

8/ In making this comparison, it may be pointed out that some wholesalers may raise objection to the accuracy of grading at the farm

On the basis of this information, we are now in a position to test our major hypothesis (Chapter 1, p. 6), that grading potatoes at the farm level is more economical than at the wholesale level. This can be done by testing the significance of the difference in the two means, viz., 17.8 - 14.4 = 3.4. This is done below:

$$t = \frac{\bar{Y}_1 - \bar{Y}_2}{S_{\bar{Y}_1 - \bar{Y}_2}}$$

where $\bar{Y}_1$ = 17.8 cents, the simple average cost of grading by machine at the wholesale level;

$\bar{Y}_2$ = 14.4 cents, the average cost of grading by machine and the cost of scale loss at the farm level;

$S_{\bar{Y}_1 - \bar{Y}_2}$ = the standard error of difference between the two means of $\bar{Y}_1$ and $\bar{Y}_2$;

$S_{\bar{Y}_1 - \bar{Y}_2}$ was calculated as follows:

$$S^2 = \frac{\Sigma y_1^2 + \Sigma y_2^2}{n_1 + n_2 - 2} \quad \text{where } n_1 = 7,\ n_2 = 25,\ y_1 = Y_1 - \bar{Y}_1,\ y_2 = Y_2 - \bar{Y}_2;$$

$$= \frac{67.76 + 372.55}{7 + 25 - 2}$$

$$= 14.68$$

$$S^2_{\bar{Y}_1 - \bar{Y}_2} = \frac{14.68}{7} + \frac{14.68}{25}$$

$$= 2.69$$

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level. However, it may be noted that for such deficiencies, a scale loss at 2 cents per hundredweight has been allowed in the analysis. It should also be noted that 33% of the potatoes graded and delivered by farmers in 75-pound bags were sold as such without any regrading by wholesalers to retailers and packers. Only in cases where wholesalers had to do pre-packaging into consumers' bags was some regrading at the wholesale level necessary. In the light of these factors, the error involved in the cost comparison is not considered to be too serious.

$$S_{\bar{Y}_1 - \bar{Y}_2} = \sqrt{2.69} = 1.6$$

$$t = \frac{17.8 - 14.4}{1.6} = 2.12.$$

Our calculated t value of 2.12 is greater than the Table t value of 2.04 with 30 degrees of freedom at 5% level of significance. Therefore, our calculated t value, 2.12, is significant at 5% level. On the basis of this, our major hypothesis is accepted at 5% level of significance, suggesting that grading potatoes at the farm level is more economical than at the wholesale level.

The above conclusion requires further comments and elaboration. It will be recalled that the comparative grading costs were estimated for a hypothetical case where the question posed was: What would be the average grading cost (1) if the entire grading work was done by the farmers themselves at the farm level, or (2) if the farmers transported ungraded potatoes in 75-pound bags to the wholesale market and the wholesalers did the entire grading work there? The cost figures for these two alternatives, as we noted, came to 14.4 cents and 17.8 cents per hundredweight at the farm and the wholesale level, respectively.

However, the 17.8 cent figure for the wholesale level does not represent a full measure of the marketing cost to the farmer if he were to haul completely ungraded potatoes in 75-pound bags to the wholesale market. The farmer in this case will also have to bear the expenses for cost of bags and the stitching material, labour charges for packing the culls, and finally, the transportation cost of the culls.

In estimating the cost of bags, an old jute bag was valued at 10 cents. As to the packing costs, an estimated rate of 30 bags per man-hour was used in our calculations. The labour costs involved were computed on the basis of the prevalent rate of 75 cents an hour. The

cost of ties and tags were estimated as $4.00 per 1,000 tags and ties. On this basis, the cost of the bags and the packaging costs per hundredweight have been calculated and shown in Appendix K. The average cost of packing and transporting culls for farmers located at different distances from the market has been calculated from Appendix K, and is shown in Table 3.7.

From the cost calculations shown in Table 3.7, it is clear that, on an average, a farmer located in the crop regions included in this study will have to bear an expense of 36.2 cents per hundredweight for packing and transportation of culls. But since only 16% of culls (see Table 3.3) is involved in any given hundredweight of the gross product, he will have to bear only 16% of the 36.2 cents cost per hundredweight of the salable product. However, to get the appropriate amount of this cost which can be added to the grading cost at the wholesale level, we first have to determine the <u>gross</u> volume of ungraded potatoes containing 16% culls, that a farmer will have to haul to end up with 100 pounds of <u>salable</u> graded potatoes. This is shown below:

Suppose X is the volume of ungraded potatoes,

$$\therefore X - .16X = 100 \text{ pounds of graded potatoes}$$

$$\therefore .84X = 100 \text{ pounds}$$

$$X = \frac{100}{.84}$$

$$= 119.05 \text{ pounds of ungraded potatoes.}$$

Thus, at 16% cull rate, a farmer will bear 16% x 36.2 cents x $\frac{119.05}{100}$ = 6.9 cents towards the cost of packing and transporting culls per hundredweight of graded potatoes. Recalling that the farmer has also to pay an additional sum of 19.0 cents per hundredweight of salable

TABLE 3.7

TRANSPORTATION AND PACKING COSTS OF CULLS PER HUNDREDWEIGHT FOR VARYING FARM DISTANCES TO THE WINNIPEG MARKET

Mileage Group	Transportation Cost (cents)	Cost of bag and packaging (cents)	Total Cost (cents)
0 - 20	14.4	17.0	31.4
21 - 40	17.0	17.0	34.0
41 - 60	23.3	17.0	40.3
61 - 80	21.8	17.0	38.8
81 and over	19.5	17.0	36.5
Average:	19.2	17.0	36.2

potatoes to the wholesaler for his (wholesaler's) grading services, the total cost of the farmer amounts to 25.9 cents (19.0 plus 6.9) per hundredweight of salable potatoes. Against this, his cost of grading per hundredweight of graded potatoes is 14.1 cents (see Appendix F) plus 2 cents as scale loss (see Appendix J), totalling to 16.1 cents.

Two important exceptions to the validity of our cost calculations for the above situation may be noted here: (1) one may ask why must the farmer haul potatoes in 75-pound bags, and, instead, why not transport them in bulk, thereby saving the cost of the bags and packing expenses, particularly when we know that the wholesaler will have to unload and repack the potatoes after grading into appropriate sized consumer bags? and (2) why must we assume an "either-or" situation where either the entire grading is done at the farm level, or absolutely ungraded potatoes are hauled to the wholesale level for complete grading there? In other words, why not analyze the cost implications of a situation where the farmer may do partial grading at the farm, keep for on-farm use the

potatoes bruised or mechanically injured while picking at harvest time, and haul the partially graded potatoes in bulk? Both these questions are valid, and in order to test the validity of our conclusion that on-farm grading is more economical than wholesale grading, we must develop comparative grading cost estimates for both the situations separately.

In the first case, where farmers may haul completely ungraded potatoes in bulk rather than in 75-pound bags direct from the field, packing costs and the cost of bags would be saved, but the farmer will still have to incur the cost of transporting culls in addition to paying 19.0 cents per hundredweight of graded potatoes (see Appendix I) as grading charge to the wholesaler. The cost of transportation of culls per hundredweight for farmers located in various mileage groups from Winnipeg, and other pertinent costs for this situation have been calculated and shown in Appendix K. A summary of these costs is also presented in Table 3.8.

Table 3.8 shows that a farmer will have to bear, on an average, 19.2 cents per hundredweight as the cost of transportation of culls. Since only 16% culls (see Table 3.3) is involved for machine grading in the total gross product, he will actually bear 16% of 19.2 cents x $\frac{119.05}{100}$, i.e., 3.7 cents per hundredweight of salable potatoes. The total cost to the farmer would amount to 22.7 cents (19.0 plus 3.7) per hundredweight of graded potatoes. Since the difference between the farm grading cost at 16.1 cents and the wholesale grading cost at 22.7 cents per hundredweight is significant, our conclusion as to the economic optimality of the on-farm grading still holds good.

Under the second situation, partial grading is done on a field run basis, and these partially graded potatoes are hauled in bulk (but

TABLE 3.8

COST OF TRANSPORTATION OF CULLS AND GRADING COST PER HUNDREDWEIGHT OF GRADED POTATOES AT THE WHOLESALE LEVEL

Mileage Group	Cost of Transportation of culls (cents)	Grading cost (cents)	Total cost to be borne by farmer (cents)
0 - 20	14.4	19.0	33.4
21 - 40	17.0	19.0	36.0
41 - 60	23.3	19.0	42.3
61 - 80	21.8	19.0	40.8
81 and over	19.5	19.0	38.5
Average:	19.2	19.0	38.2

mechanically damaged potatoes are kept on the farm). Here, in addition to the saving on packing costs and the cost of bags, the farmer would also be able to realize some savings on the transportation of culls because of the lower percentage of culls involved in partially graded potatoes. However, a factor which will partially offset these savings would be the cost of culling involved in on-farm partial grading. We had five farmers in our survey who sold their produce according to this method. The estimated cost of culling in the case of these five farmers came to approximately 20% of the total labour cost of picking, culling and bagging. On this basis, the cost of culling per hundredweight has been worked out and is shown in Table 3.9 below. Under this situation, a farmer, on the average, incurs a cost of 5.8 cents per hundredweight for culling out potatoes in the field in addition to paying 12.8 cents per hundredweight of graded potatoes (see Appendix H) to the wholesaler for re-grading the potatoes into different grade sizes at the wholesale level. Thus, altogether he has to bear an expenditure of

TABLE 3.9

CULLING COST PER HUNDREDWEIGHT AT FARM LEVEL
ON FIELD RUN BASIS

Farm No. (1)	Volume (cwts) (2)	Total cost of labour for picking, culling & bagging ($) (3)	COST OF CULLING PER CWT. IN CENTS OF CULLED POTATOES AT 20% of Total cost (4)	50% of Total cost (5)
20	6,000.0	1,600.00	5.3	13.3
19	5,479.8	2,045.68	7.5	18.7
26	1,365.0	368.54	5.4	13.5
21	2,625.0	670.80	5.1	12.8
30	6,648.0	1,768.36	5.3	13.3
Total:	22,117.8	6,453.38	28.6	71.6
Average:	4,423.5	1,290.68	5.7	14.3
Wtd. Av.:	-	-	5.8	14.6

18.6 cents (5.8 + 12.8) compared to only 16.1 cents per hundredweight of graded potatoes if he were to grade his produce on the farm with the aid of mechanical graders.

At this point, it may be helpful to summarize our cost analysis for all the four situations discussed above. This is done in Table 3.10 per hundredweight of graded potatoes. In comparing the above situation it may be seen (Table 3.10) that the complete on-farm grading cost (situation No. 4) at 16.1 cents per hundredweight of graded potatoes is significantly lower than the grading costs involved in situations No. 1 and No. 2. However, the difference between grading costs (2.5 cents) for situations No. 4 and No. 3 is not significant. Nevertheless, it should be kept in mind that all the culls and "B" type potatoes are more fully utilized in situation No. 4 than in situation No. 3, where all "B" type potatoes are left

TABLE 3.10

POTATO GRADING COST STRUCTURE AT FARM IN DIFFERENT SITUATIONS

Situations	PER HUNDREDWEIGHT OF GRADED POTATOES IN CENTS						
	Culling cost	Cost of transportation of culls	Cost of transportation of culls, bags and packaging cost	Grading cost at the wholesale level	Grading cost at the farm level	Scale loss	Total cost borne by farmer
(1) Hauling ungraded potatoes from storage packed in 75-pound jute bags	-	-	6.9 a/	19.0 b/	-	-	25.9
(2) Hauling ungraded potatoes direct from the field in bulk	-	3.7 c/	-	19.0	-	-	22.7
(3) Hauling partially graded potatoes in bulk on field run basis	5.8 d/	-	-	12.8 e/	-	-	18.6
(4) Hauling graded potatoes from storage in 75-pound jute bags	-	-	-	-	14.1 f/	2.0 g/	16.1

Source: a/ p.80 b/ Appendix I c/ p.82 d/ Table 3.9 e/ Appendix H f/ Appendix F
g/ Appendix J

unpicked in the field. If all the culls and "B" type potatoes were picked up in situation No. 3, our calculations show (see Table 3.9, column 5) that the culling cost would amount to 14.6 cents per hundredweight instead of 5.8 cents per hundredweight (see Table 3.9, column 4), calculated on the basis of picking up only better than "B" type potatoes.

Further, time is an important factor in deciding the choice between hauling partially graded potatoes direct from the field and graded potatoes from the storage. It is gathered that farmers in a majority of cases find no time to haul potatoes direct from the field as they remain pretty busy in the operation of other crops. Thus our conclusion regarding the optimality of grading at the farm level does not change.

On the basis of the above analysis, and in view of the fact that opportunities to use culls are better on the farm than at the wholesale plant, the conclusion, once again, is that the optimum location of grading potatoes under the present marketing set-up in Manitoba is at the farm level rather than at the wholesale level.

CHAPTER 4

POLICY IMPLICATIONS, SOME RELATED ISSUES, AND SUGGESTIONS FOR FURTHER RESEARCH

Our analysis of grading costs, thus far, has shown that the grading function for potatoes can be performed more economically at the farm level than at the wholesale level. An important, and perhaps the obvious, policy implication of this conclusion is that since any reduction in marketing costs to the farmer should, ceteris paribus, result in higher net returns to him, serious consideration should be given to the possibility of changing the present costly grading arrangements in favour of the more economical system, where farmers will do their own grading. The desirability of such a change assumes an added importance in view of the fact that eventually the reduction in grading and other marketing costs may in part also benefit the consumer in the form of reduced potato prices for given quality grades. 1/ This broad policy implication, however, raises some related issues of practical importance, which are discussed below.

Two of the important assumptions underlying our analysis, as it will be recalled, were (1) that packaging the graded potatoes into appropriate sized consumer bags and their labelling are functions of the wholesalers, and (2) that most of the farmers sell their produce through

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1/ The exact amount of this retail price benefit will, of course, depend upon the price and income elasticities of demand and supply of potatoes.

wholesalers, whether the potatoes are to be sold within Manitoba or outside of Manitoba.

These two assumptions, on surface, would seem to limit severely the scope of the change recommended in the present grading system. In light of the first assumption, one may argue that separation of the basic grading function from the other related functions (washing, labelling, and packaging into different-sized consumer bags) may result in increased cost of performing just these related functions at the wholesale level, because some important joint economies of performing the entire sequence of grading and packaging at one location may be lost under the changed system. Consequently, one may further argue, unless the reduction in the basic grading costs either outweighs the increase in the cost of the related grading and packaging functions, or the related functions can also be performed at the farm level, a mere reduction in the basic grading costs need not necessarily warrant the implied change in the present grading system.

The scope and time limitations of this study do not permit testing the validity of the above argument in detail. However, even if, for the sake of argument, it is granted that a consolidated performance of all the grading and packaging activities at one place is, on the whole, more economical than a divided and split arrangement, the implication of the argument, that the present arrangements should continue, does not necessarily follow. For, the pertinent questions would then be: If a consolidated grading function is relatively more economical, is it feasible to consolidate the grading and packaging functions at the farm level? And, if so, will the on-farm consolidation of grading be more or less economical than a similar consolidation at the wholesale level?

To answer the above question, we examined the grading facilities of those farmers in our sample who were as well equipped as the wholesalers are to perform the handling, washing, brushing, pre-packaging, and other related grading work. Cost estimates were developed for these grading activities and compared with the corresponding cost estimates for similar activities at the wholesale level. These comparative estimates are given in Appendix L, and a summary of the results is presented in Table 4.1 below.

The Table shows that, for almost every consumer-size bag, grading and packaging costs are significantly lower at the farm level than at the wholesale level. This would seem to give further support to our policy recommendation for a change in the present grading system. If both the basic grading costs and the costs of packaging and labelling, etc., can be lowered through on-farm consolidation of grading activities, such a consolidation would seem highly desirable from the standpoint of economic efficiency.

This, however, establishes only the <u>desirability</u> of such a change on economic grounds, but does not, in itself, prove or disprove the <u>feasibility</u> of the recommended change. And this brings us to the issues related to the second assumption that most of the farmers sell their produce through the wholesalers. Since this assumption is quite realistic in the present marketing system, at least two important reservations are possible with regard to the feasibility of the recommended on-farm consolidation.

First, it might be argued that wholesalers play an important role in the present agricultural marketing complex. They provide a crucial link between the consumer and the producer by performing the difficult

TABLE 4.1

COMPARATIVE COST OF GRADING ON PACKAGE BASIS
AT THE FARM AND WHOLESALE LEVEL
(CENTS PER HUNDREDWEIGHT)

Size of bags (pounds)	DRY		WASHED	
	Farm	Wholesale	Farm	Wholesale
5	-	33.5	35.5	45.9
10	22.7	21.3	22.3	29.7
25	12.0	15.6	18.8	24.9
50	8.2	16.2	13.5	23.9

task of gauging and interpreting the market for the farmer in terms of needs and preferences of the consumer which are continuously changing with time. In the case of potatoes, e.g., Holms notes that a Manitoba housewife wants potatoes of uniform size and quality, which are easy to clean, attractively packed and displayed, with easy-to-follow storage and cooking directions written on the package, and are easy to cook. 2/ So, one might wonder if the farmers can read the market and perform the required grading and packaging functions as effectively as the wholesalers can.

Second, and perhaps the more important reservation about the possibility of the recommended on-farm consolidation, stems from the problem of "Quality Control." Even if the farmers could read the market and do the grading and packaging work as effectively as the wholesalers can, will it be possible to administer the quality control and the related inspection programme as efficiently under the new system,

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2/ Shirley Holms, "Can You Help us to Promote Manitoba Produce?" Proceedings of Ninth Annual Convention, Vegetable Growers' Association of Manitoba, Winnipeg, January, 1962, pp. 69-70.

where the consolidated grading work will be so widely dispersed over the potato-producing areas, as is possible under the present system where the inspection has to be exercised at much fewer (wholesale) points? An effective and honest operation of the quality control programme, to be sure, is extremely important not only for ensuring that potatoes supplied for local (Manitoba) consumption are of a quality high enough to meet competition from potatoes imported into Manitoba, but also to ensure that Manitoba potatoes can stand competition in external markets.

Reservations and difficulties involved in the above-posed problems are both quite important and serious, but not insurmountable. Two considerations seem to provide hopeful answers which point toward the feasibility of the recommendations made in this study. The first of these relates to the suggestion made by Peters for the establishment of potato grading stations. Under this scheme, a qualified wholesaler (or first receiver who had premises that were satisfactory from the standpoint of sanitation) who had adequate space, washing, grading and storage facilities to handle the produce, and, in addition, had some cold storage facilities, could apply to the "board" for a license to set up a Registered Grading Station. This board, made up of one member from the Department of Agriculture, one member of the Inspection Branch, and one health officer, would visit the premises and decide the eligibility of the concern, taking into consideration the physical requirements and also the past record, if any, of this establishment in the field of grading. These grading stations will not only enable the enforcement staff to exercise inspection more satisfactorily than is possible under the present situation, but will also achieve the much-cherished goal by growers, traders, and consumers; namely, supply of

dependably-graded Manitoba produce to the market at all times. 3/

The second consideration relates to some of the important market-structure trends which have been developing in the food distribution system of the Canadian and American economy as a whole during the past ten to fifteen years. Included among these trends are the expanding size and importance of the food retailing chains and the concomitant decline in the importance of the independent wholesalers. As Professor Mehren relates:

> In a rapidly-expanding economy, there has been a steady increase in the relative volume sold through retailers, a correlative long-run relative decline in sales through wholesalers, a stable relative mark-up by wholesalers, an increasing retail mark-up as volume and services performed at retail have increased, and a long-run increase in the combined wholesale-plus-retail mark-up. The apparent relative decline in the wholesaling volume to a large measure merely reflects the absorption of wholesaling functions by retailers. 4/

The statement is easily corroborated by the significant increase in the scale and number of large supermarkets in our food distribution complex during recent times. In the U.S.A., for example, supermarkets, with annual gross sales of at least $375,000 per outlet, increased from 4.4 to 8.7 percent of all stores between 1952 and 1956. Their share in all grocery-store sales went up from 43.8 to 62.8 percent during the same period. This meant, as Mehren points out, that less than nine percent of the stores were moving more than 62 percent of the total

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3/ For further details, see P. J. Peters, "A New Approach to Grade Control for Manitoba Vegetables," Proceedings of Seventh Annual Convention, Vegetable Growers' Association of Manitoba, Winnipeg, 1960, pp. 56-59.

4/ George L. Mehren, "Marketing Co-ordination and Buyers' Requirements," Policy for Commercial Agriculture--Its Relation to Economic Growth and Stability, Paper submitted by panelists appearing before the Subcommittee on Agricultural Policy (United States Government Printing Office, Washington 25, 1957), p. 284. This Paper provides an excellent description and analysis of the structural changes prevalent in the food distribution system and their implications for agricultural producers in the American economy as a whole.

United States sales in the grocery business. Within this supermarket group, no doubt, there has been some change in the relative market position of chain stores and independent units. In the United States, e.g., even though the relative increase in the number and volume of sales of independent stores was relatively faster, chain stores still did a little more than half of the 62.5% of total grocery business done by supermarkets. 5/ The advantage of owning several outlets by a chain store such as Safeway in any given market very likely gives a differential advantage to the chain store in its buying power.

However, "the issue is not," as Mehren puts it, "chain versus independent. The issue is that a few large retailers in all parts of the United States comprising less than one-tenth of stores are doing almost two-thirds of the business." 6/ Like the small farmer, the "papa-mama" grocery is also on its way out. And these structural changes in the number and operative scale of the retailing unit, especially the supermarkets, have important implications for the relative strengths and correlative merchandising policies of the wholesaling and the food retailing chains. Due to the increase in their size, many of the big retail stores such as Safeway are in a position to develop a complete enterprise policy. They can use practically all the physical efficiencies. Consequently, they have been able to either absorb wholesaling functions and facilities by developing their own promotion, procurement, and merchandising facilities or they have become affiliated with wholesalers. This has been done through a variety of formal contractual arrangement,

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5/ Ibid., pp. 284-285.

6/ Ibid., p. 285.

including different types of integration, and through formal co-ordination amongst suppliers. An important effect of these arrangements "has been a correlative decrease in the effectiveness of pricing, branding, and promotion policies among many of their (retail stores') suppliers." 7/ Thus, the role of the independent wholesalers in the modern agricultural marketing system has been on the decline and holds little prospect in the future in view of the projected expansion of the economic system as a whole.

If the past and present trends, therefore, are any indicator of the future, there is good reason to believe that as the retailing units grow bigger, even more of them will try to take over the wholesaling functions and develop closer and more direct co-ordination with the producer and/or the processor in order to meet the ever-growing challenge posed by the fierce competition between chains and the continually-changing nature of buyers' requirements. These trends, it must be noted here, even at the risk of emphasizing the obvious, are not unique or peculiar to the United States. They are, to some extent, also noticeable in the Canadian economy. Taking over of a good many wholesaling functions by processors, like Old Dutch, Hunter's, etc., illustrates the point. Promotion of their own brands, and other merchandising and procurement policies by some of the supermarkets, such as the Safeway and A. & P., are illustrative of similar trends. Also, production of potatoes under contract farming has been on the increase. There are some indications of the decline in the percentage of potatoes being channeled through wholesalers. During 1944-45 in Winnipeg, e.g., it was observed that

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7/ Ibid., p. 283.

69.5% of the total marketable surplus was delivered to wholesalers 8/ and our present study (1961-62) reveals that the proportion of production sold to the wholesalers had declined slightly to 67.5%. 9/ This seems to be due to the trend toward contract farming which is developing in Manitoba. 10/ It was ascertained from the Manitoba Department of Agriculture that in the year 1960 about 800 acres of potatoes were produced by growers under contract with processors. The figure increased to 4,500 acres in the year 1961, and the same acreage was also contracted in the year 1962.

All these trends and changes, to wit, increase in the size of the supermarket, the ensuing direct contractual arrangements and closer co-ordination among the producers, processors, and growers, and the resultant decline in the importance of the independent wholesalers, it would seem, will facilitate, if not necessitate, rather than impede consolidation of the grading and packaging facilities at one location. And if, as our cost analysis suggests, such costs are lower at the production locale than at the wholesale level, it stands to reason that any rational form of food-business enterprise should accept and favour a system which is economically efficient, institutionally feasible, structurally logical, and currently already in the offing.

8/ R. S. Elliot, et al., op. cit., p. 24.

9/ Manuscript, p. 46 (for comparative analysis with Elliot's figure, the percentages under own seed, sold as seed, farm consumption, waste and culls have been excluded, and the other items in Table 2.10 have been modified accordingly.)

10/ It is conceivable that the establishment of Carnation Simplot at Carberry, Manitoba, may have played a significant role in contributing to the trend toward contract farming. Whatever the cause, however, the point to be made is that acreage under contract farming seems to be increasing.

Some suggestions for further research

The purpose of this study has been to determine a location where the costs of grading and packaging the potatoes would be minimum. Since the ultimate object of any such cost reduction is to increase the farmer's net returns, this study, it is hoped, has provided some useful information pertinent to the problem of improving the profit position of potato growers. It should be stressed, however, that due to time, data and scope, limitations of this study, several important aspects, implicit and explicit in our conclusions and recommendations, could not be either explored at all or to a sufficient degree of detail. Consequently, many further research studies are in order, both as a follow-up on this study with a view to testing and/or improving the validity of conclusions reached here and as independent inquiries in the related cost and profit determining factors in regard to potato cultivation.

(1) Our study reveals that farmers use various methods and types of equipment for harvesting potatoes. Mechanical injuries and other type of damages which occur during the process of harvesting affect the appearance of potatoes, cause waste, and hasten decay and increase the paring loss. For our sample study, it was estimated that on the average, the use of mechanical harvesters resulted in as much as 26.3% cut and damaged potatoes; whereas, the percentage of damaged potatoes was lower (14%) with the use of diggers.

Since a high percentage of cut or injured potatoes through mechanical harvesting means higher labour cost in grading, a careful study is necessary to determine the relationship between the proportion of injured potatoes and the rates of output (in terms of harvesting and picking) associated with different types of equipment. A study of this

relationship will be helpful in determining the use of optimum harvesting technology for use in potato production. Such an optimum, no doubt, will have to be determined in the over-all context of the soil and climatic conditions and the considerations relevant to the control of harvester's depth of operation with a view to minimizing the damage, and maximizing the recovery of potatoes, and finally, the regulation of travel and apron speed of the harvester.

(2) In addition to the problem of choosing the most appropriate harvester, growers have also faced the problem of deciding the most appropriate variety of potatoes to be grown, and the related problem of the quantity and quality of fertilizer to be used for the variety chosen, so that both the potato variety and the fertilizer variety are suitable to their soil conditions. Research on potato production cost associated with different soils designed to determine the optimum potato enterprise in conjunction with suitable fertilization, irrigation (where possible) and cultural practices will be extremely useful to the farmers.

Information provided by both the above studies will throw considerable light on grading rates and percentage of culls associated with different production techniques and technologies, and will thus add to the precision of grading cost analysis developed in this study.

(3) As we have noted earlier in this chapter, there has been an increasing tendency toward contract farming by potato growers. In this situation, a farmer under contract may shift some of the important marketing functions like grading and warehousing to the processors. Alternatively, it is equally conceivable that the processors may encourage, if not require, the grower to grade and even condition potatoes. In fact, Old Dutch, e.g., prefers, it is gathered, to have their growers grade,

condition, and deliver potatoes upon notice. The farmer's decision to produce under contract farming or independently will presumably depend upon whether his net returns under contract farming will be greater and/or his marketing risks smaller than under any alternative production and marketing arrangements. A thorough evaluation of the various aspects of the contract (such as the contract price versus the market price, credit facilities, adoption of the technological developments in production) would prove most helpful to the farmer in deciding the advisability or otherwise of contract farming.

(4) We have established earlier, in Chapter 3, p. 79, that on-farm grading is more economical than grading at the wholesale level, and we also noted in Chapter 3, p. 56, that most of the farmers under the present arrangement do some amount of grading work at their farm and after grading the potatoes, they pack them in 75-pound jute bags and haul them in their own trucks. New bags cost 15 to 17 cents each, while the old bags cost 8 to 10 cents. These bags are discarded after some use. Thus, for packaging potatoes, cost of bags seems to be a recurring expenditure which adds to increase the marketing costs of the farmers. It seems desirable, therefore, that some device should be introduced to minimize this cost of packing materials. Hauling potatoes in bulk boxes or, in pallet bins to load different grades and varieties, seem to be some of the possible solutions to the problem. However, a careful research on the question of transporting potatoes in suitable containers is badly needed. Results from such a study should prove most helpful to the farmers in further minimizing grading and transportation costs.

(5) Our study also reveals that some of the farmers have attempted to raise an early potato crop in order to capitalize on the

higher prices prevalent during the early crop period. It is conceivable, however, that raising the early crop may entail higher production costs per bushel due to low acreage yield, which may more than offset the price advantage. Research should, therefore, be conducted to develop comparative cost-return estimates for the early and late potato crops.

(6) From our survey data relating to acreage and production, it was difficult to draw any conclusion regarding the optimum size of potato farm, because with increase in farm size, there was no consistent yield pattern. However, this need not necessarily mean that an optimum scale of production in potato farming does not exist. Rather, it suggests an imperative need for conducting a separate and more comprehensive study to analyze the size-yield relationship. Such a study would have to analyze and isolate the effects of many important aspects, such as: (1) the local climatic conditions; (2) the incidence of pests and diseases; (3) the quantity of fertilizers; (4) the type, variety, and quantity of seed; (5) the timeliness and method of planting; (6) the soil type which affects the yield with different intensities. Results of such a study will be useful to the farmers in choosing the optimum grading and harvesting machinery.

(7) One of the difficulties encountered in this study was related to estimating the cost of picking and bagging cull potatoes in those cases where partial grading was being done at the farm on the field run basis. There were only five farmers in this category in our sample. The question asked these farmers was: What percentage of the total labour cost for picking and bagging all the potato crop can be apportioned to picking and bagging the culls? Answers given showed a wide variation in the cost figures. Some thought that the cost of picking and bagging

culls was approximately 20% of the total cost, while others considered it to be as high as 50%.

On further inquiry, it was discovered that the variation in the percentages quoted by the farmers was largely due to the differences in the picking and culling methods used by different farmers. Some farmers, for example, picked up all the culls and "B" type potatoes, while others picked up only better than "B" type potatoes.

Due to time and data limitations, cost calculations for picking and bagging the culls were made on 20% and 50% basis. The 20% cost figure was considered a fairly reasonable approximation of the norm by some of the leading wholesalers in Winnipeg. The 50% cost-rate was used to illustrate the nature of results at the extreme. However, an independent study designed to determine the optimum cost-rate for picking and bagging culls would be most fruitful in improving the cost estimates of the study.

(8) We have recommended in this study the establishment of the "Registered Grading Stations" for the purpose of "Quality Control." Any producer or wholesaler under this system who meets certain basic conditions is eligible to get a license for such a station. A farmer who has adequate storage, washing, grading, and pre-packaging facilities, and whose grade standards have in the past been found satisfactory, may be particularly encouraged to set up a "Registered Grading Station." On such a grading station, he may not only grade and pack his own produce, but may also meet, to the extent his facilities permit, the grading and packaging needs of his neighbouring growers. It will be, therefore, worthwhile to investigate the optimum location of these stations in relation to the volume available in the various production zones so that the benefit of a combined optimum of the transportation economies and

the economies of scale in grading, washing, pre-packaging, and storage can be attained. Similar investigation may also be carried out with regard to the economies of scale of "Registered Grading Stations" functioning at the wholesale point.

(9) One of the assumptions in this study, it will be recalled, was that culls have little or no economic uses at the wholesale point. Even at the farm level, their utilization is restricted to uses for home consumption, stock feed, and, in rare cases, they may be sold to neighbouring farmers as seed or stock feed at discount prices. Possibilities of using these culls more profitably in manufacturing potato by-products, such as potato starch, granules, or flakes, should be explored. Potato starch is used in textile and paper manufacture and in the baking and confectionery trades. There are potato starch plants located in the Atlantic Provinces, but the available statistics on Canada's exports and imports of potato starch and flour indicate that the local production is not enough to meet the Canadian demand for starch and flour. 11/

Availability of culls and existence of surplus labour due to lack of enough work on the farm, particularly during the winter season, indicate a strong possibility of setting up similar potato-starch factories in Manitoba. It is suggested that research should be conducted to explore the possibilities of setting up these and similar other potato-by-product industries in the province. It is possible that potato processors may be hesitant to use culls for manufacturing potato

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11/ There were 5,006,000 pounds of potato starch and flour exported from Canada in 1960, but 6,484,103 pounds were imported by the food industries in the same year, so the net import to Canada was 1,478,103 pounds.

flakes, it is also possible that the tonnage of culls available may not be enough to make starch production an economic proposition. But not until a careful research study is undertaken can one assume answers to such questions. If, however, such a study does reveal that potato starch industries could be run efficiently, it would seem that such enterprises could significantly alleviate not only the seasonal problem of under-employment on the farm, but also the more general problem of over-all rural under-employment. Increased demand for culls and the consequent increase in farmers' returns due to the establishment of these potato enterprises would be an important benefit of such industries.

(10) Finally, an important and interesting study could be undertaken to explore the possibilities of integrating the grading activities with the production of potato starch at the Registered Grading Stations. The basic purpose of such a study would be to determine whether any important joint economies of potato grading and starch production could be achieved through such an integration.

CHAPTER 5

SUMMARY AND CONCLUSIONS

Potatoes are an important vegetable in Manitoba, contributing between 30 and 40 percent to all the income from vegetables. The Manitoba Fruit and Vegetable Sales Act, 1960, requires that potatoes must be graded either at the farm level or at the wholesale level according to the specifications laid down in Section 38 of the said Act, before they can be sold in the retail market. In the present system of marketing in Manitoba, potatoes are being graded both at the farm and the wholesale level. Partially graded potatoes at the farm are regraded by wholesalers. In certain cases, even those potatoes which have been completely graded at the farm have to be regraded by the wholesaler to meet the legal grading requirements. Thus, the present grading system involves a substantial amount of duplication of work, and the grading and packaging costs alone account for nearly half of the total primary marketing costs, and 20% of the selling price of potatoes. Yet, no study seems to have been undertaken so far to carefully examine the present grading situation, and to explore the possibilities of developing an alternative grading set-up which might be more economical than the one in existence.

This study was an attempt to fill up this gap. Specifically and primarily, it was an attempt to determine the optimum location of grading and packing of Manitoba potatoes. On the basis of grading cost

comparisons, an effort was made to determine whether the existing arrangement with respect to grading is the most economical or whether some alternative system would be more efficient and reduce the grading costs. In addition, an attempt was also made (1) to determine the optimum size of potato farm in the region studied for this project, and (2) to evaluate the economics of hand grading versus machine grading at the farm level and, on the basis of this evaluation, to determine the size of crop a farmer must have in order to justify the purchase of a grading and packing machine.

The following major and minor hypotheses were tested:

Major hypothesis: Grading costs for the potato producer will be minimized if he grades his potatoes fully at the farm level rather than transporting them ungraded or unsatisfactorily graded to the wholesaler.

Minor hypothesis: On-farm grading with the aid of mechanical graders is more economical than hand grading.

In testing the above hypotheses, the following conditions were assumed to prevail:

(a) Non-availability of a subsidiary occupation to farmers during the winter is a constraint common to all or most of the potato growers;

(b) The farmer uses only family labour in the operation of his grading equipment;

(c) Culls have little or no economic value at the wholesale point;

(d) Pre-packaging into appropriate consumer bags is a function of the wholesalers;

(e) Farmers sell most of their potatoes through wholesalers for disposal in, as well as outside of, Manitoba.

The study was limited to the 1961 potato crop and to growers in the three crop districts (Winnipeg, Red River, and Springfield) who used Winnipeg as their central market. Thirty-eight growers were selected with the help of officials of the Manitoba Department of Agriculture. Information on grading and packaging costs were obtained from seven wholesalers in the Winnipeg market. A set of questionnaires, one for the farmers and one for the wholesalers, was prepared to secure information needed to calculate the grading and packaging costs. All the growers and wholesalers selected for the study were interviewed and the information was collected as per the questionnaire. Statistical techniques, such as regression analysis (Cobb-Douglas function) and "t" tests were used in the analysis of the data.

The 38 producers included growers operating farms of all sizes. Potato farm size ranged from 10 to 1,000 acres. On approximately 82% of the farms studied, potatoes were grown only as a supplement to some other crop. The 38 growers accounted for a total production of 473,981 hundredweights out of 799,800 hundredweights of potatoes produced in the province during the year 1961. The production by these farmers represented 59.3% of the total production.

Twelve varieties of potatoes were grown by the 38 Manitoba growers. Norland was the most popular variety, followed by Pontiac. Of the total potato acreage, 39.1% and 21.6% were devoted to Norland and Pontiac varieties, respectively.

From the information collected for this study, it was difficult to draw any definite conclusion regarding the optimum size of potato farms, because with increase in farm size, variation in yield did not show any consistent pattern. Acreage yield of potatoes per acre varied

with farm size depending upon the type of soil, production practices, weather conditions, and availability or absence of irrigation facilities.

Potato farmers used various alternative methods and equipment for harvesting and picking, but the three major ones were: (1) conventional system; (2) completely mechanized system; and (3) partially mechanized system. Use of the mechanical harvester resulted in the highest proportion (26.3%) of cut and damaged potatoes; whereas the percentage was comparatively low (11.0 to 17.2 percent) where diggers were used.

Potatoes were sold to different purchasing agents, but by far the largest proportion (48.2%) of the total production went to wholesalers. The next highest percentage (17.7%) went to processors. Other marketing functionaries were retailers and institutions. Growers also sold a fair portion (8.4%) of their crop as seed to other farmers. The study revealed that processors are becoming more important in the field of potato marketing. Acreage under producers-processors contract increased from 800 acres in 1960 to 4,500 acres in both the years 1961 and 1962.

Four different methods of transportation, namely, farm truck, rail, public service vehicles, and buyer's truck were used by growers. In the three crop districts, farm trucks handled, on an average, 65.7% of the crop. Buyers' trucks were the next in importance, handling 18.1%. Public service vehicles and rail hauled 9.0% and 7.2%, respectively. Trucks are becoming increasingly important in potato marketing, the main reasons being low costs and speed.

Two methods of grading were used by the farmers: (1) hand grading, and (2) machine grading. A sample of 38 growers in the survey revealed that two farmers with a production of 6,000 hundredweights each graded their entire produce by hand in the field while harvesting the crop;

whereas, 36 graded at their storage bins, 11 by hand, and 25 by machine. Also, among the 25 machine-grading farmers, three farmers used a combination of both hand grading on the field run basis and machine grading at their storage bins.

Items included in the grading and packaging cost analysis (excluding the cost of bags) were the cost of labour, power, interest; depreciation, insurance, and repairs on the grading machine and on the building area used for grading and packaging.

Packing potatoes, without washing, in 75-pound jute bags was most common among farmers. Accordingly, a 75-pound bag as the unit of measurement of grading rate per man-hour was used to estimate the labour cost. Only two factors: (1) percentage of culls in the yield, and (2) the size of the grading machine, were analyzed to determine their effects on the rate of grading. The analysis showed the following relationships between the percentage of culls in the yield and volume graded per man-hour by different methods of grading.

(a) Hand grading: $\hat{Y} = 7.38X^{-.19}$

(b) Machine grading (S),

(length of machine less than 20'): $\hat{Y} = 20.0X^{-.31}$

(c) Machine grading (L),

(length of machine greater than 20'): $\hat{Y} = 110.5X^{-.69}$

As the equations show, $\hat{Y}$ refers to the expected volume graded per man-hour, X refers to the percentage of culls in the yield of potatoes. The elasticity of grading (E_g) (defined as the percentage change in the volume graded per man-hour, associated with a one percent change in the volume of culls) for hand grading was .19 (.19 x 75-pound bags = 14 lbs.), for machine grading (S) .31 (.31 x 75-pound bags = 23 lbs.), and for

machine grading (L) .69 (.69 x 75-pound bags = 52 lbs.). The analysis revealed that in the case of hand grading, percentage of culls in the yield of potatoes did not significantly affect the rate of grading, but there appeared to be a significant effect of culls on the grading rate when machines were used for grading. The analysis also revealed that the effect of higher percentage of culls on the rate of grading was offset by the use of large grading machine (L). Probably, this is one of the reasons why big farmers and wholesalers use large grading machines to economize their labour cost by realizing a greater turnover per man-hour.

The volume graded by hand ranged from 750 to 5,625 hundredweights. The weighted average grading cost for this group was 23 cents per hundred-weight (or 26.3 cents per hundredweight of salable graded potatoes). The grading cost decreased with the increase in the volume graded. This relationship was expressed in the form: $\hat{Y} = 512.8X^{-.41}$, where $\hat{Y}$ represents the expected grading cost per hundredweight in cents, and X is the volume of potatoes graded. However, the data collected for this survey did not exhibit the optimum volume for hand grading.

The volume graded by machine varied from 675 to 105,600 hundred-weights with a weighted average of 11.8 cents per hundredweight (or 14.1 cents per hundredweight of graded potatoes). With increase in the volume graded, variation in the grading cost did not show any consistent pattern. It was, therefore, not possible to analyze the data stistically to show any precise cost-volume relationship.

A comparison between hand grading and machine grading showed that machine grading was not only more economical, but also twice as fast as hand grading. Specifically, the simple average grading cost per hundred-

weight by hand grading for a volume range up to 6,000 hundredweights was 26.5 cents as against 13.6 cents by machine for the same volume range. The difference (26.5 - 13.6), 12.9 cents per hundredweight, was significant both at 5% and 1% level. The use of "Student's" t-Test was made for this purpose. From the above analysis, the minor hypothesis, viz., on-farm grading with the aid of mechanical graders is more economical than hand grading, was accepted.

The formula used in estimating the minimum crop which a farmer should have in order to justify the purchase of a grading and packing machine was: $X = \frac{\alpha M}{H - D}$, i.e., the minimum number of hundredweights per year necessary (X) equals α (the coefficient of the annual fixed cost) times the original purchasing cost of the machine (M) divided by the cost of hand grading per hundredweight minus the direct cost per hundredweight by machine, i.e., H - D. Using the data from the survey in this formula, it was estimated that 1,967 hundredweights (approximately 24 acres) of potatoes were required to make an economic use of a grading and packing machine costing $1,650.

The volume graded by machine at the wholesale level varied from 27,500 to 335,610 hundredweights, with a simple average grading cost of 13.3 cents per hundredweight (or 12.8 cents per hundredweight of graded potatoes). This cost was based on potatoes which had been previously graded to some extent at the farm level. For a valid comparison of grading costs between farm and wholesale level, it was assumed that the wholesalers received ungraded potatoes from the farmers. According to this, the simple average grading cost by machine for a wholesaler amounted to 17.8 cents per hundredweight compared to a simple average grading cost of 14.4 cents (12.4 cents as grading cost + 2 cents as scale loss)

at the farm level by machine. The difference of 3.4 cents (17.8 - 14.4) per hundredweight was found to be significant at 5% level.

The grading cost of 17.8 cents per hundredweight when converted to the grading cost per hundredweight of salable graded potatoes came to 19.0 cents per hundredweight. This grading cost at the wholesale level, however, does not represent a full measure of the marketing cost to the farmer if he were to haul completely ungraded potatoes in 75-pound bags to the wholesale market. To this cost should be added another 6.9 cents which the farmer has to incur as the cost of bags, stitching material, and labour for packing culls. The total cost to the farmer would then amount to 25.9 cents (19.0 + 6.9 cents) per hundredweight of graded potatoes.

Two other situations were analyzed where farmers hauled (1) ungraded potatoes direct from the field in bulk, and (2) partially graded potatoes in bulk on a field run basis. In the former case, the grading cost per hundredweight of graded potatoes amounted to 22.7 cents (3.7 cents as the cost of transportation of culls + 19.0 cents as the grading cost at the wholesale level) and in the latter case of hauling partially graded potatoes, the grading cost came to 18.6 cents (5.8 cents as the cost of culling + 12.8 cents as the grading cost at the wholesale level for regrading partially graded potatoes) per hundredweight of salable potatoes. Against all these costs, if the farmer were to grade the potatoes at his own farm, he would bear only 16.1 cents (14.1 cents as grading cost + 2 cents as scale loss) per hundredweight of salable potatoes. On the basis of the above cost estimates, and in view of the fact that opportunities to use culls are better on the farm than at the wholesale level, the major hypothesis was accepted and it was concluded that the optimum location of grading potatoes was at the farm level

rather than at the wholesale level.

One major policy recommendation, on the basis of the above conclusion, was that the possibility of changing the present expensive grading system in favour of the more economical system should be seriously considered. The changed system would involve complete on-farm grading of potatoes which, as the analysis revealed, would be the least costly for the farmer.

Having established the desirability of such a system on grounds of economic efficiency, the feasibility of such a system was examined from the standpoint of technical, market structure, operational and administrative considerations. The three considerations that were examined in this context are briefly discussed below.

First, if the potatoes are only graded at the farm level, but packed and labelled in appropriate sized consumer bags at the wholesale level, some of the important joint economies of performing the entire sequence of grading and packaging at one location might possibly be lost under the new system. And this may result in increased cost of packaging and labelling at the wholesale level. Consequently, the present consolidated system where the entire or most of the grading, packing and labelling work is done at the wholesale level may not be less economical than a system where grading processes are performed at two separate locations. Due to time and data limitations, it was not possible to examine the validity of this argument. However, granting that a consolidated set-up would be relatively more economical, the available cost information was analyzed. The analysis indicated that consolidation of the entire grading process would be more economical at the farm level than at the wholesale level, because for almost every

consumer size bag the costs of grading, packing, and labelling were significantly lower at the farm level than at the wholesale level.

The second consideration pertained to the important role played by wholesalers in terms of gauging and interpreting the market, and conveying to the farmers the needs and preferences of consumers. The question examined, therefore, was: If the grading process is consolidated at the farm level, would the farmer be able to read the market as effectively as the wholesalers can? Some important recent trends in the market structures of the American and Canadian economies were considered. These trends revealed three important changes which are under way in the marketing system of these two economies:

(a) Increasing size and importance of the food retailing chains, particularly the supermarket, and the concomitant decline in the importance of the independent wholesaling function;

(b) Taking over of many of the wholesaling functions by the food retailing chains themselves and/or developing more direct and effective co-ordination with the producers; and

(c) Rising trend toward contract farming which again results in direct arrangement with the producers.

In the light of these trends, it was concluded that if the past and current market structure trends continue to develop, a consolidated grading at the farm level would not pose any serious difficulties to the farmer.

The third and final consideration examined was posed by the "Quality Control" programme. If the entire grading and packaging work was done at the farm level, one might argue that the operation of the "Quality Control" and the related inspection programme would become

more difficult and less effective insofar as under the new system grading activities would be performed at numerous farms which are so widely dispersed in potato producing areas. The suggestion made to overcome the "Quality Control" problem was that the possibility of establishing "Registered Grading Stations" in various production zones should be given a serious consideration.

Finally, some recommendations were made in Chapter 4 for further research with a view to testing and/or improving the validity of the cost analysis and conclusions made in this study, and also to throw light on some important related aspects of production and marketing of potatoes.

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A P P E N D I X

APPENDIX A

POTATO ACREAGE IN THREE CROP DISTRICTS

Crop District	Schedule No. of farm	Potato Acreage	Distance from Winnipeg market (miles)
WINNIPEG:	31	20	10
	37	20	15
	34	24	6
	38	24	23
	36	26	18
	35	37	23
	32	46	9
	39	60	45
Total:	8	251	149
Average:	-	31.4	18.6
SPRINGFIELD:	1	10	18
	13	14	24
	17	15	35
	10	19	25
	8	25	22
	16	33	35
	11	36	28
	6	40	20
	4	46	25
	9	53	25
	14	55	30
	15	55	35
	5	60	20
	12	60	28
	3	65	16
	7	95	25
	2	115	35
	33	182	24
Total:	18	978	470
Average:	-	54.3	26.1

APPENDIX A--Continued

Crop District	Schedule No. of farm	Potato Acreage	Distance from Winnipeg market (miles)
RED RIVER:	20	40	75
	26	40	40
	19	65	35
	21	65	37
	30	110	45
	29	215	90
	18	245	35
	27	445	80
	24	502	50
	28	525	75
	23	550	50
	22	1,000	85
Total:	12	3,802	697
Average:	-	316.8	58.1

APPENDIX B

UTILIZATION

		PERCENTAGES OF THE PRODUCTION UTILIZED AS								
		SEED		TABLE STOCK		SOLD TO				
Farm No.	Production (cwts.)	Own seed	Sold as seed	Wholesalers	Retailers	Institutions	Consumers	Processors	Farm Consumption	Wastage
WINNIPEG CROP DISTRICT:										
31	750.0	30.0	-	62.5	-	-	-	-	2.5	5.0
32	3,000.0	-	-	93.0	-	-	-	-	-	7.0
34	907.8	16.5	-	71.0	-	-	-	-	2.5	10.0
35	4,491.0	5.0	4.2	86.4	-	-	-	-	0.4	4.0
36	1,950.0	23.1	-	71.7	-	-	-	-	0.2	5.0
37	3,300.0	6.8	91.8	-	-	-	-	-	0.4	1.0
38	2,156.4	-	-	90.0	-	-	-	-	-	10.0
39	5,625.0	4.7	-	20.0	66.2	-	-	4.0	0.1	5.0
Total:	22,180.2	-	-	-	-	-	-	-	-	-
Weighted Average:	-	6.9	14.5	55.2	16.8	-	-	1.0	0.4	5.2

APPENDIX B--Continued

		PERCENTAGES OF THE PRODUCTION UTILIZED AS								
		SEED		TABLE STOCK		SOLD TO				
Farm No.	Production (cwts)	Own seed	Sold as seed	Wholesalers	Retailers	Institutions	Consumers	Processors	Farm Consumption	Wastage
SPRINGFIELD CROP DISTRICT:										
1	750.0	12.5	-	84.3	-	-	-	-	0.2	3.0
2	10,780.8	9.0	23.2	13.9	-	-	-	33.8	0.1	20.0
3	6,960.0	14.1	5.4	71.7	5.4	-	0.2	-	0.2	3.0
4	2,760.0	13.6	-	80.6	-	-	-	-	0.8	5.0
5	4,050.0	25.9	1.8	40.0	19.7	-	1.4	9.0	0.2	2.0
6	2,625.0	-	14.3	36.0	31.4	14.3	-	-	-	4.0
7	7,125.0	10.5	-	83.9	-	-	-	0.4	0.2	5.0
8	1,950.0	7.7	-	86.9	-	-	-	-	0.4	5.0
9	3,206.4	11.7	-	83.3	-	-	-	-	-	5.0
10	1,143.6	-	13.1	76.5	-	-	-	-	0.4	10.0
11	6,918.6	-	-	94.8	-	-	-	-	0.2	5.0
12	3,375.0	31.1	-	35.0	22.2	6.7	-	-	-	5.0
13	1,012.8	8.9	-	74.6	-	-	-	-	1.5	15.0
14	2,962.8	-	-	83.6	1.3	-	-	-	0.1	15.0

APPENDIX B--Continued

		PERCENTAGES OF THE PRODUCTION UTILIZED AS								
		SEED		TABLE STOCK		SOLD TO				
Farm No.	Production (cwts.)	Own seed	Sold as seed	Wholesalers	Retailers	Institutions	Consumers	Processors	Farm Consumption	Wastage
15	2,062.8	21.8	-	72.5	-	-	-	-	0.7	5.0
16	2,193.6	9.4	-	80.2	-	-	-	-	0.4	10.0
17	1,162.8	6.4	3.2	79.5	-	-	-	-	0.9	10.0
33	23,250.0	5.5	54.3	11.3	-	-	-	25.8	0.1	3.0
Total:	84,289.2	-	-	-	-	-	-	-	-	-
Weighted Average:	-	9.4	19.1	48.6	3.3	0.7	0.08	11.9	0.2	6.7
RED RIVER CROP DISTRICT:										
18	20,699.0	9.2	10.4	62.8	5.4	-	1.8	-	0.4	10.0
19	5,479.8	-	3.4	64.7	21.5	-	-	-	0.4	10.0
20	6,000.0	8.3	-	-	-	31.2	-	40.0	0.5	20.0
21	6,263.2	3.8	2.4	52.6	31.1	-	-	-	0.1	10.0
22	105,600.0	8.5	10.0	36.2	2.2	0.7	1.5	25.9	-	15.0

APPENDIX B--Continued

		PERCENTAGES OF THE PRODUCTION UTILIZED AS								
		SEED		TABLE STOCK		SOLD TO				
Farm No.	Production (cwts)	Own seed	Sold as seed	Wholesalers	Retailers	Institutions	Consumers	Processors	Farm Consumption	Wastage
23	54,750.0	2.1	-	46.4	-	-	-	36.5	-	15.0
24	43,680.0	-	0.7	61.0	1.0	-	-	29.3	-	8.0
26	2,040.0	10.2	-	11.0	35.8	-	35.8	-	0.2	7.0
27	31,387.5	7.2	-	77.7	-	-	-	-	0.1	15.0
28	44,460.0	-	-	29.2	10.8	-	-	23.0	-	37.0
29	34,965.0	4.5	20.4	61.1	-	-	-	-	-	14.0
30	12,187.8	1.5	-	51.4	30.8	-	-	6.1	0.2	10.0
Total:	367,512.3	-	-	-	-	-	-	-	-	-
Weighted Average:	-	4.6	5.6	47.7	4.4	0.7	0.7	20.0	0.05	16.2
Grand Total:	473,981.7	-	-	-	-	-	-	-	-	-
Weighted Average:	-	5.6	8.4	48.2	4.8	0.7	0.6	17.7	0.09	14.0

APPENDIX C

MANITOBA REGULATION 38/60

being a regulation under

THE FRUIT AND VEGETABLE SALES ACT

Definitions: 38. (1) In this section

"bright" (a) "bright" means free from dirt or other foreign matter, damage or discoloration from any cause, so that the outer skin has the attractive colour normal for the variety;

"damage" (b) "damage" means

(i) pitted scab or any other form of scab that affects the tissue of the tuber;

(ii) surface scab that affects more than five per centum of the surface of the aggregate area; and

(iii) any surface scab that affects more than twenty per centum of the potatoes in the lot;

(iv) sprouts that are more than one inch in length where more than ten per centum of the potatoes in the lot are affected;

(v) any injury or other defect that requires more than five per centum of the weight of a potato, including peel covering the defective area to be wasted.

"firm" (c) "firm" means not soft, flabby or shrivelled;

"mature" (d) "mature" means that the outer skin is firm and that there is no evidence of feathering;

"reasonably clean" (e) "reasonably clean" means that the general appearance is not materially affected and that individual potatoes are not materially caked with dirt or materially stained;

APPENDIX C--Continued

"reasonably mature"

(f) "reasonably mature" means that the outer skin does not loosen or feather readily during the ordinary methods of handling;

"serious damage"

(g) "serious damage" means

(i) surface scab that affects more than twenty-five per centum of the surface area of the potatoes in aggregate;

(ii) dirt, where more than one-third of the potatoes in any lot are seriously caked with dirt; and

(iii) any injury or other defect that requires more than ten per centum of the weight of a potato including peel covering the defective area to be wasted;

"soft rot"

(h) "soft rot" means any soft, mushy condition of the tissue from any cause;

"well shaped"

(i) "well shaped" means the typical shape for the variety in the district where grown, and free from pointed or excessively elongated and other ill-shaped specimens.

Grades

(2) The grades for table potatoes are

(a) Canada Fancy;
(b) Canada No. 1;
(c) Canada No. 1 Large;
(d) Canada No. 1 Small, that shall be used for shipment out of Canada only; and
(e) Canada No. 2.

Canada Fancy

(3) Canada Fancy potatoes are potatoes that are

(a) of one variety in any lot;
(b) bright, well shaped, mature, and firm;
(c) free from

(i) dumbells,
(ii) specimens from which knobs have been removed,
(iii) secondary growth,
(iv) growth cracks,
(v) sprouts,
(vi) sunburn,
(vii) hollow heart,

APPENDIX C--Continued

(viii) sprain or spraing,
(ix) necrosis,
(x) cuts,
(xi) bruises,
(xii) freezing injury,
(xiii) dry rot,
(xiv) scab,
(xv) bacterial ring rot,
(xvi) blight,
(xvii) soft rot,
(xviii) internal discoloration,
(xix) insect injury,
(xx) mechanical injury, and
(xxi) any other disease or defect;

(d) not less than two and one-quarter inches in diameter or more than three and one-half inches in diameter; and

(e) properly packed.

Canada No. 1

(4) Canada No. 1 potatoes are potatoes that are

(a) of similar varietal characteristics in any lot;

(b) firm, reasonably mature, and reasonably clean;

(c) free from

(i) dumbells,
(ii) specimens from which knobs have been removed,
(iii) sunburn,
(iv) hollow heart,
(v) necrosis,
(vi) sprain or spraing,
(vii) freezing injury,
(viii) bacterial ring rot, and
(ix) soft rot;

(d) free from damage caused by

(i) greening,
(ii) abnormal growth,
(iii) growth cracks,
(iv) cuts,
(v) dry rot,
(vi) blight,
(vii) sprouts,
(viii) insect injury,
(ix) mechanical injury, or
(x) other disease, injury, or defect;

APPENDIX C--Continued

(e) not less than two and one-quarter inches in diameter or more than four inches in diameter, except in cases of long shaped varieties the minimum diameter may be two inches; and

(f) properly packed.

Canada No. 1 Large

(5) Canada No. 1 Large potatoes that meet the standards set out in clauses (a), (b), (c), (d), and (f) of subsection (4) and that are not less than three and one-quarter inches in diameter.

Canada No. 1 Small

(6) Canada No. 1 Small potatoes are potatoes that meet the standards set out in clauses (a), (b), (c), (d), and (f) or subsection (4) and that are not less than one and one-half inches in diameter and not more than two and one-quarter inches in diameter.

Canada No. 2

(7) Canada No. 2 potatoes are potatoes that are

(a) of similar varietal characteristics in any lot;

(b) reasonably mature and reasonably firm;

(c) free from

(i) dumbells,
(ii) specimens from which knobs have been removed,
(iii) sprain or spraing,
(iv) freezing injury,
(v) hollow heart,
(vi) bacterial ring rot, and
(vii) soft rot;

(d) free from serious damage caused by

(i) sunburn,
(ii) greening,
(iii) abnormal growth,
(iv) growth cracks,
(v) cuts,
(vi) dirt,
(vii) scab,
(viii) dry rot,
(ix) blight,
(x) insect injury,
(xi) mechanical injury, or
(xii) other injury, disease or defect;

(e) not less than one and three-quarter inches in diameter with not less than seventy-five per centum by weight of the potatoes in the lot of a diameter of not less than two inches; and

(f) properly packed.

Exception

(8) The standards set out in this section apply to new potatoes of the grades described in this section except

(a) new potatoes need not be mature or reasonably mature; and

(b) until the fifteenth day of September in each calendar year, the only standard of size that applies to new potatoes is that they shall be not less than one and seven-eighths inches in diameter.

Tolerances

(9) In each of the grades described in this section the potatoes may have the following variations from the standards set out for the grades as incident to proper grading, packing and handling:

(a) one specimen may be defective and one off-sized in each package or container; or ten per centum by weight of the potatoes in a package or container may have grade defects but such defects shall not exceed

(i) as to size, five per centum below minimum diameter and five per centum above maximum diameter,

(ii) one per centum with soft rot other than bacterial ring rot,

(iii) three per centum with hollow heart, except in Canada No. 2 potatoes where the variation may be as high as ten per centum with hollow heart, and

(iv) four per centum with other defects except at point of destination where the variation for other defects may be as high as six per centum.

(b) up to but not exceeding ten per centum of the packages or containers in any lot may have potatoes with grade defects in excess of the variations set out in subclauses (i), (ii), (iii), or (iv), of clause (a) but no package or container shall have potatoes with grade defects in excess of two and one-half times any single one of those variations.

APPENDIX D

DELIVERIES OF POTATOES BY GRADE AND SIZE OF CONTAINER
(percentage of production)

Farm No.	100 lb.		75 lb.		50 lb.		25 lb.		10 lb.		5 lb.		Bulk box	
	No. 1	No. 2	No. 1	No. 2	No. 1	No. 2	No. 1	No. 2	No. 1	No. 2	No. 1	No. 2	No. 1	No. 2
31	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-
32	-	-	50.0	50.0	-	-	-	-	-	-	-	-	-	-
34	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-
35	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-
36	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-
37	1.3	-	81.5	9.2	0.5	-	3.0	-	4.5	-	-	-	-	-
38	-	-	75.0	25.0	-	-	-	-	-	-	-	-	-	-
39	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-
1	-	-	88.2	11.8	-	-	-	-	-	-	-	-	-	-
2	32.7	-	19.7	-	-	-	-	-	-	-	-	-	47.6	-
3	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-
4	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-
5	-	-	51.4	48.6	-	-	-	-	-	-	-	-	-	-
6	-	-	29.8	70.2	-	-	-	-	-	-	-	-	-	-
7	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-
8	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-
9	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-
10	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-
11	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-
13	-	-	14.6	85.4	-	-	-	-	-	-	-	-	-	-
14	-	-	66.7	33.3	-	-	-	-	-	-	-	-	-	-

APPENDIX D--Continued

Farm No.	100 lb.		75 lb.		50 lb.		25 lb.		10 lb.		5 lb.		Bulk box	
	No. 1	No. 2	No. 1	No. 2	No. 1	No. 2	No. 1	No. 2	No. 1	No. 2	No. 1	No. 2	No. 1	No. 2
15	-	-	85.1	14.9	-	-	-	-	-	-	-	-	-	-
16	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-
17	-	-	-	100.0	-	-	-	-	-	-	-	-	-	-
33	14.1	-	48.3	-	-	-	-	-	-	-	-	-	37.6	-
18	-	-	85.7	14.3	-	-	-	-	-	-	-	-	-	-
19	-	-	50.0	50.0	-	-	-	-	-	-	-	-	-	-
20	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-
21	-	-	43.1	56.9	-	-	-	-	-	-	-	-	-	-
22	20.0	10.0	40.0	15.0	0.8	0.2	2.0	1.5	8.0	2.0	0.5	-	-	-
23	-	-	75.0	25.0	-	-	-	-	-	-	-	-	-	-
24	-	-	51.2	31.0	-	0.4	0.5	9.4	0.8	0.8	0.4	-	5.5	-
26	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-
27	-	-	-	85.0	-	5.0	-	10.0	-	-	-	-	-	-
28	-	-	45.0	30.0	10.0	5.0	5.0	5.0	-	-	-	-	-	-
29	-	-	100.0	-	-	-	-	-	-	-	-	-	-	-
30	-	-	93.1	-	-	-	2.4	-	4.5	-	-	-	-	-
Wtd. Av.	5.7	2.2	51.6	29.5	0.9	0.8	0.9	2.3	1.9	0.5	0.1	-	3.6	-

Total of No. 1 grade: 64.7

Total of No. 2 grade: 35.3

APPENDIX E

PRODUCTION OF POTATOES BY GRADE

Farm No.	% OF TOTAL PRODUCTION No. 1	No. 2	Type of Grader
HAND GRADING:			
31	-	100.0	-
36	-	100.0	-
38	75.0	25.0	-
39	-	100.0	-
1	88.2	11.8	-
4	51.4	48.6	-
8	-	100.0	-
10	-	100.0	-
13	14.6	85.4	-
15	85.1	14.9	-
17	-	100.0	-
19	50.0	50.0	-
20	100.0	-	-
Total:	464.3	835.7	-
Average	35.7	64.3	-
MACHINE GRADING:			
32	50.0	50.0	Boggs
34	-	100.0	Home-made
35	100.0	-	Lockwood
37	90.8	9.2	Boggs
2	100.0	-	Lockwood
3	-	100.0	Lockwood
5	51.4	48.6	Lockwood
6	-	100.0	Lockwood
7	-	100.0	Lockwood
9	-	100.0	Lockwood
11	100.0	-	Lockwood
12	-	100.0	Boggs
14	66.7	33.3	Boggs

APPENDIX E--Continued

Farm No.	% OF TOTAL PRODUCTION No. 1	No. 2	Type of Grader
MACHINE GRADING--Continued:			
16	-	100.0	Boggs
33	100.0	-	Lockwood
18	85.7	14.3	Lockwood
21	43.1	56.9	Boggs + F.R.*
22	71.3	28.7	Lockwood
23	75.0	25.0	Lockwood
24	58.4	41.6	Lockwood
26	100.0	-	Home-made + F.R.*
27	-	100.0	Trojer
28	60.0	40.0	Lockwood
29	100.0	-	Skinner
30	100.0	-	Lockwood + F.R.*
Total:	1,352.4	1,147.6	
Average:	54.1	45.9	

*F.R. means on Field Run basis.

APPENDIX F

GRADING COST AT FARM LEVEL--HAND AND MACHINE

Farm No.	Volume Graded (cwts)	DIRECT COST ($)		OVERHEAD COSTS ($)				Total Cost ($)	Cost per cwt. (cents)
		Labour	Power	Depreci-ation	Insur-ance	Repairs	Interest		
HAND GRADING:									
Group A: 0-3,000 cwts.									
1	750.0	200.00	4.00	17.50	-	5.60	-	227.10	30.3
31	750.0	320.00	2.00	10.00	1.75	-	-	333.75	44.5
13	1,012.8	192.86	2.00	13.50	-	-	-	208.36	20.6
10	1,143.6	348.80	5.00	8.00	0.20	-	-	362.00	31.6
17	1,162.8	465.00	3.00	5.00	-	6.40	-	479.40	41.2
8	1,950.0	520.00	10.00	19.20	-	-	-	549.20	28.2
36	1,950.0	390.00	3.00	10.50	0.30	-	-	403.80	20.7
15	2,062.8	275.00	10.00	9.00	0.75	-	-	294.75	14.3
38	2,156.4	575.00	5.00	5.00	0.06	-	-	585.06	27.1
4	2,760.0	345.00	15.00	25.00	-	-	-	385.00	13.9
Total:	15,698.4	3,631.66	59.00	122.70	3.06	12.00	-	3,828.42	272.4
Average (cents):	-	-	-	-	-	-	-	-	27.2
Wtd. Av. (cents):	-	23.10	0.40	0.80	0.02	0.08	-	-	24.4

APPENDIX F--Continued

Farm No.	Volume Graded (cwts)	DIRECT COST ($) Labour	Power	OVERHEAD COSTS ($) Depreci-ation	Insur-ance	Repairs	Interest	Total Cost ($)	Cost per cwt. (cents)
HAND GRADING--Continued:									
Group B: 3,001-6,000 cwts.									
39	5,625.0	1,050.00	8.00	15.75	1.05	-	-	1,074.80	19.1
Wtd. Ave. (cents):	-	18.67	0.14	0.28	0.02	-	-	-	19.1
Total (A + B):	21,323.4	4,681.66	67.00	138.45	4.11	12.00	-	4,903.22	291.5
Average (cents):	-	-	-	-	-	-	-	-	26.5
Wtd. Av. (cents):	-	21.96	0.31	0.65	0.02	0.06	-	-	23.0
Wtd. Av. of graded potatoes (deducting 12.5% culls from the gross volume):	-	-	-	-	-	-	-	-	26.3

APPENDIX F--Continued

Farm No.	Volume Graded (cwts)	DIRECT COST ($) Labour	Power	OVERHEAD COSTS ($) Depreci-ation	Insur-ance	Repairs	Interest	Total Cost ($)	Cost per cwt. (cents)
MACHINE GRADING:									
Group C: 0-3,000 cwts.									
26	675.0	83.70	2.00	26.50	2.64	5.00	3.00	122.84	18.2
34	907.8	84.70	5.00	31.20	-	3.60	13.50	138.00	15.2
16	2,193.6	438.75	5.00	42.40	0.48	8.00	4.00	498.63	22.7
6	2,625.0	315.00	16.00	57.50	1.50	10.00	10.00	410.00	15.6
14	2,962.8	298.44	5.00	99.00	5.12	-	4.50	412.06	13.9
32	3,000.0	333.35	8.00	51.90	0.15	-	15.00	408.40	13.6
Total:	12,364.2	1,553.94	41.00	308.50	9.89	26.60	50.00	1,989.93	99.2
Average (cents):	-	-	-	-	-	-	-	-	16.5
Wtd. Av. (cents):	-	12.57	0.33	2.49	0.08	0.21	0.40	-	16.1
Group D: 3,001-6,000 cwts.									
9	3,206.4	427.50	20.00	91.50	2.70	9.00	24.00	574.70	17.9
37	3,300.0	176.00	5.00	16.25	5.00	3.33	1.50	206.08	6.2
12	3,375.0	270.00	8.00	55.00	0.35	-	3.50	336.85	10.0
5	4,050.0	345.60	8.00	62.50	2.85	1.05	13.50	433.50	10.7

APPENDIX F--Continued

Farm No.	Volume Graded (cwts)	DIRECT COST ($) Labour	Power	OVERHEAD COSTS ($) Depreciation	Insurance	Repairs	Interest	Total Cost ($)	Cost per cwt. (cents)
MACHINE GRADING (Group D)--Continued									
35	4,491.0	224.55	8.00	62.50	3.30	5.50	27.00	330.85	7.4
21	3,538.2	396.28	5.00	70.00	3.25	2.50	12.50	489.53	13.8
30	5,539.8	537.36	8.00	80.00	4.60	-	-	629.96	11.4
Total:	27,500.4	2,377.29	62.00	437.75	22.05	21.38	82.00	3,002.47	77.4
Average (cents):	-	-	-	-	-	-	-	-	11.1
Wtd. Av. (cents):	-	8.64	0.23	1.59	0.08	0.08	0.30	-	10.9
Group E: 6,001-9,000 cwts.									
11	6,918.6	615.00	6.00	70.00	-	-	20.00	711.00	10.3
3	6,960.0	401.73	15.00	100.00	4.55	14.00	29.60	564.83	8.1
7	7,125.0	712.50	15.00	114.50	2.79	2.65	22.75	870.19	12.2
Total:	21,003.6	1,729.23	36.00	284.50	7.34	16.65	72.35	2,146.02	30.6
Average (cents):	-	-	-	-	-	-	-	-	10.2
Wtd. Av. (cents):	-	8.23	0.17	1.35	0.03	0.08	0.34	-	10.2

APPENDIX F--Continued

Farm No.	Volume Graded (cwts)	DIRECT COST ($) Labour	Power	OVERHEAD COSTS ($) Depreci-ation	Insur-ance	Repairs	Interest	Total Cost ($)	Cost per cwt. (cents)
MACHINE GRADING--Continued									
Group F: 9,001-12,000 cwts.									
2	10,780.8	862.44	10.00	150.75	0.42	7.70	45.00	1,076.31	10.0
Wtd. Av. (cents):	-	8.00	0.09	1.40	-	0.07	0.41	-	10.0
Group G: 12,001 and over									
18	20,699.0	1,766.34	20.00	264.50	6.00	30.00	57.25	2,144.09	10.3
33	23,250.0	2,342.23	35.00	98.00	9.10	106.00	8.75	2,599.08	11.2
27	31,387.5	4,185.00	20.00	411.50	1.18	38.25	540.00	5,195.93	16.5
29	34,965.0	2,565.75	30.00	268.50	7.20	51.80	40.00	2,963.25	8.5
24	43,680.0	3,307.50	30.00	1,047.44	-	31.36	400.00	4,816.30	11.0
28	44,460.0	4,149.60	30.00	1,146.80	-	74.30	325.00	5,775.70	13.0
23	54,750.0	5,547.98	20.00	460.00	16.00	40.00	130.00	6,213.98	11.3
22	105,600.0	11,264.00	40.00	1,500.00	25.00	52.50	225.00	13,106.50	12.4
Total:	358,791.5	35,128.40	225.00	5,196.74	64.48	424.21	1,726.00	42,764.83	94.2
Average (cents):	-	-	-	-	-	-	-	-	11.8
Wtd. Av. (cents):	-	9.80	0.06	1.40	0.02	0.10	0.48	-	11.9

APPENDIX F--Continued

Farm No.	Volume Graded (cwts)	DIRECT COST ($)		OVERHEAD COSTS ($)				Total Cost ($)	Cost per cwt. (cents)
		Labour	Power	Depreci-ation	Insur-ance	Repairs	Interest		
Total of Machine (C to G):	430,440.5	41,651.30	374.00	6,378.24	104.18	496.54	1,975.35	50,979.61	311.4
Average (cents):	-	-	-	-	-	-	-	-	12.4
Wtd. Av. (cents):	-	9.68	0.09	1.48	0.02	0.11	0.46	-	11.8
Wtd. Av. of graded potatoes by machine (deducting 16% culls from the gross volume):	-	-	-	-	-	-	-	-	14.1

APPENDIX G

MACHINE COST AT FARM LEVEL

Farm No.	Volume Graded (cwts)	Depreciation ($)	Repairs ($)	Insurance ($)	Interest ($)	Total fixed cost on machine ($)	Original cost of machine ($)	Fixed cost as % of original machine cost
32	3,000.0	50.0	-	-	15.00	65.00	500.00	13.00
6	2,625.0	40.0	10.0	-	10.00	60.00	400.00	15.00
14	2,962.8	15.0	-	-	4.50	19.50	150.00	13.00
16	2,193.6	10.0	5.0	-	4.00	19.00	100.00	19.00
26	675.0	10.0	5.0	-	3.00	18.00	100.00	18.00
34	907.8	30.0	-	-	13.50	43.50	300.00	14.50
5	4,050.0	45.0	-	1.80	13.50	60.30	450.00	13.40
9	3,206.4	60.0	-	-	24.00	84.00	600.00	14.00
12	3,375.0	40.0	-	-	3.50	43.50	400.00	10.90
35	4,491.0	60.0	5.0	3.00	27.00	95.00	600.00	15.50
37	3,300.0	10.0	-	-	1.50	11.50	100.00	11.50
21	3,538.2	50.0	-	1.00	12.50	63.50	500.00	12.70
3	6,960.0	65.0	-	-	29.60	94.60	650.00	14.60
7	7,125.0	65.0	2.6	-	22.75	90.35	650.00	13.90
11	6,918.6	50.0	-	-	20.00	70.00	500.00	14.00
2	10,780.8	135.0	-	-	45.00	180.00	1,350.00	13.33
30	5,539.8	60.0	-	2.00	-	62.00	600.00	10.33
18	20,699.0	114.5	10.0	3.00	57.25	184.75	1,145.00	16.13
22	105,600.0	750.0	30.0	15.00	225.00	1,020.00	7,500.00	13.60
23	54,750.0	260.0	15.0	12.00	130.00	417.00	2,600.00	16.04
24	43,680.0	700.0	15.0	-	400.00	1,115.00	7,000.00	15.92

APPENDIX G--Continued

Farm No.	Volume Graded (cwts)	Depreciation ($)	Repairs ($)	Insurance ($)	Interest ($)	Total fixed cost on machine ($)	Original cost of machine ($)	Fixed cost as % of original machine cost
27	31,387.5	400.0	20.0	-	540.00	960.00	8,000.00	12.00
28	44,460.0	500.0	30.0	-	325.00	855.00	5,000.00	17.10
29	34,965.0	172.5	20.0	3.00	40.00	235.50	1,725.00	13.65
33	23,250.0	35.0	40.0	-	8.75	83.75	350.00	23.93
Total:	430,440.5	3,727.0	207.6	40.80	1,974.85	5,950.75	41,270.00	365.03
Average:	17,217.6	149.1	8.3	1.63	78.99	238.03	1,651.00	14.60
Wtd. Av. (cents):	-	0.87	0.05	0.01	0.46	1.38	-	14.42

APPENDIX H

GRADING COST OF POTATOES AT THE WHOLESALE LEVEL
(based on regrading of farmers' graded potatoes)

Farm No.	Volume Regraded (cwts)	Labour ($)	Power ($)	Depreciation ($)	Insurance ($)	Repairs ($)	Interest ($)	Total Cost ($)	Cost per cwt. (cents)
40	94,900	7,909	55	208	5	-	32	8,209	8.6
46	83,696	6,975	260	6,450	150	300	170	14,305	17.1
42	27,500	2,521	200	1,000	60	-	20	3,801	13.8
43	29,250	3,290	150	600	-	50	72	4,162	14.2
45	35,187	3,958	80	250	-	25	60	4,373	12.4
44	22,500	1,875	400	1,025	50	-	210	3,560	15.8
47	335,610	27,967	1,540	6,794	313	372	1,147	38,133	11.4
Total:	628,643	54,495	2,685	16,327	578	747	1,711	76,548	93.3
Average:	89,806	7,785	384	2,332	83	107	244	10,935	13.3
Wtd. Av. (cents):	-	-	-	-	-	-	-	-	12.0
Wtd. Av. of graded potatoes (deducting 5% culls from the gross volume):	-	-	-	-	-	-	-	-	12.8

APPENDIX I

GRADING COST OF POTATOES AT THE WHOLESALE LEVEL
(based on grading of farmers' ungraded potatoes)

Farm No.	Volume Graded (cwts)	Labour ($)	Power ($)	Depreciation ($)	Insurance ($)	Repairs ($)	Interest ($)	Total Cost ($)	Cost per cwt. (cents)
40	94,900	13,635	103	208	5	-	32	13,983	14.7
46	92,800	11,047	432	6,450	150	300	170	18,549	20.0
42	45,500	5,958	491	1,000	60	-	20	7,529	16.5
43	45,000	9,204	461	600	-	50	72	10,387	23.1
45	81,625	13,774	297	250	-	25	60	14,406	17.6
44	45,000	6,114	1,412	1,025	50	-	210	8,811	19.6
47	335,610	34,245	1,945	6,794	313	372	1,147	44,817	13.3
Total:	740,435	93,978	5,141	16,327	578	747	1,711	118,482	124.8
Average:	105,776	13,425	734	2,332	83	107	244	16,926	17.83
Wtd. Av. (cents):	-	-	-	-	-	-	-	-	16.00
Wtd. Av. of graded potatoes (deducting 16% culls from the gross volume):	-	-	-	-	-	-	-	-	19.00

APPENDIX J

SCALE LOSS AND GRADING COST BY MACHINE AT FARM LEVEL PER HUNDREDWEIGHT

Farm No.	Grading Cost (cents)	Scale Loss ($)	Scale loss valued at 2¢ a pound (cents)	Total Cost (cents)
32	13.6	.75	1.5	15.1
6	15.6	.75	1.5	17.1
14	13.9	.75	1.5	15.4
16	22.7	.75	1.5	24.2
26	18.2	1.00	2.0	20.2
34	15.2	.75	1.5	16.7
5	10.7	1.50	3.0	13.7
9	17.9	.75	1.5	19.4
12	10.0	.75	1.5	11.5
35	7.4	.75	1.5	8.9
37	6.2	.50	1.0	7.2
21	13.8	1.50	3.0	16.8
3	8.1	.75	1.5	9.6
7	12.2	.75	1.5	13.7
11	10.3	.75	1.5	11.8
2	10.0	1.00	2.0	12.0
30	11.4	.75	1.5	12.9
18	10.3	1.00	2.0	12.3
22	12.4	2.50	5.0	17.4
23	11.3	.75	1.5	12.8
24	11.0	1.00	2.0	13.0
27	16.5	1.50	3.0	19.5
28	13.0	1.50	3.0	16.0
29	8.5	.75	1.5	10.0
33	11.2	.75	1.5	12.7
Total:	311.4	-	48.5	359.9
Average:	12.46	-	1.94	14.40

APPENDIX K

COST OF PACKAGING AND TRANSPORTATION OF CULLS PER HUNDREDWEIGHT TO WINNIPEG

Farm No. (1)	Volume of culls (cwts) (2)	Transportation cost (cents) (3)	Cost of bag & packaging (cents) (4)	Total Costs (cents) (5)
0 - 20 miles				
31	75.0	13.3	17.0	30.3
32	210.0	13.3	17.0	30.3
34	127.1	13.3	17.0	30.3
36	97.5	16.0	17.0	33.0
37	99.0	13.3	17.0	30.3
1	112.5	13.3	17.0	30.3
3	208.8	16.0	17.0	33.0
5	81.0	20.0	17.0	37.0
6	105.0	13.3	17.0	30.3
Average:	-	14.4	17.0	31.4
21 - 40 miles				
35	179.6	13.3	17.0	30.3
38	215.6	13.3	17.0	30.3
2	3,342.0	20.0	17.0	37.0
4	138.0	16.0	17.0	33.0
7	356.2	13.3	17.0	30.3
8	97.5	16.0	17.0	33.0
9	288.6	20.0	17.0	37.0
10	228.7	20.0	17.0	37.0
11	345.9	16.0	17.0	33.0
12	6.7	20.0	17.0	37.0
13	303.8	20.0	17.0	37.0
14	740.7	16.0	17.0	33.0
15	103.1	16.0	17.0	33.0
16	394.8	13.3	17.0	30.3
17	209.3	13.3	17.0	30.3
18	2,069.9	20.0	17.0	37.0
19	548.0	20.0	17.0	37.0
21	1,252.6	20.0	17.0	37.0
26	285.6	20.0	17.0	37.0
33	2,325.6	13.3	17.0	30.3
Average:	-	17.0	17.0	34.0

APPENDIX K--Continued

Farm No. (1)	Volume of culls (cwts) (2)	Transportation cost (cents) (3)	Cost of bag & packaging (cents) (4)	Total Costs (cents) (5)
41 - 60 miles				
39	843.7	26.7	17.0	43.7
23	16,425.0	20.0	17.0	37.0
24	6,988.8	20.0	17.0	37.0
30	1,828.2	26.7	17.0	43.7
Average:	-	23.3	17.0	40.3
61 - 80 miles				
20	1,980.0	20.0	17.0	37.0
28	16,450.2	21.3	17.0	38.3
27	7,846.9	24.0	17.0	41.0
Average:	-	21.8	17.0	38.8
81 miles and over				
29	8,741.2	23.0	17.0	40.0
22	21,120.0	16.0	17.0	33.0
Average:	-	19.5	17.0	36.5
Overall Average:	-	19.2	17.0	36.2

APPENDIX L

GRADING COST OF POTATOES AT THE WHOLESALE AND FARM LEVEL ON PACKAGE BASIS
(cents per hundredweight)

PACKAGE SIZE:	5#		10#		25#		50#	
Farm No.	Dry	Washed	Dry	Washed	Dry	Washed	Dry	Washed
WHOLESALE								
40	17.3	44.8	10.4	21.3	6.0	12.4	-	-
46	-	42.9	29.8	33.7	25.8	28.5	23.8	26.2
42	-	51.5	17.0	39.0	10.2	30.3	8.3	-
43	33.8	44.7	26.5	34.4	25.0	33.1	-	-
45	-	-	14.7	19.9	8.3	-	-	-
44	-	39.6	-	28.6	-	20.8	-	-
47	49.5	52.1	29.6	30.7	18.1	24.4	16.6	21.6
Total:	100.6	275.6	128.0	207.6	93.4	149.5	48.7	47.8
Average:	33.5	45.9	21.3	29.7	15.6	24.9	16.2	23.9
FARM								
22	-	31.0	-	19.6	10.9	11.0	7.1	7.2
24	-	40.0	-	25.0	13.7	-	10.0	-
27	-	-	-	-	-	16.0	-	11.0
37	-	-	23.2	-	12.1	-	7.5	-
28	-	-	-	-	-	29.4	-	22.4
30	-	-	22.3	-	11.5	-	-	-
Total:	-	71.0	45.5	44.6	48.2	56.4	24.6	40.6
Average:	-	35.5	22.7	22.3	12.0	18.8	8.2	13.5

APPENDIX M

QUESTIONNAIRE

"THE OPTIMUM LOCATION OF THE GRADING AND PACKAGING OF MANITOBA POTATOES"

A research study sponsored by the Department of Agricultural Economics and Farm Management, University of Manitoba--Manitoba Department of Agriculture and the Manitoba Fruits and Vegetables Wholesalers' Association Co-operating.

---

1. Name of the firm _____

2. Address _____

3. Volume received in different types of containers from farmers and others from June 1, 1961 to May 31, 1962:

(in bags of 75 pounds or hundredweight)

Size of packing (pounds)	Canada No. 1	Canada No. 2	Ungraded	Remark
5				
10				
25				
50				
75				
100				
in pallet bins				
in bulk unloading box				
Total				

4. Percentage of the total volume received, graded and packed into different size of containers during June, 1961 to May, 1962.

Size of packing (pounds)	Containers used (in numbers								
	Kraft		Opaque		Poly		Jute		
	No.1	No.2	No.1	No.2	No.1	No.2	No.1	No.2	Remarks
5									
10									
25									
50									
75									
100									

5. Grading equipment used

(a) Make and Model _____

(b) Size _____

(c) Year (age) Purchased _____

(d) Purchase price _____

(e) Major fuel _____

(f) Number of bags graded and packed per hour (indicate washed or dry)

5 lb. _____ numbers

10 lb. _____ "

25 lb. _____ "

50 lb. _____ "

75 lb. _____ "

100 lb. _____ "

(g) Size of crew _____ persons

GRADING AND PACKAGING COSTS

(All costs under question #7 should relate to the period from June 1, 1961 to May 31, 1962)

	TOTAL COSTS OF BOTH GRADES FOR DIFFERENT SIZES OF PACKAGING[1]													
	5 pounds		10 pounds		25 pounds		50 pounds		75 pounds		100 pounds		Remarks	
Cost Items	Dry ($)	Washed ($)	Dry ($)	Washed ($)	Dry ($)	Washed ($)	Dry ($)	Washed ($)	Dry ($)	Washed ($)	Dry ($)	Washed ($)	Dry ($)	Washed ($)
LABOR														
(for washing, grading and packaging or general crew)														
MATERIALS														
(Cost of Jute, Kraft, Opaque, Poly and Master Container, cost of ties, twine, wire, needles, etc.														

(1) If separate costs for each size of package that is 5 pounds, 10 pounds ... 100 pounds are not available, the total labor and material costs on the total volume graded (dry and washed) during the year may be given under Remarks column.

OTHER COSTS (from June 1, 1961 to May 31, 1962)

(a) Total amount paid to the foreman for the year if exclusively kept for the grading machine _____$

(b) Cost of haulage from the storage bin to the grading table (delete if included under labor costs above) _____$

(c) Total costs for the year on (i) Water _____$

(ii) Power _____$

(iii) Gas _____$

(iv) Light _____$

(d) Miscellaneous costs for the year

Cost Items	On building area used for grading and packaging ($)	On grading and packaging plant ($)
Depreciation		
Repairs and maintenance		
Insurance		

(e) Total volume graded during the year _____ bushels/cwt.

Total man-hours employed (including woman labor) _____ man-hours

(f) Average shrinkage loss due to (i) culls _____$

(ii) scale loss _____$

6. General

(a) Do you regrade potatoes which have been graded by farmers themselves; if so, why?

_____

_____

_____

_____

_____

(b) Indicate the percentage of defects in farmers' grading _____%

(c) Will your costs of grading and packaging be affected in any way if the farmers stop grading their potatoes at the farm altogether and bring ungraded potatoes to your plant? Please give reasons for your answer.

_____

_____

_____

_____

_____

(d) Wages paid per hour

Labor	Fall	Spring	Winter
	$	$	$
Man			
Woman			

QUESTIONNAIRE

"THE OPTIMUM LOCATION OF THE GRADING AND PACKAGING OF MANITOBA POTATOES"

A research study sponsored by the Department of Agricultural Economics and Farm Management, the University of Manitoba--Manitoba Department of Agriculture and the Vegetable Growers' Association of Manitoba Co-operating.

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1. Name of Grower _____

2. Address _____

3. Potato varieties grown during 1961:

Variety	Acres	Yield: Bags/Acre
Total:		

Total acreage of all crops _____ acres.

4. Harvest and method of sale:

(a) Equipment used for harvesting _____

_____

(b) Equipment used for haulage to bin _____

_____

(c) Estimated percentage of cut or damaged tubers in total yield

_____%.

(d) Value and quantities disposed of as

(i) Utilized as own seed _____ bags or % of total production

(ii) Sold as seed _____ "

(iii) Sold for table purposes _____ "

(iv) Sold for processing _____ "

(v) Others (specify) _____ "

_____ "

(e) Method of sale (exclude seed potatoes):

to wholesalers _____ "

to dealers _____ "

to retailers _____ "

to institutions _____ "

to processors _____ "

to roadside stands _____ "

to peddling _____ "

to consumers _____ "

to consumption by farm family ___ "

_____ "

to others (specify) _____ "

_____ "

5. Transportation:

(a) Average distance from the potato field to bin: _____ miles

(b) Average cost of haulage per bag from field to bin _____

(c) Truck mileage to central market:

(i) from the potato field _____ miles

(ii) from the grading shed _____ miles

(d) Actual/estimated cost of transport to the central market per bag from grading shed _____

(e) Volume delivered by different means:

(i) own truck _____ bags or % of total production

(ii) buyer's truck _____ "

(iii) P.S.V. truck _____ "

(iv) Rail _____ "

6. Volume of table stock sold (June 1, 1961 to May 31, 1962):

(a) Methods of delivery: (i) Graded _____ bags

(ii) Direct from the field _____ "

(iii) from the bin (ungraded) _____ "

(b) Volume sold in different size of bags of Canada No. 1 and No. 2 grades, or % of total sales in different bags by grade:

Size of packing (pounds)	Kraft		Opaque		Poly		Jute		Remarks	
	No.1	No.2	No.1	No.2	No.1	No.2	No.1	No.2	No.1	No.2
5										
10										
25										
50										
75										
100										

(c) Volume sold in different types of containers

Containers	Canada No. 1 (bags)	Canada No. 2 (bags)	Ungraded (bags)	Remarks
Pallet bin				
Bulk unloading box				

7. Cost of grading and packaging:

Please check if you used (a) hand grading

(b) machine grading

In case of machine grading,

please state (i) Type and make _____

(ii) Size _____

(iii) Purchase price _____$

(iv) Year of purchase _____

(v) Size of motor _____

(vi) Volume graded/hour _____

(vii) Size of crew _____

8. Different costs (from June 1, 1961 to May 31, 1962):

(a) Total amount paid to the foreman for the year if exclusively kept for the grading machine _____$

(b) Cost of haulage from the storage bin to the grading table (delete if included under labor cost) _____$

(c) Total cost for year on (i) Water _____$

(ii) Power _____$

GRADING AND PACKAGING COSTS

Items	5 pounds		10 pounds		25 pounds		50 pounds		75 pounds		100 pounds		Remarks	
	Dry	Washed	Dry	Washed	Dry	Washed	Dry	Washed	Dry	Washed	Dry	Washed	Dry	Washed
Bags graded per hour in different sizes														
Size of crew														
Cost of bags in different sizes														
Cost of ties														
Cost of tags														
Cost of clips														

(d) Miscellaneous costs for the year:

Cost Items*	On building area used for grading and packaging ($)	On grading and packaging plant ($)
Rate of Depreciation		
Total repairs and Maintenance		
Total insurance		

*Indicate the total area, cost and rate of depreciation of storage bin and the area occupied for grading and packaging.

(e) Average shrinkage loss due to (i) culls _____%

(ii) scale loss _____%

8. Average cost of labour per hour during the year:

(i) Male _____$

(ii) Female _____$

9. (a) Cost of a pallet bin _____$

depreciation _____$_____¢ per annum

(b) Cost of bulk unloading box _____$

depreciation _____$_____¢ per annum

10. Net price received by farmers per 75-pound bag

Period	Canada No. 1	Canada No. 2	Ungraded
1st Qr. (ending Aug/61)			
2nd Qr. (ending Nov/61)			
3rd Qr. (ending Feb/62)			
4th Qr. (ending May/62)			

11. General

(a) Do you grade your potatoes on the farm? Yes _____

No _____

Reason _____

_____

_____

_____

(b) Since when have you stopped grading at the farm? _____ year(s)

Reason _____

_____

_____

_____