A STUDY OF LABOR PRODUCTIVITY
IN
SASKATCHEWAN AGRICULTURE

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INTRODUCTION

Historical Background

For the greater part of its history Canada has been primarily an agricultural nation. Since the days of the fur trade more people have been employed in agriculture than in any other single occupation. Even today more people are directly dependent on farming as a means of making a living than on any other occupation except manufacturing as a whole.[1]

The predominance of agriculture has been due, in part, to the abundance of land suitable for farming, the comparatively steady demand for wheat in world markets and the relative ease with which land could be exploited as a natural resource through farming. Although considerable amounts of capital are required in commercial farming today, it was possible for the first settlers on western farms to build up a farm enterprise with comparatively little original capital. Individuals are still able to work up to the position of farmer, through the stages of hired laborer, renter and owner. The total amount of capital required in an efficient size of farm unit can normally be acquired by plowing back farm earnings into the business throughout the productive years of the entrepreneur.

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1. On June 1, 1950, the number of paid workers in manufacturing was 1,215,000 while persons with jobs in agriculture numbered 1,066,000. Dominion Bureau of Statistics, Canadian Labour Force Estimates, 1950.

As other industries developed in Canada, farming assumed a decreasing relative importance in the national economy.[2] A stable balance may eventually be struck between agriculture and the other industries in the Canadian economy. It seems unlikely in the foreseeable future that Canada will become a net food-importing nation. In wheat, at least, Canada will probably remain a net exporting nation almost indefinitely. The United States is still more than self-sufficient in wheat[3] despite a hundred years longer of industrial development, a much larger home population to provide a domestic market for agricultural products and a smaller proportion of her agricultural land devoted to growing wheat.

Though agriculture is declining in relative importance in Canada as a whole, it is still practically the only industry in large sections of the country. Saskatchewan, in particular, is almost wholly an agricultural province. Other industries, such as uranium mining and petroleum production, may become significant in the next few years but the largest group of gainfully occupied in the Province will probably remain dependent on agriculture as a means of living for many decades in the future.

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2. On March 1, 1952, persons with jobs in agriculture in Canada formed 16.6 percent of all persons with jobs at that date. Dominion Bureau of Statistics, The Labour Force Quarterly Survey, Vol. 8, No. 1.
3. The lowest percentage of the annual wheat crop in the United States to be exported in the forty years prior to 1939 was 3.5% in 1935. Reported by Barger and Landsberg, American Agriculture, 1899-1939, New York, 1942, p. 10.

For Saskatchewan, in particular, agriculture and its problems will continue to be of major concern not only to farmers themselves but to the majority of the non-farm population. Agriculture and its associated industries provide the major source of problems for legislators and the research staffs of provincial educational institutions and government laboratories. Considerable numbers of researchers are engaged in attempts to find new outlets for the application of human endeavor. The majority, however, are engaged in research on projects which seek improved methods, techniques and machines for agriculture.

All research on agricultural problems is to some extent concerned with methods of increasing the efficiency of agricultural production. All plant breeding programs are directed toward improving the quality, yield or dependability of varieties of field crops. The main emphasis, however, must be placed on the latter factor. The element of risk in wheat production from hail, rust, insects and frost damage gives rise to some of the major problems in the industry. Normally the development of new varieties resistant to rust or insect damage entails the effort at least to maintain yield and quality at the standards of the susceptible varieties in use.

Gains in yields and quality of the major crop, hard red spring wheat, have not been significant since the introduction of Marquis wheat, whose qualities and yield have been the standard against which all new varieties have been measured for most of

the twentieth century. Gains in average yield due to the development of more dependable varieties have not been noticeable. Losses in yield due to rust, frost and insects, though disastrous over certain areas at certain times, have not been sufficiently great to depress the average provincial yield per acre significantly. Drought has had a greater effect on yields than all the other factors combined and its effects have not yet been eliminated. Such improvements as have been made in yielding ability have been partly offset by gradual depletion of essential plant nutrients, particularly in the one-crop (wheat) areas. The use of fertilizers has not been sufficiently general to halt the depletion of phosphates. Loss of fertile top soil by wind and water erosion and destruction of organic matter by the burning of wheat stubble have further contributed to the loss of fertility and the capacity of soil to retain needed moisture during dry growing seasons.

Since little has been accomplished in the way of developing higher yielding varieties, increases in the efficiency of agricultural production have been mainly due to improved cultural techniques and better organization of the farm enterprise. Improved cultural methods have been the principal means of overcoming the hazards of dry-land agriculture. Better organization of the farm enterprise, in particular as regards the proportional inputs of labor, land and machinery in the enterprise, has been the principal means of increasing the efficiency of the process of production.

Cultural methods required for successful dry-land agriculture were developed quite early in the period of prairie farm land settlement. The summerfallow technique was adopted before the turn of the century and it has only varied in the proportion of the land fallowed and the actual cultivation methods used in summerfallowing. The main changes in cultivation methods on summerfallow have not been exclusively concerned with improving the productiveness of summerfallow land in the immediately succeeding year. Moisture conservation is the major concern in the drier areas but weed control requires a continuous and long-term program of crop rotation including summerfallow over most of the prairie area. In the drier areas protection of the soil from the effects of wind and water erosion is of great importance. Erosion control through the use of improved types of tillage implements has been an important aspect of the changes in methods of cultivation.

Changes in farm organization, then, have been the significant factors in improving the efficiency of prairie agriculture. These changes have been greatly affected by circumstances of historical development. Initial settlement on the quarter-section homestead basis, although modified by the provision for pre-emption of a second quarter, fixed a rather rigid pattern of rural settlement and farm size on the early agricultural community of Saskatchewan. Quarter and half-section farms still form a considerable proportion of the farms in the Province though the pattern of farm-size distribution has been steadily modified since the days of original settlement.

Adjustment of the proportional inputs of land and labor in the farm enterprise has been achieved almost wholly by an increase in farm sizes and a reduction in numbers of farms rather than by the use of smaller amounts of labor on each farm. The increase in the size of farms has been inhibited by three factors: (1) social inertia which maintains some farmers on uneconomic units at least until the retirement or death of their generation; (2) limitation of capital to farmers generally so that they are financially unable to build up their farm units to an efficient scale except over very long periods of time; and (3) the lack of alternative job opportunities for surplus farm population during long periods of industrial stagnation such as the depression period of the thirties. The latter factor has not only delayed the adjustment of farm population downward to a level more consistent with relative efficiencies between agriculture and other industries but has also reversed the process by back-to-the-land movements in periods of severe unemployment in industry.

Changes in the amount of machinery used on farms have been influenced by, (1), the rate of development of power machinery suitable for Saskatchewan conditions, and (2), the availability of capital to farmers. The latter factor has influenced the rate of mechanization in the same way as it has inhibited the increase in farm size. In fact the two processes are inseparably related. Capital is required for the acquisition of additional land and also for the purchase of newer and larger machine units.

Normally these investments must be made concurrently. Larger acreages require the use of larger machines. In turn, farmers must have larger farms before they can accumulate the larger amounts of capital required for the purchase of largermachinery.

The development of power machinery, though influenced by the demand for new type of machines, has been largely an historical process. Improved types of machines enabling farmers to increase their efficiency of output have often been available many years before they have come into common use. Though the gasoline tractor was adopted fairly rapidly as the motive power on Saskatchewan farms, the grain combine, which has been almost as significant in the mechanization trend, did not come into widespread use until after the first quarter of the twentieth century. It had, however, been invented and used in the United States nearly half a century earlier.[4] The early machines were adaptable to Saskatchewan farming conditions to a limited extent. The development of combines powered by auxiliary motors or run by tractor power by means of a power-take-off shaft made it possible for more farmers to use the combine with a minimum of reorganization in their farm machinery requirements. Other developments making the combine more suitable were the growing use of the one-way disc which could operate efficiently in combine stubble, the installation of seed recleaners on combines to remove green weed seeds and the development of the swather for use in areas where the crop did not ripen evenly.

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4. Horse-drawn combines were used in California in the 1880's. Two-thirds of the California wheat crop was harvested by combine in 1900. Reported by Barger and Landsberg, op. cit., pp. 198-9.

The process of mechanization has been, on the whole, affected by social factors to a large though indeterminate extent. Mechanization has lagged in some areas which are apparently as suited to the use of mechanized equipment as other areas where it has been adopted somewhat earlier. Farmers as a group have been generally conservative and slow to change their methods. Mechanization in most areas, though it came suddenly when it did come, was often delayed for a considerable period after the first farmers ventured to change. The majority of farmers had to be shown, directly, by the example of enterprising farmers who mechanized their farm operations early, that newer methods were more efficient than the old. When new methods were accepted generally in an area, mechanization came about with great rapidity except when inhibited by lack of capital or a shortage of new machinery such as occurred during World War II.[5]

Mechanization was effected almost universally by the demonstration of its efficiency. The use of tractors and combines did not become general in most districts until some time after their advantage in economy had been demonstrated. The change, once begun, was often very rapid. Many farmers emulated their neighbors in mechanizing even though, in some cases, their farms were too small to make efficient tractor use possible.

Mechanization, accompanied by, and dependent on increasing scale of enterprise, has so far been the key to changes in

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5. Though machinery was restricted in supply during the war, sales were high due to the limited labor supply. A large backlog of demand was built up which kept factories in full production for several years after the war.

efficiency. To a large extent it has made possible still further changes in the same direction. Mechanization and the increase in size of farm units have increased efficiency and profitability in farming and to many individuals this has eased the limitations on the supply of capital available to them. The result has been a continued growth in the size of the farm unit in terms of land and a trend to larger and still larger implement units which enable the farmer to handle ever more acres of cropland per man.

Implications of Labor Productivity

One of the most significant results of these changes in agriculture has been the increase in the volume of production associated with the labor of one man. The ratio of production, or output, to the corresponding input of labor is known as the productivity of labor.[6] When this ratio increases (the output per man employed goes up) the productivity of labor is said to increase. The increase in output per man is not attributed to an increase in the intensity, duration or effectiveness of labor although it may entail an increase in skill on the part of the laborers. Labor productivity is merely a convenient concept by which we can measure the effectiveness of production methods as they change through time or as they differ between regions or countries.

Increases in labor productivity in agriculture have great implications for farmers individually and for the workers elsewhere

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6. Report of the International Labour Office, Methods of Labour Productivity Statistics, Geneva, 1951, p. 7.

in the national economy. A nation is generally considered to be well off in inverse proportion to the percentage of its population which is required to produce its own food, either directly or by exchange of products. This is a very broad generalization, but it is obvious that the less the labor time required in producing the essentials for living, the more time there will be available for producing luxuries or for enjoying leisure. Since food is the major universal essential for life, the productivity of labor in agriculture is significant in all countries at all times.

Just as the whole population may be better off if fewer workers are required in food production, workers in agriculture can expect similar gains as a part of that population. But gains to agriculture through increased labor productivity are not limited to those achieved as consumers. Returns to labor, management and capital in all industries are influenced by labor productivity. In agriculture, where laborer, manager and capitalist are typically the same individual, gains through increased productivity accrue largely to the farm operator.

When productivity increases throughout a whole industry, the major benefit may accrue to society rather than to the workers in that industry. When it increases differentially between firms within the industry, those firms with the greatest increases are in a position to gain the most. If the farmers with the lowest output per man could increase their volume of output by reorganization of their enterprises, they would improve

their economic positions relative to their more efficient competitors in the industry and relative to those employed in other industries.

Essentially, the standard of living of the whole population depends on the productivity of labor in all industries and occupations. According to a report of the Seventh International Conference of Labour Statisticians:

> "Since economic welfare is the sum of material production and leisure in which to enjoy the fruits of production, productivity is a far better index of economic welfare than actual production." 7

Rising standards of living are closely related to the output per man-hour of labor in all industries combined. An increase in productivity in one industry may have no advantage to welfare if it is made possible by a shift of part of the production process to another industry. Only if the total labor employed in the whole production process decreases relatively to output is there a social gain.

Output per man is merely one method of expressing productivity. Such a measure relates changes in efficiency to the human element which enters into production. Increases in productivity calculated on any basis are attributable to a whole complex of factors, including labor, but primarily to improved methods of production and more efficient sources of power. Changes in productivity can be related to inputs of labor, capital, land, management or other factors. Relating them to inputs of labor is often more useful in inter-industry or inter-

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7. Ibid., p. 1.

regional comparisons since labor is a universal and often a more homogeneous factor than land or management. Though capital is as universally used and is as homogeneous as labor, it is not as universally supplied by all individuals. Labor productivity should concern everyone while only a minority are directly interested in the productivity of capital.

Labor productivity bears a direct relationship to living standards. Though differences in productivity may be primarily due to differences in the amounts of capital invested in two industries or countries, the measurement of the differences in terms of output per man gives an approximate measure of the relative standards of living in the two areas. This is not the case when productivity is measured in terms of invested capital. The productivity per invested dollar may be extremely high and yet, if the capital invested per man is low, the standard of living may be quite low.

Measures of labor productivity, then, reveal most clearly the differences in productivity and, indirectly, differences in efficiency in the industries of different countries. Such measures are probably more significant in agriculture than in other industries because of the greater influences of social forces and institutions in primary industries. Farming is a way of life and its development is influenced by that fact. It is also the world's oldest industry and its roots extend backward for centuries. Some of its methods are still shaped by tradition and historical patterns which were age-old before modern manufacturing and tertiary industries began to develop.

Semi-feudal methods of land tenure, institutionalized by family custom and peasant tradition, still survive in a majority of the agricultural areas of the world. The world food problem will involve, in its solution, the effort to raise the output per man in agriculture in the food deficit areas of the world.[8] The output per man in agriculture is highest at the present time in the food surplus countries. However, labor productivity on the more efficient farms in countries with food shortages may well be considerably higher than that on the less efficient farms in food surplus countries. Reorganization of inefficient farm enterprises may be the most important single measure that could be undertaken to increase the efficiency and volume of food production.

Some theorists assert that the problem of production has been solved by science and that the main problem facing us is one of finding better methods of distribution. Granting that the production potential may be sufficient to provide the whole population of the world with an adequate diet, it is still probable that for some time to come increases in living standards will depend to a greater extent on actual production than on a complete reorganization of distribution and the solution of the

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8. The International Labour Office report notes that "the development of full employment policies and the pursuit of high levels of production have shown labor productivity to be of vital importance to all national and international bodies. The productivity of labor may be considered a cornerstone of the economy of the future". Methods of Labour Productivity Statistics, p. 1.

production problems which would almost inevitably follow such a change. The experiences of Soviet Russia in food production during a period of radical changes in economic organization of production and distribution give adequate warning that production may be disorganized for some time by changes in distribution methods which have detrimental effects on the producer. Theoretically, increased production and better distribution are possible at the same time but it seems doubtful that this can be achieved easily or quickly. Although distribution cannot be ignored, production problems will continue to be a major consideration in the future.

With increased government intervention in production, marketing and price policies in agriculture, the measurement of changes in productivity becomes more important. Without fixed or supported prices and production quotas the adjustments in resource use between agriculture and other industries are automatic though not necessarily exact, equitable or efficient. Adjustments may be distorted and of an undesirable nature due to the difference in the degrees of competition prevailing in agriculture and other industries. Labor can and does flow into agriculture during periods of industrial depression and unemployment. Even if labor did not flow into agriculture the rate of movement out of agriculture and into industry may be slowed down or stopped completely.[9] Impediments to the flow of excess labor

9. The net migration from farms in the United States in the five year period between 1930 and 1934 was less than one million compared to almost three million in the preceding and succeeding five year periods. Figures given by T.W. Schultz in Agriculture in an Unstable Economy, p. 90.

out of agriculture result in an unbalanced distribution of labor between agriculture and other industries. If agricultural prices were not subject to extreme variations and did not drop relatively further than those of industry during depression periods, the adverse migration of workers would presumably be heavier than it has been in the past.

When prices of farm products are supported by government action, rigidities appear in the economic system which did not exist before. Adjustments in resource use between agriculture and other industries and within agriculture itself become less automatic. Production quotas and price adjustments are then needed to guide production decisions within agriculture. Many governmental regulations cannot be made fully equitable to all producers and may be difficult to justify. Inter-industry adjustments through regulation of output or prices may be even more difficult to make. Even if such measures are generally acceptable a knowledge of productivity trends is useful if decisions are to be sound economically.

Price supports for agricultural products, if based on parity, do not take into account changes in productivity. In a period when productivity of labor is increasing more rapidly in non-agricultural industries than it is in agriculture, parity prices will not serve to maintain farm real income in the same position relative to real income in the non-farm segment of the economy. This will be the case even though the prices farmers pay for the things they buy enter into the calculation of parity.

Though the farmers get price adjustments for their products when prices change for non-farm goods, they get no advantage from the greater increase in productivity in the non-farm segment where such increase is not reflected in price.

During a period when productivity is increasing more rapidly in agriculture than in non-farm industries, the farmer gets an excessive advantage from a parity price. All the benefits of increased productivity in agriculture then go to the farmer and none to the workers in other industries even though such increase is made possible largely by advances in science and technology utilized by non-farm industries in supplying farm equipment. Increased production of farm equipment usually requires an increase in the amount of labor and capital used in equipment-producing industries. The increase in agricultural productivity should then be shared with workers in industry.

Over moderately short time periods, changes in relative efficiencies are usually not great enough to be an important consideration. If parity is based on an historical period twenty years previous, however, it is quite possible that resulting prices will be distorted from a desirable relationship because of intervening changes in efficiencies.

This aspect of the problem is not confined to agriculture but is common throughout the whole economy when prices and wages are controlled by governmental policies or monopolistic practices. In a freely competitive economy, even though it be regulated by

government, all groups continually seek an increasing real income, justifiably so if national output per man is rising. Theoretically, if increased productivity results from more efficient methods of production, all benefits go in the long run to society as a whole. If labor or any other factor of production is able to compel the diversion of more than its share in the increase to itself, such benefits do not reach all of society.

Ideally the benefits should accrue to all, as consumers, but under imperfectly competitive conditions, part at least, is often engrossed by the entrepreneur or by labor. Agriculture, being more nearly perfectly competitive, would theoretically be unable to make excess profits from increased productivity. Assuming that it does not, as an industry, retain the benefits there is such a great differential in productivity between individual firms and regions within the industry that individual farmers may make great gains by increasing their own productivity. Under such conditions, farms with the greatest increase in productivity, gain, and those with the least, lose. The same applies to all industries to some extent but it is much more obvious in agriculture. Concentration of efforts on raising the productivity in the least efficient segments of agriculture should have a greater effect in raising average productivity and increasing the benefits to society than encouraging the most efficient to improve still further.

The reallocation of resources to a more efficient use is not readily susceptible to governmental regulation. Pricing policies for agricultural products might distort resource allocation in an undesirable direction if they placed any premium on inefficiency. Guaranteed prices for a fixed level of output per farm with no guarantee above that level could discourage attempts to build up larger farms if the differential between fixed and open market prices were large. At best, such a policy would have no effect on productivity levels. On the other hand, fixed prices at profitable levels for all output would aid the most efficient producers the most. Such a policy might aid small farmers in increasing their scale of business to some extent. In general, price policies are not effective for guiding or aiding farmers in making more efficient resource allocations.

Probably of greatest importance to agriculture and its individual producers are the implications of productivity differentials associated with scale of farming. Variations in productivity with scale of enterprise parallel and are actually part of the cause of variations of returns to scale. Most surveys of farm businesses show, under normal conditions, increasing returns to scale. These have direct significance only for farmers themselves except when inefficient sized units are a contributory factor when farmers require relief or emergency aid. Then the taxpayer may be concerned with efficiency in farm business organization. Productivity differentials with

scale have direct implications not only for the individual producer but for the whole economy. Low output per man in one industry or in a segment of an industry means inefficient organization of production. The result is a higher average cost of production and product price than would otherwise obtain.

A knowledge of labor productivity and the factors affecting it is useful in the analytical investigation of individual businesses, industries within a country and for each industry in different countries. Only in recent years has much research been directed specifically to the measurement of labor productivity. Though many studies have been made, research is still required into the most effective, reliable and useful methods of measuring labor productivity.

Problems of Measurement

The greatest amount of research on labor productivity has been done in the manufacturing industries. In those industries the problems of measurement are more easily solved and the results of investigations are more easily put to practical use.

Two alternative methods of calculating and expressing labor productivity are in terms of output per man-hour and in terms of labor time required per unit of product. The latter method of expressing productivity is generally preferred because (1) it is easier to compare productivity in production of different items when both measures are expressed in the same unit, the hours of work per unit, and (2) the latter measure is additive

and the labor hours required per unit in several successive processes may be summed in order to calculate the total labor hours without calculating the reciprocals of each item.[10]

Calculations of labor productivity are most useful for comparative purposes if the results are expressed in standard terms. This makes inter-industry, inter-regional and international comparisons possible. The Seventh International Conference of Labour Statisticians made some preliminary recommendations regarding desirable methods of presenting data but recognized that further research into methodology was necessary. The Conference placed special emphasis on the need of accompanying data on labor productivity with descriptions of the methods of its collection, the methods of computation used and interpretations of the data in the light of the methods followed.[11]

Research into labor productivity in agriculture has lagged far behind that in manufacturing partly because of the greater difficulties of measurement. The most difficult factor to measure accurately in agriculture is the input of labor. Existing data on farm labor taken in census and other surveys are much less specific and accurate than for industries where most employees work full time and are concentrated in much larger establishments which keep accurate and comprehensive records.

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10. For further discussion of this point see the International Labour Office report, Methods of Labour Productivity Statistics, Geneva, 1951, p. 120.

11. Ibid., p. 123.

Labor time on large numbers of relatively small farms is much less accurately measured by the employer and estimates given to enumerators are usually only approximations.

The problem of getting accurate information from individual farmers depends to a great extent on the wording of the questions asked. Enumeration of farm labor involves a definition of farm employment. Definitions and categories vary from one census period to another and from one survey to another. As in all measurements of labor input, a distinction must be made between the labor force and the number of people actually at work during the period under survey. The "Labor Force" includes all those absent from their regular work due to sickness, holidays and lay-offs as well as those without jobs who are seeking work in the occupation at which they are usually employed and those who are seeking their first job.[12] Since most data give only the numbers in the labor force for each industry, estimates of actual labor inputs must be made if productivity is to be calculated on a man-hour basis.

Measurement of labor inputs in agriculture is further complicated by the composition of the labor force in that industry. Paid and unpaid family labor represents a significant proportion of the labor inputs but due to its highly variable nature it is very difficult to measure. Even the labor of the farm operator is subject to great error in measurement.

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12. Dominion Bureau of Statistics Reference Paper, Canadian Labour Force Estimates, Ottawa, 1951, p. 2.

Labor requirements over the year vary more widely in farming than in most other industries. On many farms the operator spends less than half of the year at productive work. When he puts in a full year his labor intensity and number of hours worked per day will vary considerably with periods of high and low labor requirements.

Variation in the number of hours worked per week is common to all classes of workers on farms. Even hired workers may work different hours per week at different seasons of the year and their regular hours may vary from farm to farm. Special surveys carried out at different periods of the year can provide estimates of these variations for a region or province but differentiations have not been obtained for different types or sizes of farms. Special area surveys have included some data from which estimates of these can be made.

Another problem in the measurement of labor inputs is associated with changes in mechanization. As farms are mechanized, the labor formerly applied to raising draught horses and the feed for them is eliminated and replaced by workers in industry who produce machines, oil and grease. The labor embodied in these machines may or may not be taken into account in the calculation of labor productivity in agriculture. The measurement of this embodied labor is practically impossible since it will vary with the plant producing the machines[13] and also with

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13. Methods of Labour Productivity Statistics, p. 33. The International Labour Office report notes that embodied labor represented by invested capital might justifiably be included. Then the result becomes practically identical with man-hour cost analysis rather than labor productivity as her defined.

the intensity of machine use on farms. Since measurement of labor productivity purports only to indicate the increase in output per man through time, the greater use of machines need not be considered in making such estimates unless the actual effect of machinery on productivity is under study.

Measurement of output in agriculture also involves problems not encountered in other industries. Farm output varies with the type of soil, the region, the climate and natural hazards. All attempts at measurement of production over time must eliminate the effects of climatic variations on yields at least. This can be done by using moving or long-time averages of yields. The averaging of production per acre can be done indirectly after productivity changes have been calculated by establishing a trend line for productivity.

Output measurement for productivity calculations is also complicated when two or more products are included in the output of one plant or industry. This is particularly true in agriculture when national output for the industry may include the output of twenty or more crops, several livestock enterprises and a dozen or more livestock products. If actual estimates of physical output are made for each there is a further problem of whether to use gross or net output for productivity calculations. If net output is used, it is necessary to estimate the amount of crop output fed to livestock and used for seed as well as livestock products fed to livestock.

When the proportions of different products entering into total output vary between regions or countries, a problem of weighting the different products is involved. If a composite output is used, it makes regional or national comparisons more difficult to make. The same type of problem arises when the proportions of different products involved in total output change through time in one region. Composite output calculations do not lend themselves so readily to the estimation of productivity trends.

Output of a single product or a group of products may be measured in value terms. Data on value of output are more plentiful than those for physical volume. But value of output measures are much less useful than physical output measures when international comparisons are made. Though the effects of changes in relative prices over time can be eliminated by deflating the value of output series with an index of prices, the results will not be directly comparable with similar studies in other countries. The use of purely physical measures of output per man overcomes the problem of fluctuating and sometimes indeterminate exchange rates.

OBJECTIVES AND PROCEDURE

Objectives and Scope of the Study

This study of labor productivity in Saskatchewan agriculture has a three-fold objective: (1) to compute an index of labor productivity by five year periods from 1926 to 1951; (2) to assess the influence of various factors affecting labor productivity within the industry; and (3) to investigate new methods of calculating productivity and assess their validity and usefulness.

An index of labor productivity for the period 1926 to 1951 covers the period of agricultural development in Saskatchewan from the time land settlement was nearly completed until the present time. It also covers most of the period of major changes in the extent of farm mechanization.

It is not yet known just what factors have an influence on labor productivity but farm business studies have revealed most of the main factors. These include region, soil type, size of farm, capital invested, extent of mechanization, type of farm, skill of management and the organization of the farm business in terms of particular combination of labor, land and equipment. Many of these will be rather closely associated and individual study of each would involve duplication. The attempt will be made here to give detailed study to only a few of the main factors. Capital inputs, size of farm and ability of management as well as degree of mechanization are usually closely

correlated, though the ability factor is hardly susceptible to measurement. The factor of size of farm together with those of soil zone and soil type will be dealt with in this study. Type of farm would be a further suitable factor. It is not included here because the available data are not as adequate for the purpose as are those for the other factors used. The type of farm factor is also of lesser importance in a region such as Saskatchewan where the farms are predominantly of one type.

In using new methods of calculating labor productivity, it will not be possible to compare the results directly with similar calculations made by using alternative methods since no parallel studies have been made for this area. Only their apparent values and limitations can be pointed out.

Sources of Data

Considerable quantities of data have been gathered in Canada relating to production and employment. The principal sources of statistical information regarding agriculture are the decennial census reports for the Dominion of Canada and the quinquennial census reports for the Prairie Provinces. These cover the whole period under survey and provide basic over-all figures for employment, acreages and output for the census years. They also provide tables on distributions of farms by size for each Census Division, which can be computed on a regional or soil zone basis but not on the basis of soil type.

Additional data on labor inputs are available on a regional (Prairie Provinces) basis from the Labour Force Surveys published quarterly by the Dominion Bureau of Statistics since November, 1945. This report gives data on hours worked per week and is used in this study to calculate a correction to apply to census data on total workers employed in agriculture.

Other regular bulletins published by various departments of the Dominion and Provincial governments give data on output, employment and farm wages, much of it collected from regular correspondents in all districts throughout the country. These correspondents are mostly farmers, agricultural representatives and grain company elevator agents who make periodic estimates for the department requesting the information.

Of greatest use in the main part of the study - that dealing with factors influencing productivity - were a series of Farm Business Surveys conducted in several parts of the province by the Farm Management Department of the University of Saskatchewan and by the Dominion Economics Division located at the University. The information from these surveys is available in its original form and much of it is coded on Hollerith cards for tabulation by machine. This permitted tabulations by size of farm and soil type to be made in the form required for productivity studies for a fair sample of farms and areas in each soil zone. The results of these tabulations, combined with census data, provide the basic material for the analysis.

Limitations of the Data

None of the data used were collected specifically for the purpose of labor productivity analysis. Therefore, they could not be expected to include the tabulations or the exact information required in such a study. Many of the census tabulations which were useful had shortcomings. Census classifications were not uniform in construction throughout the period under study. A major weakness was found in the census distributions of farms by size. In the six census reports used in the study, four different sets of class limits were used for the farm size distributions. This rendered census data almost useless for calculation of changes of the numbers of farms in each size group during the period studied.

The census distributions of farms by size also contained a downward bias in farm sizes. The census, for all years except 1951, classified parts of farms which were located in municipal divisions other than that in which the farm headquarters was located as non-resident farms. In the tables of distribution of farms by size, these parts of farms were included as complete farms. This increased the number of small farms absolutely and moved the farm units of which they were parts down to a smaller acreage grouping.

The same difficulty arose in the census report of numbers of farms in each census division and in the Province as a whole. The parts of farms described above are included in total farm numbers and are duplications. Though these can be subtracted

from the total to get a net number of farms, the result is only approximate since the non-resident farm category includes some complete farm units in each municipal division for which the operators were actually non-resident. Such farms increased in numbers rather rapidly during the war and post-war years. This made the resulting net farms figure unreliable for 1946.

In the tabulation of farm workers there was also a lack of continuity. In 1926 no tabulation of numbers of farm workers was given. Estimates had to be made for that year.

In the study of productivity differentials by farm size, the census reports lacked many of the required cross-classifications. Analysis for the data given was possible only for the Province as a whole since classifications were not given for smaller divisions. Even the Provincial figures were biased because of the bias in farm size distribution and in farm numbers.

The Labour Force Surveys had the most comprehensive data on labor employed in agriculture. Unfortunately, the data were given for the numbers employed for the Prairie Provinces as a whole and not for Saskatchewan alone. Numbers of hours worked per week was given only for the whole of Canada. Finally, the Surveys covered only the period from November, 1945, to the present and adjustments for hours worked per week had to be made by applying an estimated correction factor to earlier data.

The data from the Farm Business Surveys also lacked information on hours of labor input. A further limitation, though not a serious one, was that the surveys were not taken at one point of

time as was each census. To get an adequate sample from all the soil zones, surveys conducted over a period of three or four years were used. Since labor productivity does not change rapidly, surveys taken two or three years apart were considered comparable.

Methods of Analysis

Two methods have commonly been used in previous studies of labor productivity in agriculture. The first method is to take special surveys on a stratified random sample of farms in the region under study.[1] In this type of study, production functions are derived by regression analysis of the original data. Regressions are calculated for selected factors of production used in the farm enterprise. The resulting coefficients indicate the increase in product associated with the addition of one unit of a variable input of each factor included in the analysis. Strictly speaking, this does not give a measure of the productivity of labor as we have defined it. Rather, it measures the influence, at the margin of inputs, of one unit of labor on total output of an average farm. The result is marginal productivity, rather than average productivity. If all factors of production are included in the analysis, the entire output can be credited proportionally to the different productive factors. This gives an estimate of the actual amount and percentage of output which can be attributed to labor. It does not give the ratio of total output to the input of labor which we are seeking in this study.

1. For illustration of this method see Resource Productivity on Montana Dry-Land Crop Farms, by Darrell F. Fienup, a Master's thesis published by Montana State College Experiment Station, Bozeman, Montana, 1952.

The second method used in labor productivity studies is to derive annual series of physical outputs and employment in agriculture from census data and other surveys and estimates of total production and employment.[2] These are converted to annual indices and, by dividing the output index number for each year by the index of employment for that year, annual indexes of labor productivity are obtained. This gives an over-all index of labor productivity of the type we have defined and, when broken down by areas and products, gives a measure of physical productivity. This type of analysis requires the use of many previous estimates from other studies of hours per acre or livestock unit in making the detailed estimates of labor productivity on the basis of physical output.

In the present study, the methods followed were similar to the latter type but made use of both special survey analyses and census data. An attempt was made to apply the results of special survey tabulations to census data in making the study of factors which influence labor productivity on Saskatchewan farms. The greatest innovation in the study was the method of calculating output. In order to eliminate the effects of climatic variations, yields were calculated on a long-time-average basis for each area and soil type included in the study.

One of the major difficulties encountered in all studies of productivity in agriculture has been the composite nature of output.

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2. The best example of this method is illustrated by Harold Barger and Hans H. Landsberg in American Agriculture, 1899-1939, American Book - Stratford Press, Inc., New York, 1942.

On a national basis it is necessary to calculate output on a composite basis. In a region in which one product is heavily predominant, little accuracy will be lost and many arbitrary assumptions avoided by basing calculations on a normalized output of the predominant product. This was done with wheat representing the major product of Saskatchewan farms.

For Provincial estimates of productivity, census and Labour Force Survey data were adequate for analysis both by farm size and soil zone separately but not for farm size within each zone. They were also inadequate for estimates by soil type. These estimates required the application of survey data calculations to census tabulations.

For almost all calculations on regional, soil-type and farm-size bases other than for the Province as a whole, analysis required the use of data from Farm Business Surveys. Estimates based on survey tabulations were applied to census figures to derive productivity estimates for the whole area concerned in each case. Survey data did not give sufficient coverage to make time-series estimates of productivity changes for each of the factors influencing productivity. Therefore, the more detailed estimates of productivity differentials were made from a point-of-time study centered on the census year of 1941. Surveys within two years of this date gave a good sample coverage for all soil zones, soil types and farm sizes in the Province.

PRODUCTIVITY TRENDS

Measurement of Production and Employment

The problem of assigning the labor employed in an industry with a composite output to each of the separate products is difficult to solve. Estimates can be made of the labor time required per unit of output of the minor products and total time used in producing these can be deducted from total labor input to derive the labor used in the production of the major product. Though such estimates of labor time per unit are subject to wide variations, they must be made if the two or more main products are equally important. When one product is predominant, the alternative is to allocate all labor inputs to the output of the major product. This is the procedure usually followed. The International Conference of Labour Statisticians noted that:

> "When an undertaking produces entirely different products, the output of each may be allocated to each corresponding industry ...; but this separation is not feasible for labor data, and employment or man hours expended in an establishment are practically always, in labor statistics, allocated to one industry, in general that of the main product of the establishment."[1]

This method is more applicable to agricultural labor in Saskatchewan than in most farm areas because of the heavy predominance of wheat production. In very few areas of the Province does any other product approach wheat in importance.

This method was extended in this study to base the estimate of total production on average wheat yields. Throughout most of the rovince wheat is the major cash crop, and on many farms it is

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1. International Labour Office, Methods of Labour Productivity Statistics, Geneva, 1951, p. 71.

the only cash crop. Most other crops are grown only as an alternative to wheat, especially as the second crop in a three-year rotation, though in some areas coarse grains or special crops give more favorable returns on the average. If other crops could compete with wheat and give a fair margin of increased returns over wheat, the latter would be displaced in the area concerned. But wheat is grown on substantial acreages in every area of the province and is easily the leading crop in almost all areas. It is the universal standard against which alternative farm enterprises are measured.

On this record, wheat was taken to be a suitable basis for estimating a normalized output in agriculture for Saskatchewan. Production was calculated on the basis of wheat yields applied to all of the improved acres actually under production for each year and area.

Yields

The calculation of normal output for years when yields were unusually high or low could be made by using the long-time average yield for the province. For the more detailed estimates of output in smaller areas or on farms on different types of soil, average wheat yields had to be calculated from the actual yields obtained under these special conditions.

Estimates have been made of probable average yields by soil types for the different municipal divisions in the Province.[2] These probable average yields were totalled by type of soil for

2. Unpublished data compiled by W. Parkinson at the University of Saskatchewan, Farm Management Department, 1941.

each soil zone. Soil classes were grouped into three categories of light, medium and heavy soils. Light soils included sandy loams to light loams; medium soils, loams to silty loams, and heavy soils, clay loams to heavy clays. These totals were then divided by the number of municipalities for which yields were reported on each class of soil. Where yields were reported for two soil classes in a municipality, the yields of each class were given only one-half weighting. When all three soil classes were represented, each was given one-third weighting. This gave estimates of average yields for each soil class for each zone as shown in Table 1.

Table 1. Estimated Average Wheat Yields Per Acre, by Soil Class and Soil Zone, Saskatchewan.*

Zone and Soil Class	Average Bushels per Acre	Percent of Soil Class in Zone	Yield x Percent	Weighted Zone Yield	Zone as Percent of Province	Yield x Percent	Weighted Provincial Yield
Brown Zone							
Light	9.33	13.37	1.247				
Medium	11.78	42.67	5.026	11.70	26.45	3.095	
Heavy	12.35	43.96	5.429				
Dark Brown Zone							
Light	10.42	20.97	2.185				
Medium	12.50	49.78	6.222	12.37	30.05	3.717	13.93
Heavy	13.55	29.25	3.963				
Black & Grey Zones							
Light	13.22	25.91	3.425				
Medium	17.04	60.37	10.287	16.36	43.50	7.117	
Heavy	19.32	13.72	2.651				

* Compiled from data on yields in Farm Management Department, and from unpublished data on Soil Areas by Association, Type and Topography, Soils Department, University of Saskatchewan.

Average yields for zones were obtained by weighting the soil-class yields by the proportion of the zone falling in each

class according to the Saskatchewan Soil Survey. This weighting introduced some bias in so far as the proportion of area cultivated varies between soil classes. The bias was probably relatively small and no means of correcting for it was available.

A Provincial average yield was obtained in a similar manner by weighting the yield for each zone by the proportion of the Province falling in each zone as given by the Soil Survey. This result was also biased by reason of the cultivated acreages in each zone differing from the acreages surveyed. This bias was corrected whenever Provincial output was calculated by using the actual acres in production in each zone as weights for the zone yields at the time for which the output was computed.

The Provincial average yield obtained was 13.93 bushels per acre. This estimate was close to the 14.0 to 14.5 usually accepted as the average Provincial yield. This specific yield was not used in later calculations. The weighted zone average yields were applied to the acres under production in each zone to estimate total Provincial output.

Input of Land

In calculating normal output in terms of wheat, the average yield was applied to the total improved acres which may be termed "productive" in each census year. By deducting the area under summerfallow and idle land (including roadways and farmsteads) from the total of improved acres, the total net productive acres were obtained as shown in Table 2 and Chart 1.

Table 2. Total Area in Farms, Acres Improved, Acres Fallow or Idle and Net Productive Acres, by Census Years, Saskatchewan, in '000's Acres. *

Year	Total Acres	Improved Acres	Acres Idle or Fallow	Net Productive Acres
1926	45,945	27,714	8,265	19,449
1931	55,673	33,549	9,941	23,608
1936	56,904	33,632	10,769	22,863
1941	59,961	35,577	15,026	20,551
1946	59,416	35,590	12,382	23,208
1951	61,663	38,807	13,660	25,147

* Compiled from Census data.

The total area in farms has increased considerably since 1926 with most of the increase taking place in the first half of the period. The total increase over 1926 was 34 percent. Improved acres have increased relatively more, having risen by 40 percent in the same period. All of this increase has not been reflected in net productive acres since the area in summerfallow increased even more rapidly, the total increase in this category being 65 percent. Net productive acres increased by 29 percent, or at an average rate of over one percent per year.

The percentage of improved land under summerfallow increased from 20 percent to 35 percent in the twenty-five year period. This would normally result in some increase in average yield since a higher proportion of the crop would be sown on summerfallow land. This would apply particularly to the year 1941 when the area in summerfallow rose to 42 percent of improved acres due to the Wheat Acreage Reduction plan of that year.

For the purpose of estimating a productivity trend this variation was not too serious. The bias, however, was downward over time because of the increase in the proportion of land in summer-fallow in the later period. Total output per man in physical terms was also biased downward because of the underestimation of average yields given by yield averages based on data collected prior to 1941.

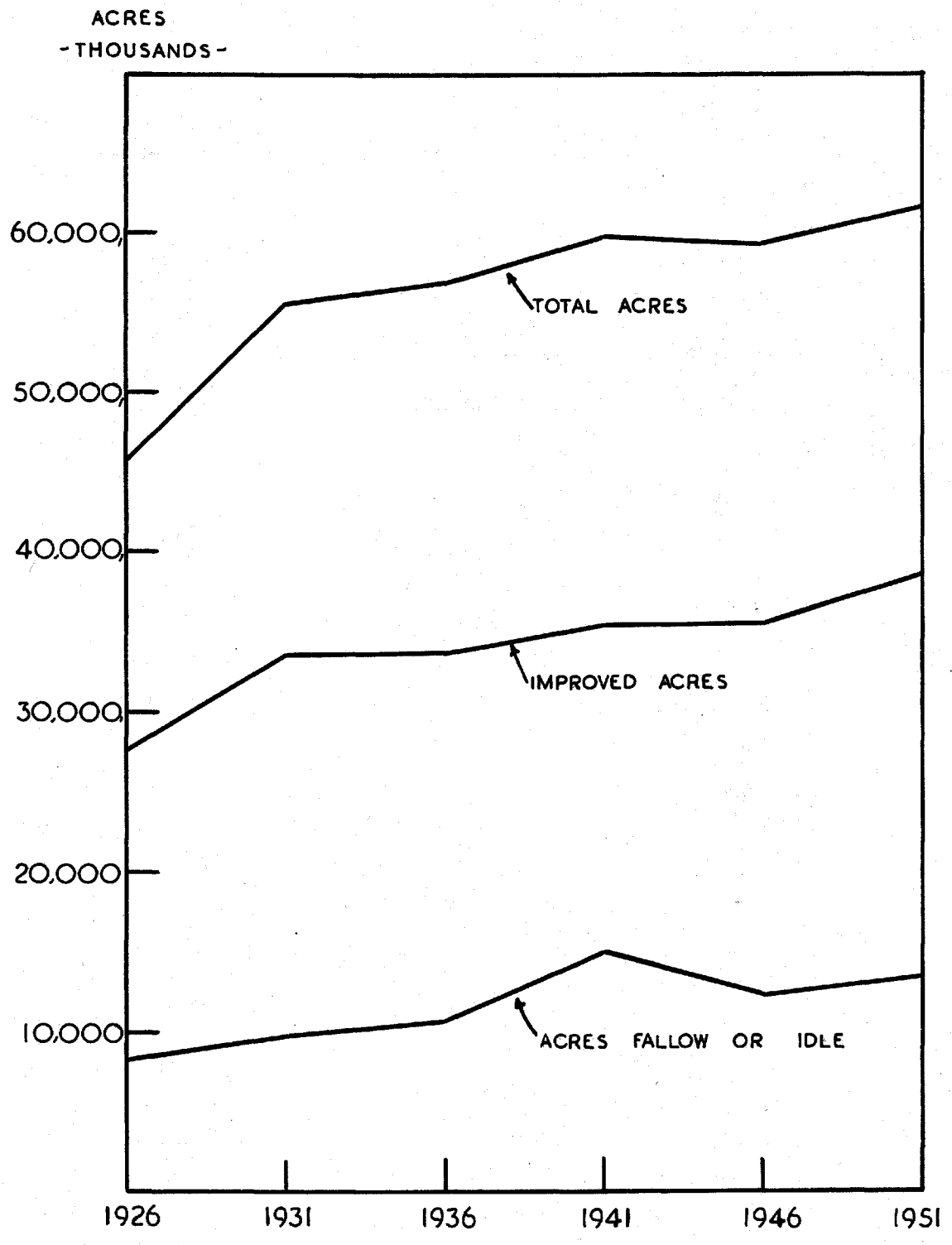
Input of Labor

The estimation of labor inputs in agriculture is more difficult than in most industries. The census figures of total numbers of farm workers are not fully comparable since the 1931 and 1936 figures include duplications of some workers who worked on more than one farm during the year. Later figures include only those who worked on farms during the last week of May just previous to the beginning of enumeration.

For the period studied, an even greater problem was to correct employment figures for the degree of under-employment of farm workers during the depression years, particularly for the census year, 1936. Since alternative job opportunities were scarce, the migration of excess farm population to towns and cities was inhibited. Some unemployed industrial workers actually migrated back to the farms. This resulted in under-employment of workers on farms, particularly of unpaid family workers. The inclusion of all under-employed workers as full time workers distorted the picture of changing labor productivity on farms. The surplus workers may have worked full time in many

CHART I - TOTAL AND IMPROVED ACREAGES IN FARMS - SASKATCHEWAN.

CENSUS PERIODS 1926 - 1951



cases because on most farms work can always be found. Much of such 'made' work is unproductive and has little or no effect on actual farm output.

A further difficulty arose from the date of the census enumeration. The census gave the numbers employed at June 1st. Employment on farms varies with seasons, normally reaching a peak during the harvest and a low point in mid-winter. Productivity of labor can be calculated on the basis of either output per man or per man-hour (or man-year) of work. The latter measure is more useful and realistic. If the former method is used, productivity will vary according to whether a farmer is credited with six or twelve months of labor when he spends six months at farm work and is unemployed but living on the farm for the other six.

In calculating inputs of labor on a man-hour basis, employment was measured according to the man-equivalent concept. One man-equivalent of labor consists of the full time labor of one man for one year. No data were available prior to the first Labour Force Survey in November, 1945, on hours worked per week and employment variations during the year. The Survey reports, issued quarterly since then, were used to obtain an estimated proportion of the June 1 figures of agricultural employment which represented the labor input in terms of man-equivalent workers for the year. The average number of workers employed in agriculture in Canada at four different dates during the

year were calculated (Table 3). The number of man-equivalents for the same dates were computed by weighting the numbers employed according to the number of hours they worked during the survey week and converting to man-equivalents on the basis of a 60-hour week. The 60-hour week was chosen because the modal class was that of 55 hours work and over in almost every survey during the period covered.

Table 3. Average Number of Workers and Man-Equivalents of Workers, by Survey Dates, 1945-52, Canadian Agriculture.*

	March	June	August	November	Average
			('000)		
Total workers	928	1,152	1,223	993	
Man-equivalents	713	980	1,053	809	888.7
Average Man-equivalents as percent of June 1 Total workers					77.1

* Compiled from Dominion Bureau of Statistics bulletins on The Labour Force, Quarterly Survey, 1945-1952.

A separate tabulation was obtained for Saskatchewan from the Dominion Bureau of Statistics for the years 1951 and 1952 only. The same calculations were made for the Province (Table 4). The difference between the number of man-equivalents as a percentage of the June 1 total workers was not great in the two different calculations. Either could be used as an approximate proportion to apply to census numbers of total workers to get an estimate of man-equivalent workers.

Table 4. Average Number of Workers and Man-Equivalents of Workers, by Survey Dates, 1951-52, Saskatchewan Agriculture.*

	March	June	August	November	Average
		(000)			
Total workers	144.5	166	182	159	
Man-equivalents	97.5	143	161	135	134.1
Ave. man-equivalents as percent of June 1 total workers-80.8					

* Compiled from unpublished data obtained from Special Surveys Division, Dominion Bureau of Statistics, Ottawa.

The surveys have not been conducted long enough to determine whether or not there is a trend of change in the percentage of the total workers on June 1 which is representative of man-equivalents for the whole year. For this study the 80.8 per cent computed for Saskatchewan was used as a conversion factor to apply to census data on total workers. For the earlier years of the period there would probably be a greater variation in seasonal labor, with the harvest labor peak particularly high. With proportionally lower employment figures for August during the years included in the survey, the conversion factor may be too low for the pre-war years. In recent years there has probably been a greater number of farmers in Saskatchewan who do not work on the farm during the winter months. This would also tend to depress the conversion factor below the correct level for earlier years.

Another important item influencing the factor was the difference in the survey and census count of women workers in agriculture. The census counts farm women as farm workers only if

they are working on the farm at other work than housework during the last week of May. The Labor Force Survey classifies them as farm workers if they spend 20 or more hours in the survey week at farm work as distinct from housework.[3]

According to the Labor Force Surveys, women worked only about half as many hours per week as did men. Since the Survey count of women workers was much higher than the census count, the shorter work week of women depressed the proportion of farm workers who worked a full week. This introduced a downward bias into the conversion factor for man-equivalents when used with census data. Because of these possibilities for under-estimation of man-equivalents, the higher figure of 80.8 percent was accepted for Saskatchewan.

The Labor Force Survey estimates of women workers, when converted to man equivalents, was very much higher than the census count of female workers in agriculture. For June, 1946, man-equivalents of female farm workers in Canada was 86,000 while total female farm workers for Canada, using the 1946 census as a basis for estimates, was 8,000. Data were insufficient for correcting census figures for this undercount of women workers on farms. The numbers of women workers have declined rapidly since 1945 according to the Labor Force Survey so that for 1951 the discrepancy would not be so great. The remaining bias resulted in too low an estimate of labor inputs for the

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3. Dominion Bureau of Statistics Reference Paper, Canadian Labor Force Estimates, 1931-1950, Ottawa, 1951.

earlier years. The final result was a higher labor productivity during the first part of the period and a reduction in the rate of change in productivity shown.

The 1926 census did not give data on numbers of farm workers but gave only value of wages and board of hired labor. Value of wages and board tabulations were available for all census years from 1926 to 1946. A series of annual farm wage rates for Saskatchewan was used to estimate the number of hired workers for all census years up to 1946 on a basis of full-time work. In comparing these figures with the census count of hired workers on June 1 for each census year, it was found that the calculated full-time workers for 1931 and 1936 formed a much smaller percentage of the census counts of hired workers than did those for 1941 and 1946. This was at least partly due to the duplications in the counting of temporary farm workers prior to 1941. For 1941 and 1946 combined, calculated full-time hired workers were equal to 69.15 percent of total hired workers by census count. For the individual years, the proportions varied by less than one percent. This proportion was assumed to be a stable one and was applied to the census count of hired workers in 1931 and 1936 and to the estimated figure for 1926 to get a corrected estimate of total hired workers for those years (Table 5).

Table 5. Estimates of Hired Workers in Saskatchewan Agriculture, by Census Years, 1926-1946‡

Year	Census hired workers	Wages and board ($'000)	Annual† wage	Calculated full-time hired workers	Adjusted census hired workers
1926	not given	32,958	576	57,219	82,746
1931	120,849	23,408	354	66,124	95,624
1936	132,321	13,205	300	44,015	63,651
1941	39,067	13,495	497	27,153	39,067
1946	26,266	17,953	996	18,025	26,266

‡ Compiled from census data.

† Annual wage rates from Monthly Bulletin of Agricultural Statistics, adjusted by index numbers of Farm Wage Rates, Western Canada, in Prices and Price Indexes, Dominion Bureau of Statistics, Vol. 22, 1948.

The census count of total farm workers was then adjusted by deducting the difference between the census count of hired workers and the adjusted number from the census counts of total farm workers for 1931 and 1936 (Table 6 and Chart 2). An estimate of total farm workers for 1926 was made by assuming that hired workers formed the same proportion of total workers in that year as they did in 1931.

The data on farm workers for the 1951 census were not yet available. An estimate for this year was made from the data on total farm population. The same percentage was taken of farm population as total farm workers were of farm population in 1946.

The final estimates of total farm workers in each census year were then converted to man-equivalents on the basis of 80.8 man-equivalents for each 100 total farm workers. The

CHART 2 - TOTAL FARM WORKERS AND MAN EQUIVALENT WORKERS, SASKATCHEWAN

CENSUS PERIODS 1926 - 1951

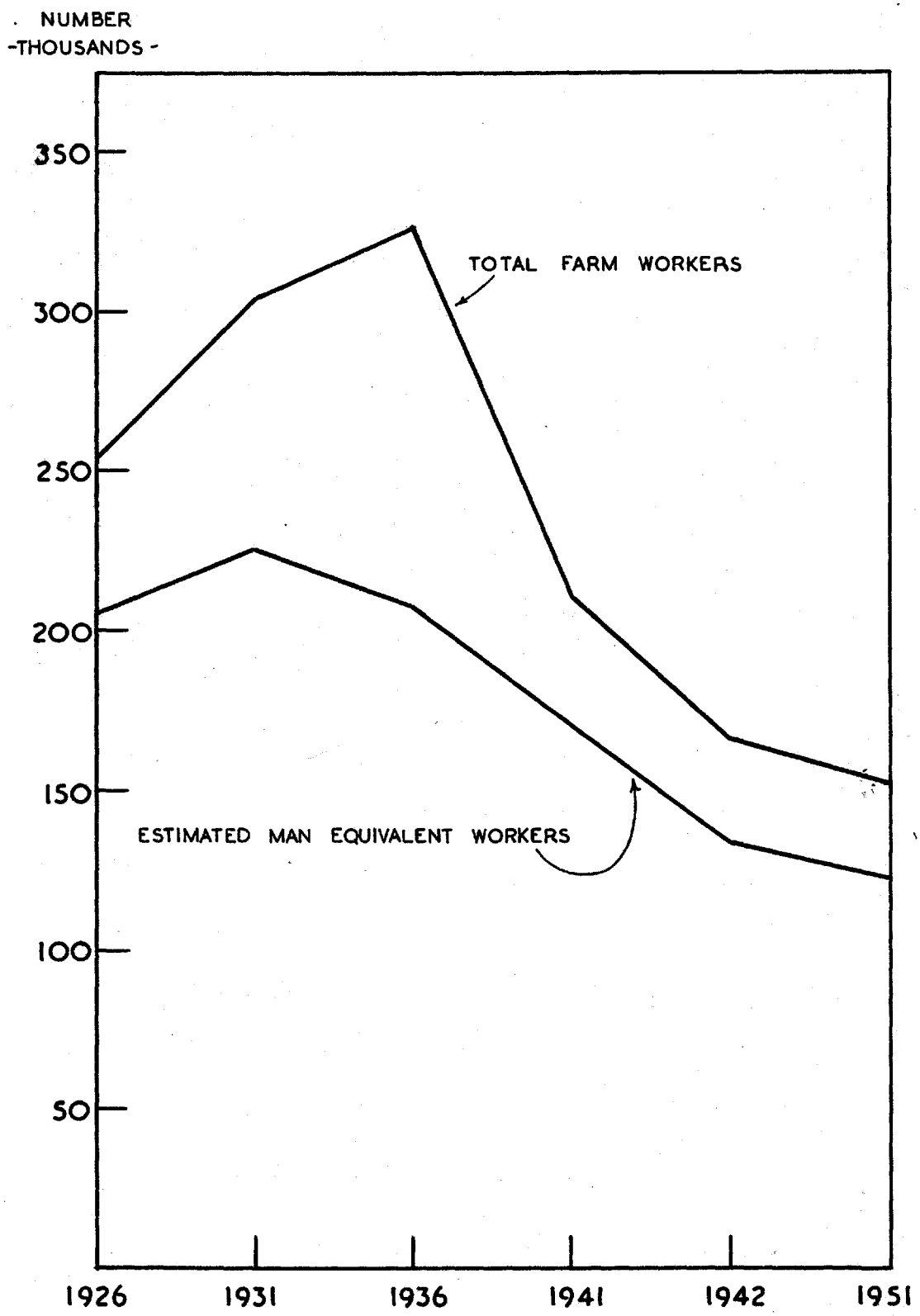


Table 6. Total Farm Workers and Man-Equivalent Workers by Census Years, 1926-1951, Saskatchewan ‡

Year	Total farm workers	Correction estimate	Adjusted total workers	Man-equivalent workers
1926	253,722[1]		253,722	205,005
1931	304,674	- 25,225	279,449	225,795
1936	326,096	- 68,670	257,426	208,000
1941	210,522		210,522	170,102
1946	166,557		166,557	134,578
1951	152,840[1]		152,840	123,495

‡ Compiled from census data and adjusted to man-equivalents by data from the Labor Force Survey.

(1). Estimated.

resulting series of labor inputs by man-equivalents showed a rise in numbers from 1926 to 1931 when the area in farms and in net productive acres was increasing most rapidly. From 1931 to 1951 the number of man-equivalent workers has steadily declined. The rate of decrease in absolute numbers was lower for the last five year period than for the two previous periods. The decline has been consistent and continuous for the last twenty years.

Productivity Changes in Saskatchewan

Data on total output and on total input of labor are all that are required for calculating labor productivity. However, since productivity is a function of relative inputs of all productive factors, it is of interest to examine briefly the changes in numbers of farms, size of farms and of investments in livestock and machinery.

In calculating total farm numbers (Table 7 and Chart 3) in the Province for each census year, non-resident farms were deducted from total farms for the years 1931 to 1946. For 1926 net farm numbers were estimated by deducting the same percentage of non-resident farms as was applied in 1931.

The total acres per farm showed a fairly consistent increase for each census year. Productive acres per farm increased generally but not consistently because of variations in the proportion of land in summerfallow. The largest proportion fallowed was in 1941 and the smallest productive acreage, except for 1926, the same year.

The number of farms for 1946 was too low since some of the non-resident farms deducted as being parts of other farms were actually complete farm units, in the clearly non-resident category. The bias was not great enough to mask the trend toward larger farms in the last five-year period.

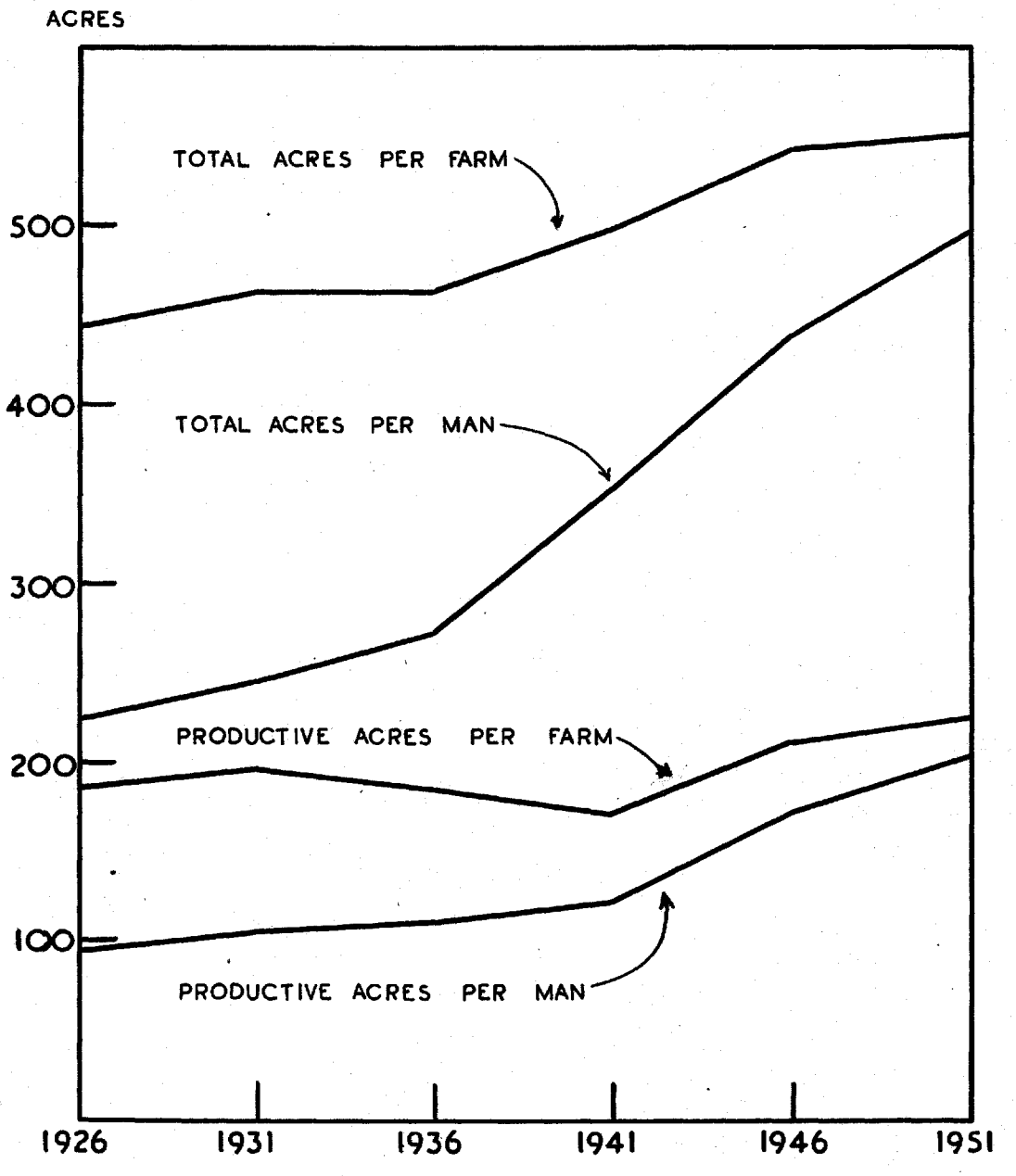
Table 7. Number of Farms, Total Area in Farms, and Total and Productive Acres per Farm, Saskatchewan, 1926-1951.†

Year	Number of farms	Total area ('000's ac.)	Acres per farm	Productive acres ('000's)	Productive acres per farm
1926	103,466	45,945	444	19,449	188
1931	120,045	55,673	464	23,608	197
1936	122,672	56,904	464	22,863	186
1941	120,176	59,961	499	20,551	171
1946	109,601	59,416	542	23,208	212
1951	112,018	61,663	550	25,147	224

† Compiled from census data.

CHART 3 - TOTAL ACRES AND PRODUCTIVE ACRES PER FARM AND PER MAN, SASKATCHEWAN.

CENSUS PERIODS 1926 - 1951



The increase in farm size was associated with an increased capital investment per farm and per man (since labor inputs also declined). A similar change in capital invested in machinery has taken place (Table 8). The value of livestock per farm has declined almost continuously though only by about $300 per farm in the 25-year period. The value of machinery, in constant dollars, has increased by approximately 800 dollars or by 50 percent in the same period though the increase has not been consistent. Value of machinery per farm actually declined from 1930 to 1936 but has shown a consistent increase since that time.

A more relevant comparison is one made on a man-equivalent basis (Table 9 and Chart 4). The number of acres and value of machinery per man is more directly associated with changes in labor productivity than are acreages and machinery values per

Table 8. Value of Livestock and Machinery per Farm, in Constant Dollars, Saskatchewan, 1926-1951†

Year	Total value of livestock ($'000)	Value of livestock per farm $	Total value of machinery ($'000)	Value of machinery per farm $
1926	109,570	1,059	173,344	1,675
1931	107,114	892	195,274	1,627
1936	102,175	833	122,255	997
1941	75,208	626	130,727	1,088
1946	65,776	600	188,417	1,719
1951	85,540	764	279,747	2,497

† Compiled from census data.

Table 9. Total Acres, Productive Acres, Value of Livestock and Machinery per Man-Equivalent Worker, Saskatchewan†

Year	Per Man-Equivalent Worker			
	Total acres	Productive acres	Livestock value	Machinery value
			$	$
1926	224	95	534	846
1931	247	105	474	865
1936	274	110	491	588
1941	353	121	442	769
1946	441	172	489	1,400
1951	499	204	693	2,265

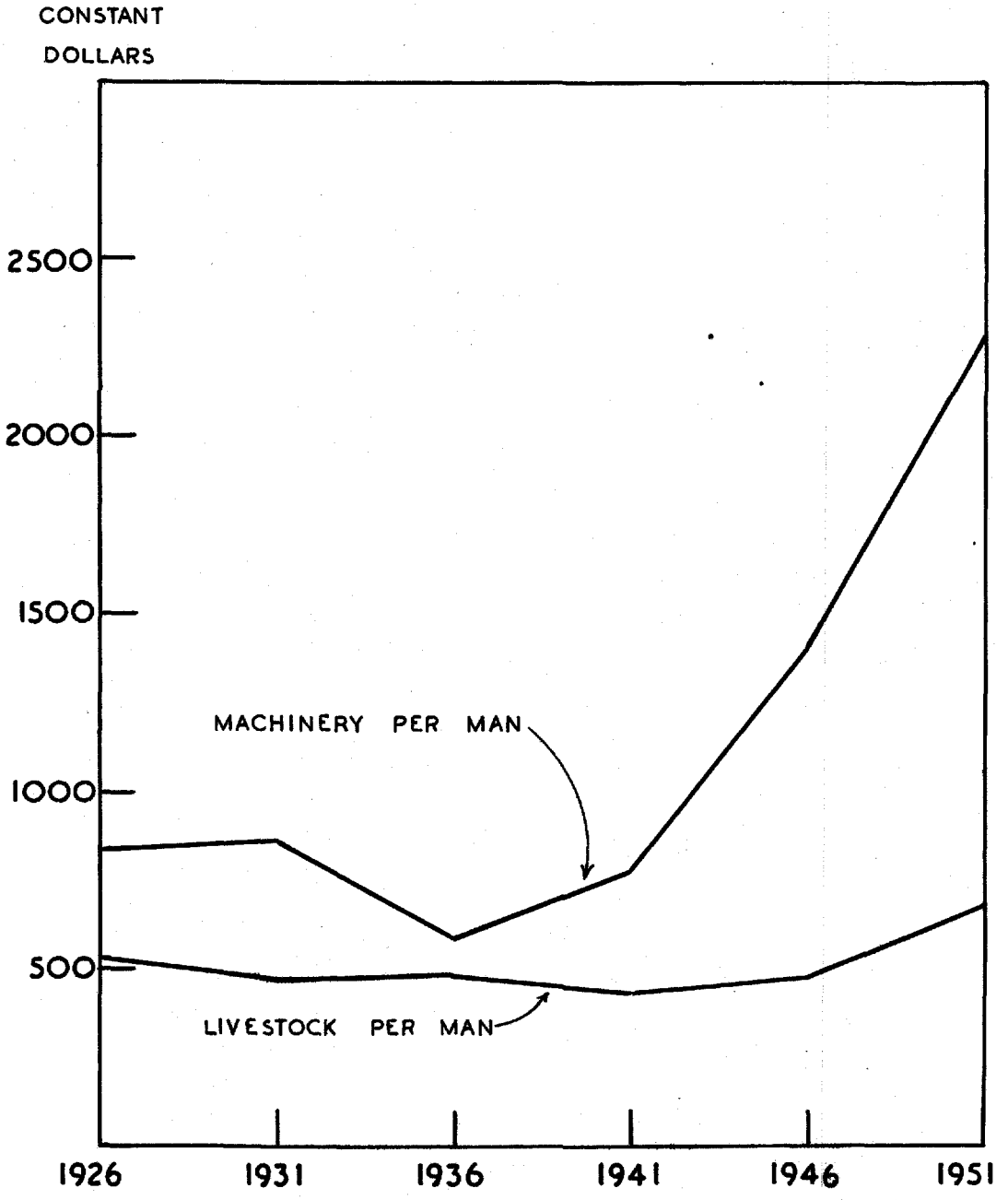
† Compiled from Tables 2, 6 and 7.

farm in so far as farm size itself is changing. Both total acres and productive acres per man have more than doubled during the period and the increase has been continuous over the whole period. Value of livestock per man has not varied significantly but value of machinery per man has increased by 167 percent between 1926 and 1951. This change has not been consistently upward and practically the whole increase came in the last half of the period. Though an increase in labor productivity usually requires an increase in the use of machinery, the most important factor at times has been the increase in the number of acres operated per man.

Calculations of labor productivity for each census year were made by estimating the normal output of wheat on the total productive acres. The yields of wheat used were those estimated for each soil zone and these were applied to the productive acres in each zone for each census year. Labor productivity was calculated on the basis of output per man-equivalent and

CHART 4 - VALUE OF LIVESTOCK AND MACHINERY PER MAN IN CONSTANT DOLLARS. SASKATCHEWAN.

CENSUS PERIODS 1926 - 1951



per man-hour. Output was expressed in terms of its wheat-equivalent and productivity in terms of bushels per man-equivalent, bushels per man-hour and as hours of labor time required per bushel of output (Table 10 and Chart 5).

For the Province as a whole, labor productivity showed an increase from 1254 bushels per man in 1926 to 2760 bushels per man in 1951, an increase of 120 percent in 25 years, or an average increase of 4.8 index points per year. The rate of increase has been far from uniform. Productivity was 6.2 percent higher in 1936 than in 1931. In 1946 it was 42.3 percent higher than in 1941. The post-war years showed a slower rate of change in productivity than did the war years but the index rose by an average of seven points per year between 1946 and 1951. This was well above the 25-year average.

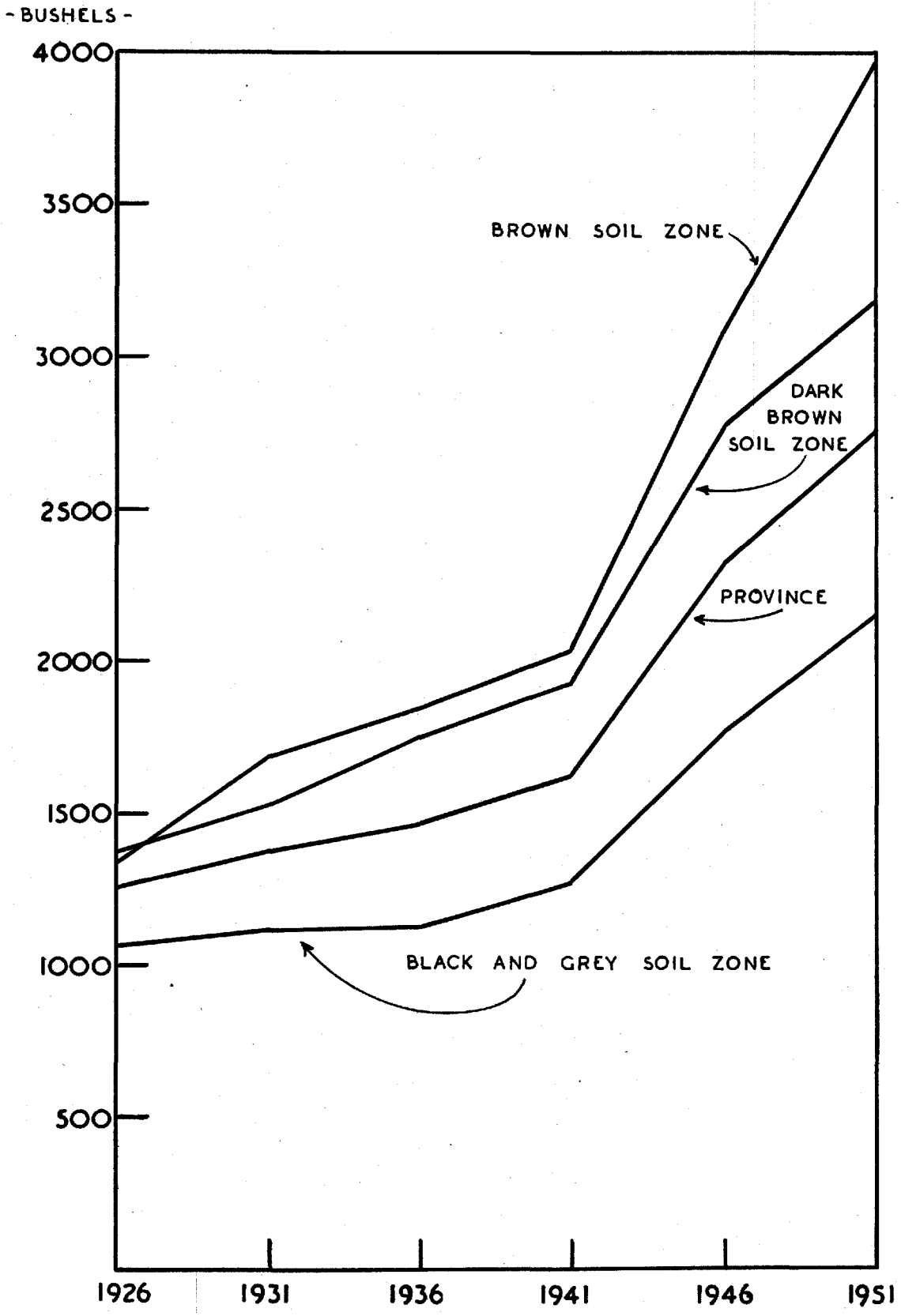
Table 10. Wheat-Equivalent Output per Man and per Man-Hour and Labor Time per Unit of Output, Saskatchewan, 1926-1951[1]

Year	Wheat-equivalent output ('000 bu.)	Bushels per man-equivalent	Percent change in five years	Productivity index 1926 =100	Bushels per man hour	Hours per bushel
1926	257,107	1,254	-	100	.40	2.50
1931	312,809	1,385	10.4	110	.44	2.27
1936	306,064	1,471	6.2	117	.47	2.13
1941	277,196	1,630	10.8	130	.52	1.92
1946	312,063	2,319	42.3	185	.74	1.35
1951	340,796	2,760	19.0	220	.88	1.14

1 Compiled from Tables 1, 2 and 6.

CHART 5 - OUTPUT OF WHEAT-EQUIVALENT PER MAN, SASKATCHEWAN AND SOIL ZONES.

CENSUS PERIODS 1926 - 1951



On the basis of these calculations, output had not yet reached a level of one bushel per hour of labor time by 1951. Labor time had declined almost to that level from 2.5 hours per bushel in 1926. It must be remembered that the calculations were not based strictly on average wheat yields on land actually sown to wheat, but on a normal wheat yield applied to the acreage in all crops including the area of improved pasture. The results, however, should be a fair approximation of actual wheat output per man-hour in Saskatchewan.

Productivity Changes by Soil Zones

The boundaries of the Saskatchewan soil zones do not coincide with political subdivisions. Hence, census data were not available for the precise zones. The province may be divided approximately into three soil zones by grouping census divisions. The Brown Soil Zone includes census divisions 3, 4, 7 and 8. The Dark Brown Soil Zone is approximately covered by divisions 1, 2, 6, 11, 12 and 13. The remaining divisions are included in the Black and Grey Wooded Soil Zones. The latter two zones are so irregular in their boundaries that it was not feasible to separate them.

Since most of the census data were given by census division, it was possible to make estimates of productivity changes over time for each soil zone. The method of computation was the same as that used in estimating productivity for the Province as a whole. The productivity index for each zone was based on 1926 equalling 100 for the respective zone (Table 11 and Chart 5).

Table 11. Estimated Man-Equivalents, Labor Productivity and Productivity Indices, by Soil Zone, Saskatchewan, 1926-1951‡

Year	Man-Equivalents			Bushels Output per Man		
	Brown	Dark Brown	Black and Grey	Brown	Dark Brown	Black and Grey
1926	47,996	79,118	77,789	1,347	1,384	1,066
1931	49,012	81,152	93,851	1,697	1,539	1,116
1936	41,341	66,048	100,497	1,852	1,759	1,127
1941	33,087	51,561	85,454	2,034	1,937	1,287
1946	24,187	41,676	68,716	3,090	2,779	1,768
1951	20,048	37,869	65,356	3,973	3,183	2,152
	Bushels Output Per Man-Hour			Percent Change in 5 Years		
1926	.43	.44	.34	- -	- -	- -
1931	.54	.49	.36	26	11	5
1936	.59	.56	.36	9	14	1
1941	.65	.62	.41	10	10	14
1946	.99	.89	.57	52	43	37
1951	1.27	1.02	.69	29	15	22
	Hours per Bushel			Productivity Index 1926= 100		
1926	2.33	2.27	2.94	100	100	100
1931	1.85	1.97	2.78	126	111	105
1936	1.69	1.79	2.78	137	127	106
1941	1.54	1.61	2.44	151	140	121
1946	1.01	1.12	1.75	229	201	166
1951	.79	.98	1.45	295	230	202

‡ Compiled from census data.

The resulting indices indicated that labor productivity increased most rapidly in the Brown Soil Zone and least rapidly in the combined Black and Grey Soil Zones. In 1926 the output per man was approximately equal in the Brown and Dark Brown Soil Zones at 1,347 and 1,384 bushels per man-equivalent, respectively. These zones, in turn, had productivities about 30 percent higher than that for the Black and Grey Soil Zones.

By 1951, output per man had reached nearly 4,000 bushels in the Brown Soil Zone, nearly 3,200 in the Dark Brown and 2,152 in the Black and Grey Soil Zones.

The proportional increases in productivity during the 25-year period were 195 percent for the Brown Soil Zone, 130 percent for the Dark Brown and 102 percent for the Black and Grey Soil Zones. The Black and Grey Soil Zones gained relatively little in productivity in the first half of the period but showed a more rapid increase after 1941. It would appear that there is no hindrance to productivity gains in the northern zone. The increase has been retarded by later original settlement and by the introduction of new settlement both during the drought period of the 1930's and since the war. From Table 11, it can be noted that the peak in farm labor employed had been reached in the two southern zones by about 1931, while the peak was not reached in the northern zone until the next census period. The exact dates of these peaks may have been as much as ten years apart since data by five-year periods do not indicate the turning points.

By 1951 output per man in the Black and Grey Zones was 2,152 bushels. This was approximately equal to the productivities shown in the other two zones by 1941 which were 2,034 bushels for the Brown and 1937 for the Dark Brown Zone.

The clearest differential gain in productivity was shown between the Brown and Dark Brown Zones. Starting with approximately equal outputs per man in 1926, the Brown Zone increased

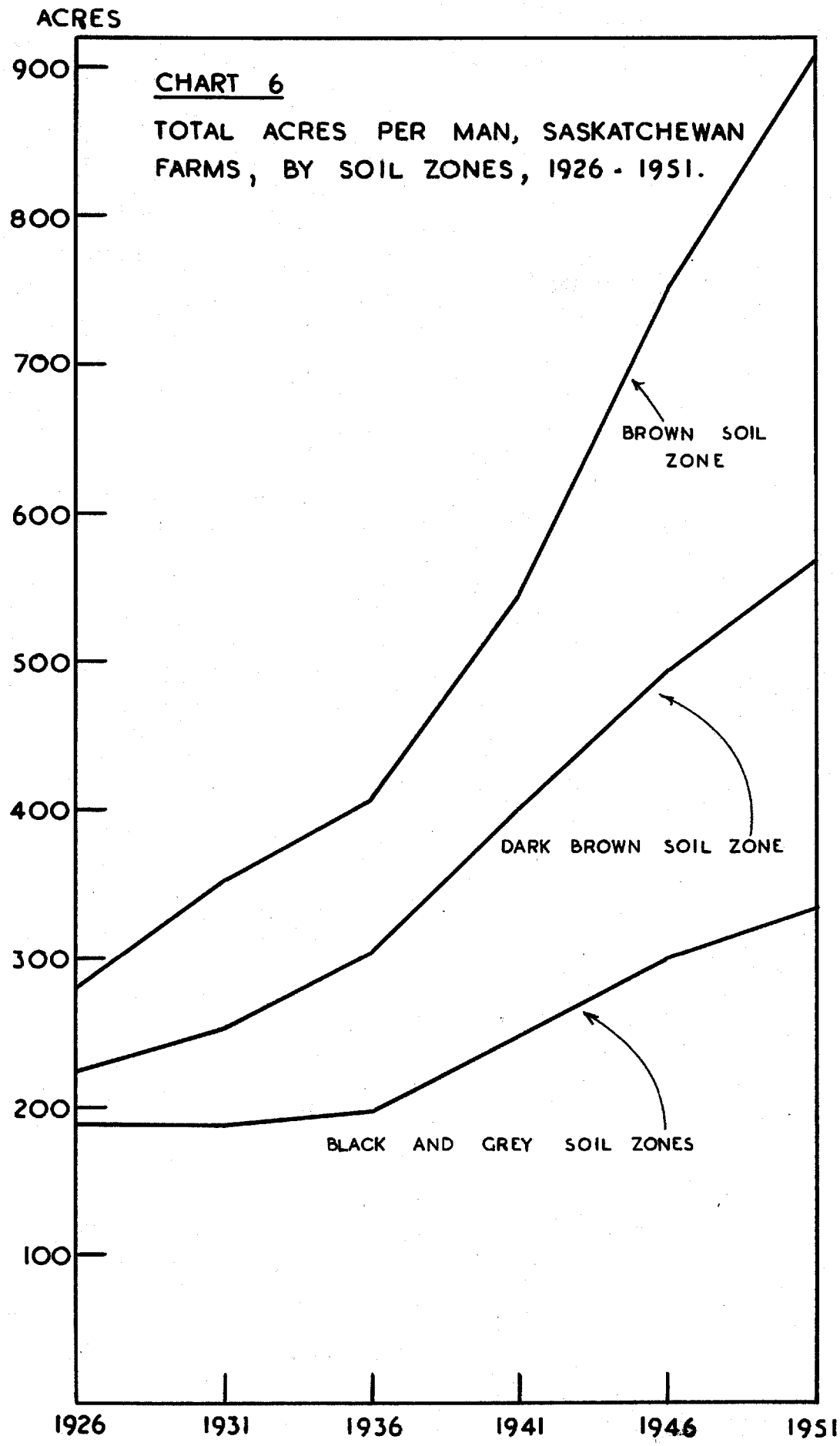
its output by over 2,600 bushels per man by 1951, while the Dark Brown Zone showed an increase of about 1,800 bushels per man for the period. The difference in rate of change was related to the change in the numbers of workers as well as to change in size of farm. The aggregate relationship is best shown by a comparison between zones of acres handled per man (Table 12 and Chart 6).

Table 12. Area in Farms and Acres per Man-Equivalent Worker, by Soil Zones, Saskatchewan, 1926-1951‡

Year	Area in Farms			Acres per Man-Equivalent Worker		
	Brown	Dark Brown	Black and Grey	Brown	Dark Brown	Black and Grey
	('000 ac.)					
1926	13,456	17,779	14,711	280	225	189
1931	17,407	20,517	17,749	355	253	189
1936	16,925	20,064	19,915	409	304	198
1941	18,033	20,655	21,273	545	401	249
1946	18,105	20,613	20,698	749	495	301
1951	18,198	21,526	21,939	908	568	336

‡ Compiled from census data.

Acres per man-equivalent increased by 224 percent in the Brown Zone, by 152 percent in the Dark Brown Zone and by 78 percent in the Black and Grey Zones from 1926 to 1951. Productivity increased by 195 percent, 130 percent and 102 percent for the respective zones. For the Brown and Dark Brown Zones, productivity differentials were proportional to changes in acres per man. For the Black and Grey Zones, productivity increased much more relatively than acres per man because the improved area of farms increased more in those zones than in the others.


ACRES
900
800
700
600
500
400
300
200
100
CHART 6
TOTAL ACRES PER MAN, SASKATCHEWAN FARMS, BY SOIL ZONES, 1926 - 1951.
BROWN SOIL ZONE
DARK BROWN SOIL ZONE
BLACK AND GREY SOIL ZONES
1926
1931
1936
1941
1946
1951

FACTORS AFFECTING PRODUCTIVITY

The fact that productivity has changed over the years is generally recognized. Measurement of such change is useful in making comparisons between different industries and areas with respect to rates of change in productivity over time. The more important questions, however, are concerned with the factors that affect productivity and how they influence productivity in different industries, regions and countries.[4] The remainder of this study deals with the influence of the three factors; soil zone, soil type and size of farm on labor productivity in Saskatchewan agriculture. An attempt was made to measure the differences in productivity associated with each of these factors.

Census tabulations were not adequate for the analysis of the influence of soil type and farm size on labor productivity. No census tabulations are made on the basis of soil type. Soils of different textures are widely distributed in all parts of the Province and in all zones. Several large areas have a fairly uniform soil texture. Data from the census, compiled for such areas, were not used as a basis for estimating productivity differentials between soil types. There was a danger of such selected areas being subject to special conditions, unrelated to soil type. Average farm size may not

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4. According to the report of the International Labor Office, "It must be realized that the ultimate objective is to find out not whether labor productivity has increased or decreased but why such changes have occurred. Therefore ... analyses ... should be undertaken to explain and measure the influence of the many and various factors affecting labor productivity". International Labor Office, Methods of Labor Productivity Statistics, Geneva, 1951, p. 122.

have been typical; rainfall may have been heavier than the zone average; the type of farm may have been more or less uniform than the zone average; and many other factors may not have been representative of that soil type throughout the zone or Province.

The Farm Business Surveys conducted by the Farm Management Department and the Dominion Economics Division at the University of Saskatchewan provided a widely-distributed sample of farm areas on all types of soil in each zone. Data were tabulated by soil type for each zone from a total of 11 different farm business surveys. Two of the surveys were made in the Brown Soil Zone, three in the Dark Brown Zone and six in the Black and Grey Soil Zones. They were all taken in the years 1939 to 1941 and, in point of time, were fairly comparable to census data for the latter year.

Census and Farm Business Survey data were collected for different purposes and involve basic differences in definition of the farm unit. Variation of conditions through time were also involved in comparisons of census data for 1941 with survey data for 1939 and 1940.

Census data included, for 1941, all farms of one acre or more in area if the value of production in 1940 was 50 dollars or more. The farm business surveys included only farms of 160 acres or more in size. The census classified many farms, which were operated as a unit but held under separate tenure.

by two or more individuals, as separate farms. The survey classified all such enterprises as a single farm. The census also included small part-time farms operated by individuals with other occupations. These farms were not included in the surveys. The census counted as separate farms those whose operators had farm headquarters in a different enumeration subdistrict. The surveys included in each farm unit all parts of the farm regardless of location.

The differences in definition resulted in higher average farm sizes for survey than for census calculations. Since output per man normally increases with scale, the productivities calculated from farm business survey data tended to be somewhat higher than those based on census data.

Measurement of labor inputs also differed between census and Labor Force Survey data on the one hand and the farm business surveys on the other. The farm business surveys measured labor inputs by months worked without any adjustment for hours per week. Work performed by farm women was considered negligible except when they did full-time work. In using farm business survey data, the number of man-equivalents was taken as counted by the enumerator and as applied to adult males.

The distribution of the farm business survey did not coincide with the proportions of farm land in respective soil zones for the Province as given by the grouping of census districts. About 35 percent of the area covered in the business surveys was in the Brown

Soil Zone compared with the 28.0 percent shown for the Province. In the other two regions, areas in the farm business survey were from three to four percent lower than the respective proportions for the Province. Hence, in using survey data for provincial totals, the Brown Soil Zone was slightly over-weighted. These discrepancies did not affect the calculation of productivity differentials between zones and soil types.

The proportion of land in summerfallow was higher than normal in 1941 due to the Wheat Acreage Reduction Plan which was in operation that year. Productivity, calculated for that year from census data and based on productive acres, was lower than it would have been with the normal acreage in summerfallow. The farm business surveys related in most cases to the years 1939 and 1940 before the increase in summerfallow acreage occurred. Productivity calculations based on the surveys therefore would be higher than comparable 1941 estimates based on census data.

Soil Zones

Variations in labor productivity between zones were indicated by the estimates given in Table 11. For 1951, the most recent year, productivity in the Brown Zone was almost 100 percent greater, and in the Dark Brown Zone almost 50 percent greater, than in the Black and Grey Soil Zones. These calculations were made from census data and, for the final year, were based on estimates made of labor inputs since census tabulations on farm

workers were not available. A check of productivity estimates based on census data was made for 1941 by comparing them with similar estimates based on farm business survey data.

In using survey data, output was calculated by applying the average yields computed by soil class (Table 1) and soil zone to the net crop or 'productive' acres. Calculations of productivity, using this output and the man-equivalents from the surveys, were made and the results compared with the estimates based on the 1941 census (Table 13). For the Province and for each soil zone, total acres per man were higher in terms of the 1941 census than for the farm business surveys of one or two years earlier. However, productive acres per man were lower in all cases for the census than for the surveys.

Table 13. Comparative Estimates of Acres per Man and Labor Productivity, by Soil Zones, Saskatchewan, According to 1941 Census Data and 1939-41 Farm Business Surveys

	Total acres per man		Productive acres per man		Labor productivity, bushels per man	
Area	By census	By surveys	By census	By surveys	By census	By surveys
Brown Zone	545	384	174	184	2034	2170
Dark Brown Zone	401	373	157	189	1937	2390
Black, Grey Zone	249	236	79	86	1287	1420
Province	353	312	121	140	1630	1879

The resulting productivities were higher for the farm business surveys in all zones. The results were not sufficiently different, in view of the differences in dates and methods of enumeration, to cast doubts on the validity of the calculations based on the census. The most useful feature of the census measures was their indication of relative productivities at different times and between regions within the Province. As absolute measures of productivity, they gave only approximations. Their accuracy depended on the suitability of the data for the particular purpose.

The differentials in productivity between zones were not nearly so pronounced in 1941 as they were in 1951. At the earlier date, productivities estimated from census data for the Brown and Dark Brown Soil Zones differed by only 100 bushels per man with the Brown Zone productivity the higher of the two. Productivity in those two zones exceeded that of the Black and Grey Zones (Park Region) by about 50 percent. Absolute levels of productivity were somewhat higher when estimated from survey data of one to two years earlier. Productivity in the Dark Brown Zone exceeded that in the Brown Zone by 200 bushels per man. Relative productivities in those two zones again were 50 percent higher than that for the Black and Grey Zones.

Soil Classes

Productivity variations with class of soil were calculated from farm business survey data only. In making comparisons with productivities for the Province and for the soil zones, the Provincial average productivity as estimated from farm business survey data was used as the base. Relatives of the Provincial average were calculated for each soil class.

Province

Output per man-equivalent was estimated for each soil class for the whole Province (Table 14). The proportions of the survey area lying in each zone differed only slightly from the census proportions for 1941. Therefore, the productivity estimated for each soil class was probably biased very little because of the lack of planned stratification in the sample surveys.

Table 14. Man-Equivalents, Wheat-Equivalent Output and Labor Productivity, by Class of Soil, Saskatchewan, 1939-1941‡

Soil Class	Man-Equivalents	Wheat-Equivalent Output ('000 bu.)	Output Per Man (bu.)	Percent of Provincial Average
Light Soils	541	634	1172	62.4
Medium Soils	1893	3218	1700	90.5
Heavy Soils	516	1692	3277	174.4
Province	2950	5545	1879	100.0

‡ Compiled from 11 Farm Business Surveys conducted by the Dominion Economics Division, Canada Department of Agriculture, in cooperation with the Department of Farm Management, University of Saskatchewan, Saskatoon.

Over the whole Province, labor productivity on heavy soils was almost three times as high as on light soils and almost twice as high as on medium soils. This was partly due to the higher yield levels on the heavier soils. However, it also reflected the greater number of acres handled per man on heavier soils. For light soils, total acres per man-equivalent were 285; for medium soils, 306 and for heavy soils, 362 acres. Variation in productive acres per man was even greater for the different classes of soil. Productive acres per man-equivalent on light soils were 102, on medium soils, 125 and on heavy soils, 232.

Soil Zones

Productivities were calculated by class of soil for each soil zone. The number of farms on which each calculation was based was reduced with each sub-division of the data. The resulting estimates were then less reliable since special conditions relating to the particular area surveyed had a greater chance to influence the result.

The differentials in productivity generally remained the same between soil classes within zones as for the Province as a whole. Medium soils in the Dark Brown Soil Zone were an exception. (Table 15). Productivity on medium soil in that zone was lower than that on light soil for the same zone. This unusual result was caused by, or associated with, a lower acreage of productive land per man than was normal for medium as compared with light soils. In all other cases, acres per man

Table 15. Man-Equivalents, Wheat-Equivalent Output, Productive Acres per Man and Labor Productivity, by Soil Class and Soil Zone, Saskatchewan, 1939-1941†

Zone and soil class	Man-equivalents	Wheat-equivalent output ('000 bu.)	Productive acres per man	Bushels output per man
Brown Zone				
Light soils	85.11	104	131	1226
Medium soils	535.57	1048	166	1957
Heavy soils	170.82	565	268	3306
Dark Brown Zone				
Light soils	80.71	179	213	2223
Medium soils	543.77	997	147	1834
Heavy soils	160.43	699	322	4359
Black and Grey Zone				
Light soils	375.53	351	71	934
Medium soils	813.37	1173	85	1442
Heavy soils	185.16	428	120	2313

† Compiled from Farm Business Surveys.

increased with heavier soil . For the surveys in the Brown Soil Zone, farms on medium soils had more livestock per 100 acres cropland (7.36 animal units) than farms on light soils (5.96 animal units). On survey farms in both the other zones the farms on light soils had substantially higher livestock numbers than farms on medium soils.

The highest productivity reached in any grouping was 4359 bushels per man on heavy soils in the Dark Brown Soil Zone. This was equivalent to 1.4 bushels per man hour or 43 minutes of labor time per bushel of output. This was over twice as high a level of productivity as was shown in any zone as a whole in 1941 when the Brown Zone productivity was .65 bushels per man hour. The range of productivity in 1941 by zones was from .41

to .65 bushels per man hour. From the survey calculations, productivity ranged from .30 bushels per man hour on light soils in the Black and Grey Soil Zones to 1.4 bushels per hour on heavy soils in the Brown Soil Zone.

Size of Farm

In all of the calculations of productivity for soil zone, soil class and by census years, a correlation between productivity and total acres per man-equivalent was evident. In order to assess the influence of this factor more fully, a division of farms was made on the basis of size. Though productivity was correlated with acres handled per man, the practical underlying factor which gave rise to a difference in acres per man was variation in farm size.

The smaller farm operators were limited in their ability to utilize fully their own labor time on an inadequate farm acreage. The labor time of the operator was not generally divisible into appropriately sized units for the most efficient use of labor. Most operators of small farm units, as well as large, put all of their labor time into the farm enterprise. Up to the size of unit that can efficiently make use of one man-year of work, such operators were under-employed or inefficiently employed. Beyond that size range it was possible to add additional labor in variable amounts so as to maintain a relatively high standard of labor efficiency.

Census data were almost completely inadequate for an analysis of labor productivity according to farm size. Farm size groupings

varied in number and interval from one census to another. For several census years, including 1941, no groupings above 640 acres were given. All farms larger than three quarter-sections were included in one group so that it was impossible to measure the influence of changes in farm size on labor productivity for farms beyond that size range.

In all census years, data on size of farms were not sufficiently complete for statistical analysis of labor productivity. Class intervals were not uniform throughout the range of size in any one census year. Many arbitrary assumptions would have had to be made in adjusting frequencies to class intervals suitable for statistical treatment. Only approximations could be made which were of doubtful value as compared to analyses made from farm business survey data. Though the latter did not conform to the requirements of a stratified random sample, the calculations on provincial, soil zone and soil class bases corresponded moderately well to calculations based on the census.

A further serious inadequacy of census classifications was the lack of data on farm workers by farm size. Weeks of hired labor was the only item of labor input tabulated by farm size. Since hired labor made up variable proportions of total labor for different sizes of farms, it was necessary to estimate, from farm business survey data, the proportion of total man-equivalent workers made up by hired workers for each farm size group. These proportions were then used as

conversion factors and applied to census data on weeks of hired labor, converted to man-years, to get estimates of total man-equivalents for each farm size group for the Province (Table 16).

Province

The year 1946 was selected for calculations of productivity by farm size for the Province as a whole. For that year census data were the most adequate for this purpose. Three more farm size groups were tabulated for that year than for 1941. When labor inputs were estimated as above for each farm size group, the total of man-equivalents was 1.4 percent lower for the whole Province than was the original estimate for 1946. The labor input for each group of farms was increased proportionately to give the same total man-equivalents as for all farms for that year.

Table 16. Labor Inputs, Wheat-Equivalent Output per Man and per Man-Hour, by Size of Farm, Saskatchewan.↓

Size of farm (acres)	Man equivalents‡	Wheat-equivalent output ('000 bu.)	Output per man (bu.)	Output per man-hour (bu.)	Productivity index (Saskatchewan average = 100)
1 - 299	31,338	30,031	958	.31	41.3
300 - 479	39,522	74,955	1,897	.61	81.8
480 - 639	19,497	55,489	2,846	.91	122.7
640 - 959	26,206	80,231	3,062	.98	132.0
960 -1,279	9,311	32,410	3,481	1.12	150.1
1,280 & over	8,707	29,070	3,339	1.07	144.0

↓ Compiled from census data.

‡ Man equivalents calculated from weeks hired labor, using proportions of hired to total labor from Farm Business Surveys.

The average labor productivity for all farms was 2319 bushels in 1946. When related to farm size, productivity ranged from less than 1000 bushels on quarter-section farms to 3481 bushels on farms of six to seven quarter-sections in size. Output per man was over three and one half times as high on the larger farms as on the farms in the smallest size group. Labor time per bushel ranged from three hours and 14 minutes on quarter-section farms to 53 minutes on six and seven quarter-section farms.

The increase in productivity with farm size, by this method of calculation, did not hold for the largest farm-size group, in which most of the cattle ranches were included. The ratio of productive to total acres was much lower for this group (22.1 percent) than for the next lower size group (40.7 percent). The farms of 1280 acres and over had gross revenues of $500 per man-equivalent from cattle sales compared to sales of $270 per man-equivalent by farms in the 960 to 1279 acre group. This extra livestock production on the largest farms was more than enough to offset the lower productivity indicated in terms of wheat-equivalent output.

A productivity index was calculated based on the Provincial average equalling 100. These indices allowed comparison with productivity indices with respect to size of farm calculated from Farm Business Surveys at a different point of time.

Soil Zones

No census tabulations by size of farm, other than numbers of farms in each farm size group, were made for areas smaller than the Province. Productivity estimates by farm size for soil zone and soil class, therefore, were based entirely on data from Farm Business Surveys. The same surveys were used as were used in calculating over-all productivity differentials by soil class. Differentials calculated remained comparable in so far as productivities were all computed from the same data on Provincial, zone and soil-class bases.

In using data from the surveys for productivity estimates by size of farm, the farms were separated into the most practical size groups. Since Saskatchewan farm land was surveyed on the section and quarter-section plan, most farm units were made up of groupings of quarter-sections. In making tabulations 160-acre intervals were used for respective classes with an open-end class for farms of 1000 acres and over. Class limits were placed mid-way between the multiples of 160 acres to give a clear grouping by full quarter-sections.

Output per man-equivalent in the Brown Soil Zone (Table 17 and Chart 7) showed differentials for farm size similar to those for the Province as a whole. The range, from 976 bushels per man on quarter-section farms to 3362 per man on farms of 1000 acres and over in size, was almost identical with the Provincial range. Productivities for the intermediate sizes of farms, as shown by the surveys, differed considerably from those shown

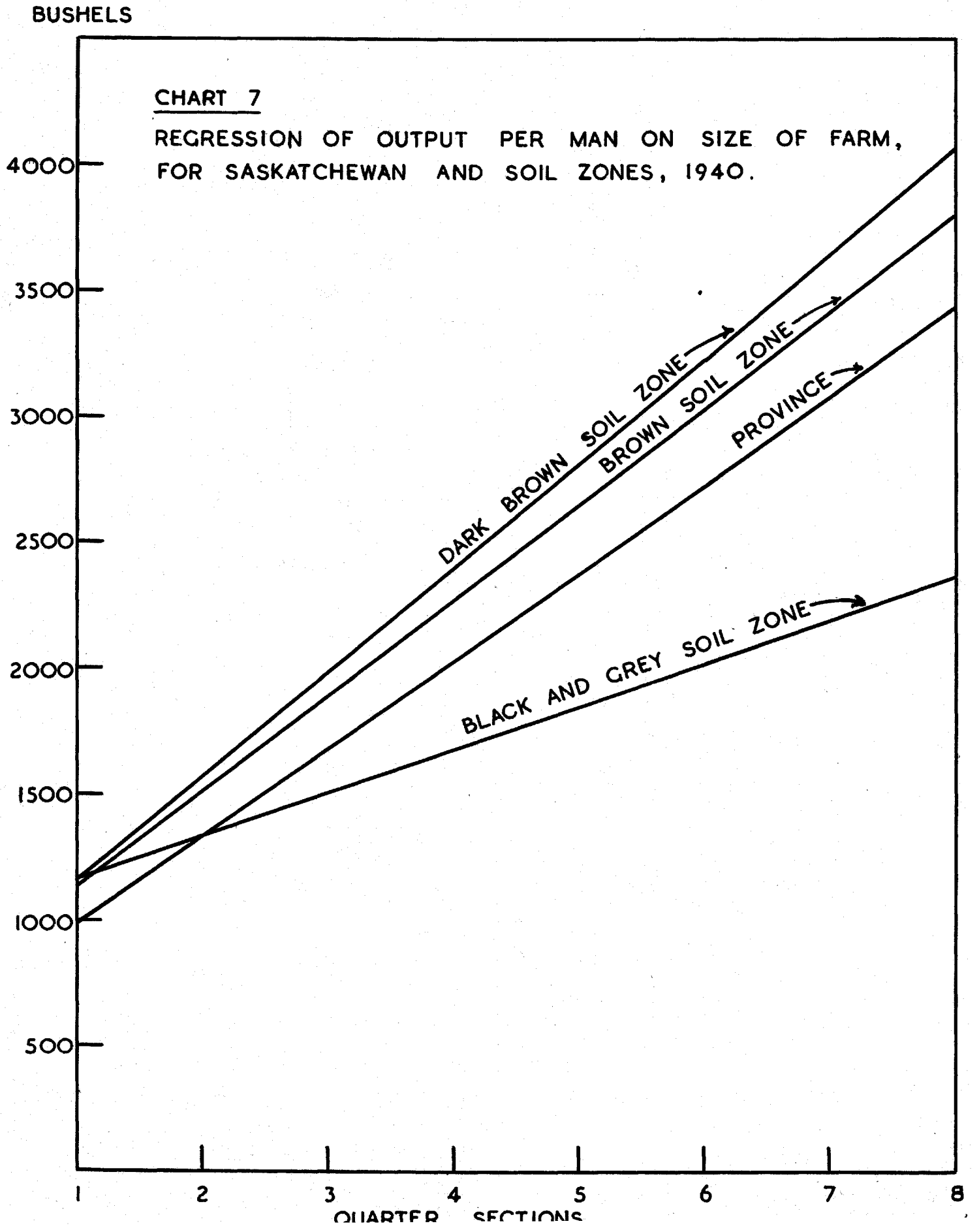

BUSHELS
CHART 7
REGRESSION OF OUTPUT PER MAN ON SIZE OF FARM, FOR SASKATCHEWAN AND SOIL ZONES, 1940.
4000
3500
3000
2500
2000
1500
1000
500
DARK BROWN SOIL ZONE
BROWN SOIL ZONE
PROVINCE
BLACK AND GREY SOIL ZONE
1
2
3
4
5
6
7
8
QUARTER SECTIONS

Table 17. Total and Productive Acres Per Man-Equivalent, and Labor Productivity, by Size of Farm and Soil Zone, Saskatchewan, 1939-1941‡

Farm size (acres)	Total acres per man	Productive acres per man	Output per man (bu.)	Output per man-hour (bu.)	Labor time per bushel (hrs.)	Productivity index Saskatchewan average =100
Brown Soil Zone						
Up to 239	143	83	976	.31	3.2	52
240 - 399	266	141	1,655	.53	1.9	88
400 - 559	327	147	1,732	.56	1.8	92
560 - 719	417	202	2,382	.76	1.3	127
720 - 879	500	214	2,514	.81	1.2	134
880 - 999	597	308	3,624	1.16	.9	193
1000 & over	620	286	3,362	1.08	.9	179
Dark Brown Zone						
Up to 239	155	78	980	.31	3.2	52
240 - 399	253	135	1,703	.55	1.8	91
400 - 559	318	142	1,798	.58	1.7	96
560 - 719	431	219	2,764	.89	1.1	147
720 - 879	460	202	2,546	.82	1.2	136
880 - 999	492	273	3,443	1.10	.9	183
1000 & over	551	327	4,124	1.32	.8	220
Black & Grey Zones						
Up to 239	132	48	799	.26	3.9	43
240 - 399	216	82	1,367	.44	2.3	73
400 - 559	277	110	1,822	.58	1.7	97
560 - 719	316	109	1,810	.58	1.7	96
720 - 879	351	125	2,078	.67	1.5	111
880 - 999	357	104	1,736	.56	1.8	92
1000 & over	427	138	2,293	.73	1.4	122

‡ Computed from data gathered in 11 Farm Business Surveys conducted by the Dominion Economics Division in co-operation with the Department of Farm Management, University of Saskatchewan.

for the Province by the census. The same peak of productivity was found for farms of the second largest group, but the decrease in the largest group was relatively much greater for the Brown Zone. The underestimation of productivity on the largest farms for the Province as a whole appeared to be a

reflection mainly of underestimation for that farm size group in the Brown Zone. This zone contained the majority of the ranch-type farms and the largest farm size group was heavily influenced by this factor.

The productivities on most of the intermediate-sized farms were lower for the Brown Soil Zone than for the Province as a whole, though productivity increased generally with farm size. Further comparisons between the Province and the other two zones were made before any conclusions were drawn from these differences.

The range of productivities by farm size was greatest in the Dark Brown Soil Zone. The maximum productivity in this zone was reached on farms in the 1000 acres and over size group. Productive acres per man continued to increase in the largest size group and a higher productivity was shown than for any farm size group in the Brown Zone.

Productivity on the intermediate sizes of farms was again lower than that estimated for the Province. The smallest farms in this zone had a productivity only half as great as the Provincial average for all farms. The largest farms had productivities over twice as high as the Provincial average.

Within the Dark Brown Soil Zone, differentials by farm size were quite pronounced. Farms over 1000 acres in area had an average labor productivity over four times as high as that for quarter-

section farms in the same zone. This differential was about the same as that shown for the Brown Soil Zone.

In the Black and Grey Soil Zones, productivities were generally lower than in the other two zones. The increase in productivity with farm size was much less definite and regular than in the other two zones. The highest labor productivity shown was only 2293 bushels per man - about equal to that on one-section farms in the other two zones. The lower productivities in the Black and Grey Zones were a reflection of the lower proportion of improved land and of higher labor inputs. Proportions of land in production were 48 percent in the Brown Zone, 51 percent in the Dark Brown Zone and 36 percent in the Black and Grey Zones.

The higher labor inputs for the northern area were revealed by a calculation of total acres per man-equivalent for each zone. The Brown Zone averaged 384 acres per man, the Dark Brown Zone 373 acres per man and the Black and Grey Zones 236 acres per man. The combined effects of these two factors were estimated by taking the average number of productive acres per man-equivalent for each zone. Productive acres per man were 184 in the Brown Zone, 189 in the Dark Brown Zone and 86 acres per man in the Black and Grey Zones.

The lower degree of regularity in productivity increases with farm size in the Black and Grey Soil Zones was associated with a greater variation in the proportion of land in crop for

the various farm size groups. The surveys in the northern part of the province included districts in which many farms were still in the process of clearing and breaking land. With the development process not yet completed the proportions of improved land shown by the surveys were subject to considerable variation.

In all zones labor productivity on intermediate-sized farms was lower than for the same farm size groups for the Province as a whole when the latter was determined from census data. No significance could be attributed to the absolute differences since the census tabulations were for the early post-war period while the survey data were from pre-war years. The census distribution of farms according to size also contained a bias due to the duplication in the count of farms.

Soil Class

Labor productivity ranged from 1172 bushels per man on light soils to 3277 on heavy soils for the Province as a whole (Table 18). It ranged from 958 bushels per man on quarter-section farms to 3481 bushels per man on farms in the largest size group. The latter estimates were made for different sizes of farms on all classes of soil. A further breakdown by farm size was made for all farms on

in industry. Only the farms in the two largest size groups, including farms of 960 acres and over, had labor productivities nearly equal to the average productivity of non-agricultural industries.

A comparison was made of the value of output per man in agriculture for Saskatchewan and three other Canadian provinces. Estimates were made on the basis of net operator income totals for each province. Net incomes were averaged for the three years 1949, 1950 and 1951. These averages were divided by the number of workers with jobs in agriculture for each province on June 2, 1951. This method does not indicate the actual output of workers but gives a reasonable approximation of the comparative output of workers between provinces. The estimates gave figures for Saskatchewan of $2368; Ontario, $1964; Quebec, $1104; and British Columbia, $1765. These suggest that productivity levels were higher in Saskatchewan agriculture than in the agricultural segments of the other three provinces. Net operator income per worker in Saskatchewan exceeded that in Ontario by $400; that in British Columbia by $600; and that in Quebec by over $1200.

Productivity Trends

Approximate trends in productivity were estimated for the same four provinces for the period 1936 to 1946. Indices of the physical volume of agricultural production were divided by the indices of farm population for each province. Estimates of farm

light soils included in the surveys. Similar estimates of productivities were made for the different farm size groups on all medium soils and all heavy soils (Table 18 and Chart 8).

Table 18. Total and Productive Acres per Man-Equivalent and Labor Productivity, by Size of Farm and Soil Class, Saskatchewan, 1939-1941†

Soil class and farm size (acres)	Total acres per man	Productive acres per man	Output per man (bu.)	Output per man-hour (bu.)	Labor time per bushel (hrs.)	Productivity index (Saskatchewan average =100)
Light soils						
Up to 239	132	43	555	.18	5.5	29.5
240 - 399	239	96	1,119	.36	2.8	59.6
400 - 559	313	116	1,387	.44	2.3	73.3
560 - 719	387	147	1,691	.54	1.9	90.0
720 - 879	477	153	1,666	.53	1.9	88.7
880 - 999	419	163	1,795	.58	1.7	95.5
1000 & over	551	155	1,641	.53	1.9	87.3
Medium soils						
Up to 239	134	53	800	.26	3.8	42.6
240 - 399	241	104	1,440	.46	2.2	76.6
400 - 559	301	125	1,681	.54	1.9	89.5
560 - 719	376	151	1,988	.64	1.6	105.8
720 - 879	435	166	2,217	.71	1.4	118.0
880 - 999	454	179	2,332	.75	1.3	124.1
1000 & over	500	217	2,798	.90	1.1	148.9
Heavy soils						
Up to 239	139	82	1,453	.47	2.1	77.3
240 - 399	233	148	2,161	.69	1.4	115.0
400 - 559	315	184	2,775	.89	1.1	147.7
560 - 719	431	279	3,823	1.23	.8	203.5
720 - 879	398	245	3,531	1.13	.9	187.9
880 - 999	479	328	4,493	1.44	.7	239.1
1000 & over	635	421	5,706	1.83	.5	303.7

† Compiled from Farm Business Surveys.

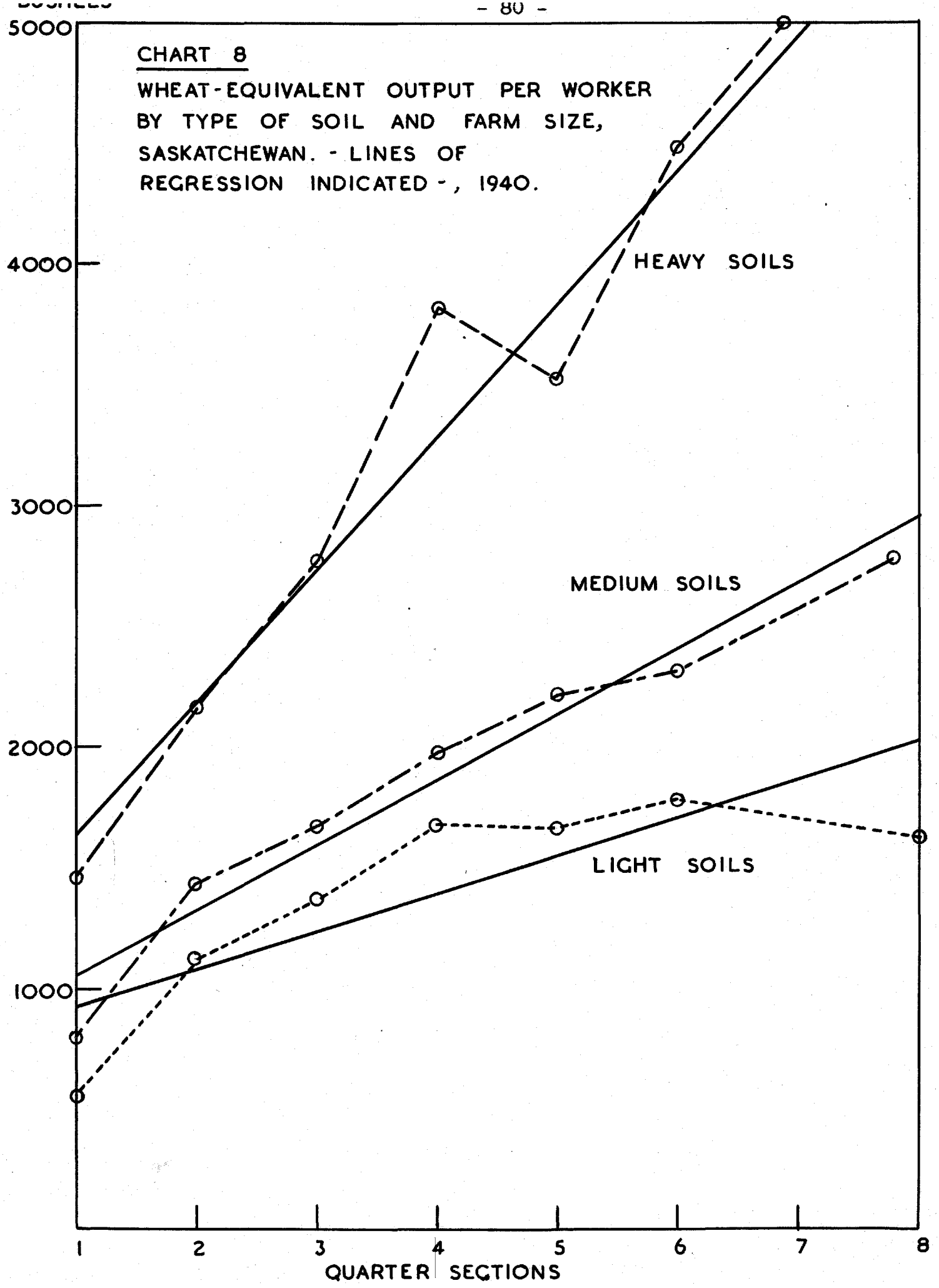


CHART 8
WHEAT-EQUIVALENT OUTPUT PER WORKER BY TYPE OF SOIL AND FARM SIZE, SASKATCHEWAN. - LINES OF REGRESSION INDICATED -, 1940.
5000
4000
3000
2000
1000
HEAVY SOILS
MEDIUM SOILS
LIGHT SOILS
1
2
3
4
5
6
7
8
QUARTER SECTIONS

On light soils in the Province, labor productivity for all size-groups fell below the Provincial average of 1879 bushels per man-equivalent. The highest level of output per man was 1795 bushels shown by the farms of the second largest size group. The largest farms of the light soil grouping were affected considerably by underestimate of productivity in terms of factors mentioned earlier. The proportion of land in crop declined from 39 percent for farms of the second largest size group to 28 percent for farms in the largest size group.

The most significant productivity differential for the light soils was that between quarter and half-section farms. Output per man on half-section farms was 1119 bushels, about double the 555 bushels per man shown for quarter-section farms. This result illustrated the extent of under-utilization of labor on quarter-section farms on light soils. The use of labor did not begin to approach an efficient level until the half-section size had been reached. Even on half-section farms, labor productivity was barely 60 percent of the Provincial average for all farms. The highest level of productivity shown on light soils was only about 50 percent greater than that shown by half-section farms on this class of soil.

As would be expected, medium-textured soils showed productivities close to the Provincial average. However, output per man-equivalent ranged from 42.6 percent of the Provincial average (for all farms) in the case of quarter-section farms to 148.9 percent of the Provincial average in the case of farms

in the largest size group. Farms below one section in size had productivities below the average for the Province, while size groups of one section and over had productivities above the Provincial average.

Productivity for the medium soils increased consistently with size, throughout the range of farm sizes. Output per man on half-section farms (1440 bushels) was 80 percent greater than on quarter-section farms (800 bushels). The increase in labor productivity between quarter and half-section farms was not as great, proportionally, on medium as on light soils but it was still highly significant. The highest labor productivity on medium soils was about 2800 bushels per man. This was approximately twice the level of productivity reached on half-section farms.

Though total acres per man were generally lower on medium than on light soils, productive acres per man were higher for all farm size groups. A higher proportion of land improved on medium soils aided farms on this class of soil in attaining a higher level of productivity. The more important contributing factor, however, was the higher yield level as compared with the lighter soil class.

Productivity on heavy-textured soils was well above the Provincial average. Only on quarter-section farms, for which output per man was 1453 bushels, did productivity fall below the Provincial average for all farms (1879 bushels). From this level of 77.3 percent of the Provincial average, productivity on heavy soils increased generally with farm size to a level

over three times the Provincial average on farms of 1000 acres and over.

Productivity differences between quarter and half-section farms were not as great on heavy soils as on medium and light soils. Half-section farms had labor productivities of 2161 bushels per man as compared with 1453 bushels per man on quarter-section farms. Productivity on farms of three quarter-sections (2775 bushels) was approximately the same as the highest productivity shown by the medium soil class. Half-section farms on heavy soils had higher productivities than for any farm size group on light soils.

The range of productivity on heavy soils was from 1453 bushels per man for quarter-section farms to 5706 bushels per man for farms of 1000 acres and over. The latter, representing the highest productivity level estimated for any of the groupings of farms in the study, was equivalent to 1.83 bushels per hour of labor input or 33 minutes of labor time per bushel of output. Compared with the lowest productivity shown by quarter-section farms on light soils, it was over ten times as high. The low productivity, given as 555 bushels per man, represented 0.18 bushels per man-hour, or five hours and thirty-seven minutes of labor time per bushel of output.

The proportion of land improved was higher on heavy soils than on light and medium soils. The proportions of total area in crop were 35.5 percent, 41.0 percent and 64.0 percent for the light, medium and heavy soils respectively. Average wheat

yields for the soil classes were 11.55, 13.54 and 14.16 bushels per acre, respectively. Not only were yields higher on heavier soils, but crop acres per man were significantly higher for all farm size groups. Were it not for this factor, productivity differentials between classes of soil would not have been nearly as significant as shown. Productivities calculated for a farm size distribution made in terms of improved acres would have given quite different results. Relative productivities, however, would have been in the same order since yields were higher on heavier soils. The yield differences were much less significant than the differences in the proportion of land in crop and productive acres per man. Absolute levels of productivity therefore would show smaller differentials for soil classes if size were taken in terms of improved acres. Nevertheless, productivity increased with farm size and heavier soil even when allowance was made for differences in improved acreages.

Productivity differentials as shown for soil classes were affected by differences in the amount of livestock production associated with the respective classes of soils. For light soils, the average number of animal units per man-equivalent shown by the farm business surveys was 10.6. Medium soils averaged 9.6 animal units and heavy soils 6.1 per man-equivalent. The greatest difference was between heavy soils and the other soil classes. Labor productivities for the three soil classes

were in inverse order to the number of animal units per man-equivalent. In terms of the comparative numbers of animal units, the amount of livestock production apparently did not have a significant influence on the productivity calculations except perhaps in the case of the larger farm sizes for the light soils. For these farms, labor productivity was probably underestimated sufficiently to mask the upward trend in productivity for farms above one section in area.

Soil Class and Soil Zone

The most detailed analysis that could be undertaken from the farm business surveys was an estimate of labor productivities for soil classes within each soil zone. Estimates of productivities were made for the respective zones and soil classes by farm sizes. In many cases they were not as reliable as the previous estimates in so far as they relied on smaller samples of farms. One-third of the classifications included ten or less farms.

To simplify presentation and facilitate comparison, the calculated productivities were grouped by soil zone and soil class in a composite table (Table 19). The tabulation also included the proportions of productive area for each group of farms since relative productivities were strongly influenced by this factor.

Table 19. Output per Man-Equivalent and Proportion of Total Area in Production, by Farm Size, Soil Zone and Soil Type, Saskatchewan, 1939-1941‡

Zone and size of farm (acres)	Wheat-equivalent output per man (bushels)			Percentage of total area in production		
	Soil type			Soil type		
	Light	Medium	Heavy	Light	Medium	Heavy
Brown Soil Zone						
Up to 239	692	936	1,483	52	56	77
240 - 399	1,284	1,537	2,059	53	49	61
400 - 559	1,125	1,560	2,901	29	43	61
560 - 719	1,047	2,121	3,980	27	46	65
720 - 879	1,486	2,342	3,596	29	40	62
880 - 999	2,064	2,797	4,536	38	46	69
1000 & over	1,372	3,062	5,227	22	45	62
All farms	1,226	1,957	3,306	32	45	63
Dark Brown Zone						
Up to 239	1,355	881	1,491	81	46	69
240 - 399	1,755	1,442	2,654	68	46	76
400 - 559	1,822	1,639	3,241	52	42	69
560 - 719	2,907	2,053	4,402	51	41	71
720 - 879	2,217	2,225	4,417	44	39	74
880 - 999	3,024	2,744	4,758	66	44	71
1000 & over	2,408	2,645	6,650	47	45	75
All farms	2,223	1,834	4,359	53	42	73
Black & Grey Zones						
Up to 239	541	837	1,446	31	37	56
240 - 399	965	1,379	1,968	32	37	56
400 - 559	1,309	1,857	2,531	35	39	51
560 - 719	1,530	1,774	2,319	36	32	43
720 - 879	1,354	2,092	2,927	24	36	50
880 - 999	1,098	1,596	3,773	23	26	58
1000 & over	1,003	2,473	3,911	15	37	46
All farms	934	1,442	2,313	31	36	51

‡ Compiled from Farm Business Surveys.

The information of Table 19 permitted direct comparisons of productivity differentials between soil classes for each zone and between zones for each soil class. For the Brown Soil Zone, productivity increased generally with farm size for all classes of soil. The increases were less consistent on light soils than on the heavy and medium soils. The proportion of land improved was highly variable for the various farm size groups on light soils. The ratio of productive acreage by size of farm declined from 52 percent on quarter-section farms to 21.5 percent on farms of 1000 acres and over. For farms in the intermediate size groups, productive acreage did not change uniformly with farm size. Farms of 640 acres had 27 percent of their total area in crop, while farms of 960 acres had 38 percent. In this case, the size of the sample was too small to give reliable results. There were only seven farms of 640 acres and two of 960 acres in the sample.

Though the numbers in the samples were small, the trend toward higher productivity with larger size was clear. The narrower range of productivities on light soils, from 692 to 2064 bushels per man, was quite significant when compared to the more distinct trend, the greater range and the higher level of productivities for medium and heavy soils. Farms on medium soils had productivities ranging from 936 bushels per man on quarter-section farms to 3062 bushels per man for farms of 1000 acres and over. Productivities on heavy soils ranged from 1483 to 5227 bushels per man for the same range of farm size.

The differences in productivity shown by quarter-section farms on different soil classes in the Brown Zone were quite significant. Productivities for light, medium and heavy soils for this size of farm were 692, 936 and 1483 bushels per man, respectively. A similar contrast in productivity with soil class was shown by the largest-sized farms, with productivities of 2064, 3062 and 5227 bushels per man, for light, medium and heavy soils, respectively. The rate of increase in productivity with farm size was approximately the same for each class of soil.

The highest productivity shown in the Brown Zone was 5227 bushels per man. In terms of labor time required per unit of output, this productivity level represented a rate of 36 minutes per bushel. The lowest productivity of 692 bushels per man constituted a labor requirement of 270 minutes per bushel. The farm size and soil class with the lowest productivity required approximately 7.5 times the labor input per bushel that was used in the group with the highest labor productivity.

In the Dark Brown Soil Zone, increases in productivity with size of farm were more uniform than in the Brown Soil Zone. The light soils again showed the most irregularity. Farms in the 1000 acres and over group on light soils showed a productivity somewhat lower than that of the next largest farm group. The proportion of land under production was 47.1 percent for the farms of 1000 acres and over and 65.7 percent

for farms in the 960 acre group. This factor accounts for the lower estimate of productivity on the larger farms. Actual productivity was probably underestimated in so far as the larger farms produced more livestock on the unimproved land. The difference in the amount of livestock carried was not great. Animal units per farm were 23 on the 960 acre farms and 31 on the farms of 1000 acres and over. The numbers of farms in the samples for these size groups were small so as to furnish relatively unreliable estimates of productivity.

Productivity on light soils in the Dark Brown Zone ranged from 1355 to 3024 bushels per man for the range of farm size. On medium soils, the range was from 881 to 2744 bushels per man and on heavy soils, from 1491 to 6650 bushels per man. Lower productivities for medium than for light soils were shown almost throughout the range of farm sizes. Though animal units per 100 acres of crop sown were only 1.4 greater on medium than on light soils, the proportion of total area in production was only 42.2 percent for medium as compared with 52.5 percent for light soils. Despite a two-bushel higher yield, this left medium soils with generally lower productivities, based on wheat-equivalent output, than light soils.

A further test of this unusual result was made to determine whether the difference in numbers of animal units for the two classes of soil was significant. When the numbers of animal units were related to labor inputs the farms on light soils

were found to have an average of 12.7 animal units per man-equivalent compared with 10.8 for farms on medium soils. On this basis labor time applied to livestock was not sufficient to explain the discrepancy.

If, as seems probable, productivity on medium soils was actually higher than on light soils, the possible explanation may rest in the distribution of the sample surveys. Most of the farms on light soils were located in one survey area and most of those on medium soils in another area. Special conditions peculiar to each of these areas may have had a strong enough influence on labor productivity to reverse the expected order of productivity of these two classes of soils.

Productivities on heavy soils in the Dark Brown Zone were substantially higher for all farm size groups than on light and medium soils. Only the quarter-section farms on heavy soils fell below the Provincial average in labor productivity. The farms of 1000 acres and over in total area had the highest labor productivity of any group of farms in the study, 6650 bushels per man-equivalent. This was equal to three and one half times the Provincial average for all farms.

Productivity differentials between soil classes for farms in comparable size groups were less significant in the Dark Brown than in the Brown Soil Zone. Light and medium soils had similar productivities while heavy soils had productivities ranging from 50 to 100 percent higher for the various sizes of farms. Productivity also increased at a greater rate with farm size on heavy soils, output per man for the largest farm size

(6650 bushels) being four and one half times as high as that for quarter-section farms (1491 bushels).

The lowest productivity for any group of farms in the Dark Brown Zone was 881 bushels per man. The highest productivity was 6650 bushels per man, about 7.5 times as high. In terms of labor time per bushel, this represented a difference between 28 minutes of labor time per bushel in the latter case and 212 minutes in the former.

Productivity increases with farm size in the combined Black and Grey Soil Zones were less consistent than in the other two zones, particularly on the light soils of these regions. Productivities on all classes of soils were lower in almost all the farm size groups than for the corresponding groups in the other two zones. Extremes of productivity were from 541 to 3911 bushels per man.

For light soils of the Black and Grey Soil Zones productivity ranged from 541 to 1530 bushels per man. The highest productivity, however, was reached on farms in the one-section size group. The proportion of total area in production increased with farm size from 31 percent for one quarter-section farms to 36 percent for one-section farms and then declined to 15 percent for farms of 1000 acres and over in total area. Animal units per 100 productive acres for the light soils of the zone were 14.08. This was higher than for any other soil type and zone grouping. Animal units per 100 productive acres were 21.26 for farms of 1000 acres and over, the highest for any of the classifications used in the

analysis.

The difference in the amount of livestock production accounted in part for the lower estimates of productivity for larger farms on light soils. Deductions were made from labor inputs for each farm size group on the basis of one man-equivalent of labor used for each 35 animal units. This resulted in a higher estimate of labor productivity for the large farms in comparison with the smaller sizes but did not establish complete consistency of increased productivity with size. Similar allowance for labor used in livestock production did not change the position of productivities for soil classes in so far as livestock numbers per man-equivalent differed only moderately between classes of soils.

Changes in productivity with farm size in the Black and Grey Zones were much more uniform for medium and heavy soils than for the light soils. Output per man ranged from 837 to 2473 bushels for medium soils and from 1446 to 3911 bushels for heavy soils. The ranges in each case represented a productivity increase of almost 300 percent between the smallest and largest sizes of farms of the two classes of soil.

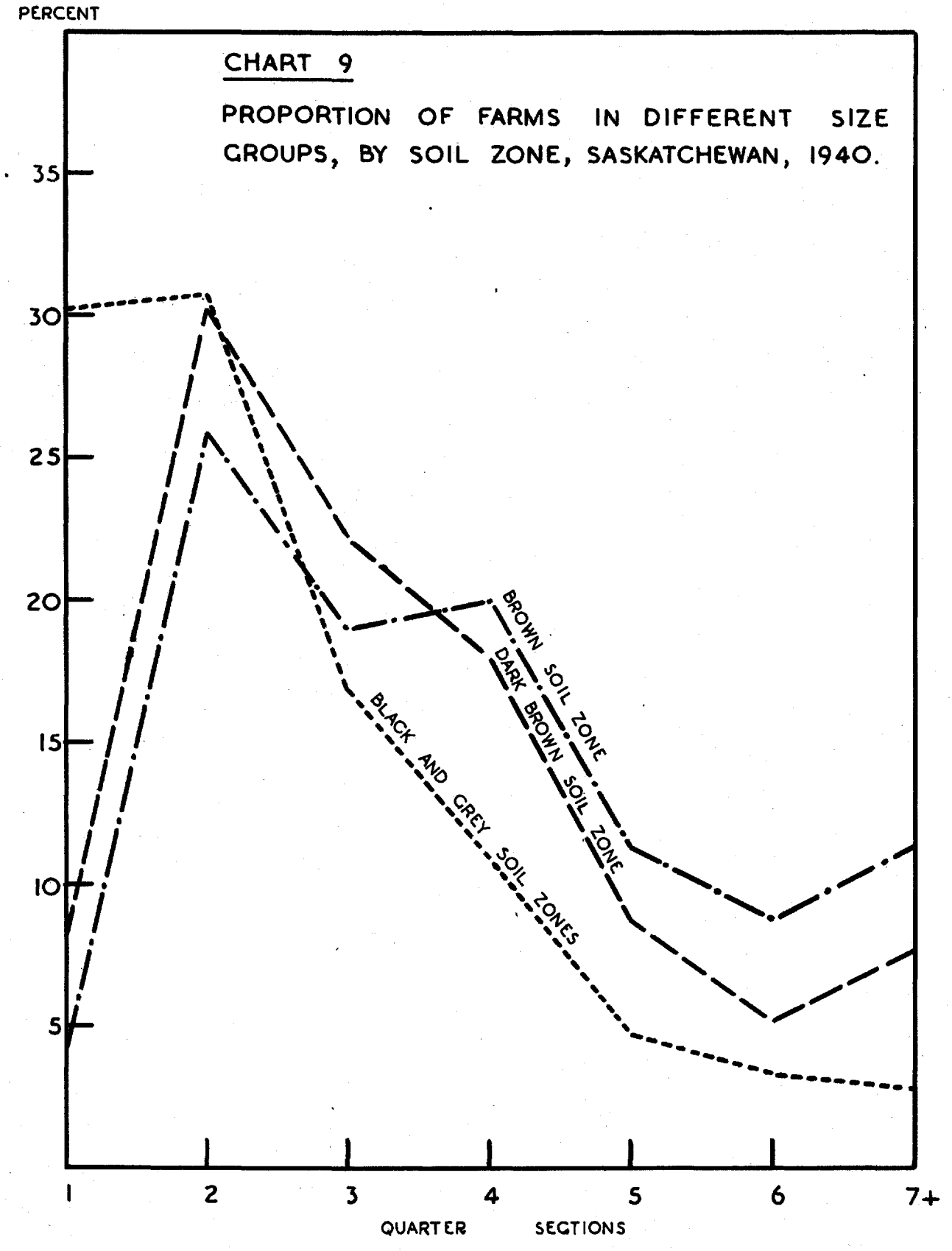
Productivity increased with better soil for all sizes of farms in the northern region. Productivities of medium soils ranged from 50 to 100 percent higher than those for light soils for the respective size groups. Productivities on heavy soils, in turn, were from 50 to 300 percent higher than the productivities of light soils for comparable farm sizes.

In terms of labor time per unit of output, small farms (quarter-section) on the light soils required an input of 346 minutes of labor per bushel. This was seven times as high as the labor requirement on the largest farms on heavy soils (48 minutes per bushel).

In all of the inter-soil and inter-zone comparisons by farm size, the estimated labor productivities were affected by the proportions of land in crop and differences in the amounts of livestock carried by the various categories of farms. Further comparison of productivity differences with particular reference to these factors reveals some of their significance.

Output per man for all classes of soils differed from zone to zone in direct relation with the proportions of land in crop. Light soils in the Dark Brown Zone showed an average productivity of 2223 bushels compared with 934 bushels for the Black and Grey Soil Zones and 1226 bushels for the Brown Zone. These positions follow closely the positions with regard to productive acreage; the Dark Brown Zone averaged 53 percent of total area in crop compared with 32 percent for the Black and Grey and 31 percent for the Brown Zone. The lower average productivity for the combined Black and Grey Zones than for the Brown Zone was due mainly to a difference in the farm-size distribution. More of the farms in the Brown Zone were in the largest size groups, the categories in which the zone showed the greatest productivity advantage (Chart9).

Although productivities for medium and heavy soils were associated with the proportion of land improved, there were few


PERCENT
CHART 9
PROPORTION OF FARMS IN DIFFERENT SIZE GROUPS, BY SOIL ZONE, SASKATCHEWAN, 1940.
35
30
25
20
15
10
5
BROWN SOIL ZONE
DARK BROWN SOIL ZONE
BLACK AND GREY SOIL ZONES
1
2
3
4
5
6
7+
QUARTER SECTIONS

cases in which productivity did not increase regularly with farm size expressed in total area. Only for light soils did proportions of acreage in crop and numbers of livestock appear to be a significant factor affecting the productivity estimates. In all three zones, for light soils, farms in the largest size group showed lower productivities than farms in the next largest group.

In all zones the proportion of land in crop was significantly lower in the largest farm-size group than in the next smallest size-group of 960 acres. Adjustment of labor inputs for the amount of animal production reduced the discrepancies in the majority of cases but did not increase the productivity estimates sufficiently to result in a uniform progression.

No reasonable basis of allowance for livestock labor appeared to give an adjustment of productivities for light soils providing a consistent increase of productivity with farm size. While the number of animal units per man-equivalent were higher for the larger farms, the differences were comparatively small. The proportions of land in crop remained the more important factor accounting for the level of productivity estimated.

The estimated productivities for the two largest farm-size groups must be qualified by reason of the relatively small numbers of farms in the particular categories. Numbers of farms for these size groups varied from two to seven, providing an approximation subject to serious unreliability.

The range of estimated productivity indicated by the analysis furnishes a striking contrast of labor efficiencies associated with groups of farms representative of the major range of farming conditions in the Province. Output per man-equivalent ranged from 541 bushels for quarter-section farms on light soils of the Black and Grey Zones to 6650 bushels for the largest farms on heavy soils of the Brown Zone. In terms of labor time per unit of output, the variation was from 28 minutes to 346 minutes per bushel. Farms with the lowest productivity required a labor input per bushel 12.3 times as great as that required by farms with the highest productivity. Although the estimated extremes were subject to errors inherent in the methods used, they were both based on reasonably good-sized samples. The particular extremes reflect the influence of all the major factors affecting labor productivity included in the study, which in turn, represent the primary factors related to labor productivity in the Province.

CONCLUSIONS

This study of labor productivity has been essentially exploratory in nature, not only in aims but also in methods. Estimates of productivity were limited to the Province of Saskatchewan and regional areas within the Province. The time period to which the study related was limited to the 25 years of the past for which more adequate data were available. Most of the comparisons of productivities were made for only one point of time which was not the most recent period. These features restricted the scope of general inter-regional and inter-industry comparisons which could be made from the results.

The methods used were exploratory in the sense that no estimates of labor productivity for other regions or industries have been made on precisely the same basis. Many serious difficulties are involved in any attempt to measure labor productivity, particularly in agriculture. All of these difficulties were by no means overcome by the methods of calculation used here. While specific estimates of trends and differentials in productivity were made for the analysis the results are subject to interpretation in the light of the limitations of the methods used.

Limitations of Methods

The concept of 'normalized output' whereby output was expressed in terms of the equivalent normal production of the major product of Saskatchewan Agriculture, wheat, was used in the study. The application of normal yields to acres in crop

and improved pasture to give an estimate of output in terms of bushels of wheat-equivalent gave quite consistent results except for areas or farm-size groups for which the livestock enterprise was of sufficient importance to require a significant proportion of the labor time of farm workers. A correction could have been applied to labor inputs in such areas to make allowance for the labor time used in the livestock part of the farm enterprise. Estimates of average labor requirements of animal production give only approximate corrections, even when applied individually to farms included in the study. When applied to a group of farms, the corrections become even less reliable and of limited usefulness for estimating specific productivities.

An alternative method of estimating labor productivities would have been to apply a type-of-farming classification of farms in these analysis. In the case of grain farming, farms with more than a nominal number of animal units would have been excluded from the sample. This would normally be done if the productivity analysis included the further classification by type of farming. For Saskatchewan alone, in view of the relatively narrow range of farm type, a type-of-farming classification carries a more restricted usefulness than for areas where one type of farming is not so predominant.

A major difficulty arose in the analysis of the influence of farm size on labor productivity. For most of the groupings by size, productivity increased generally with scale. A number of the exceptions encountered were due to the inclusion of livestock farms or of mixed grain-livestock farms in the survey

data used in the analysis. Calculation of output on the basis of land in crop resulted in underestimates of labor productivity for such farms. In other cases, though the extent of the livestock enterprises in the farm businesses was not significant, only a relatively small proportion of the total land area was in crop. Productivity, as here calculated, depended on three factors: input of labor, acres in crop, and normal yield. Where the proportion of land in crop varied irregularly with farm size, productivity changes with size were not consistent.

Irrespective of whether estimated normal yields or actual records of production had been used in the estimates of labor productivity, a clearer picture would have been obtained if the size classifications had been made by improved acres rather than by total acres. This would involve the discarding of most census data as sources of information on output by farm size since census cross-classifications were based on total rather than on improved acres per farm.

Conversion of census data tabulated in terms of a total-area distribution of farms to an improved-area distribution did not prove feasible. The census gave the distribution of farms by total acres and the aggregate improved acreage of farms in the respective size classes. The distribution by total acres of farms could be converted to a distribution by improved acres. However other data tabulated by total acres could not be converted in the same way in so far as farms falling in one size group by total acres would be distributed among several size groups

by improved acres.[1] Thus the necessary output and labor input data given by the total-area classification could not be converted to a distribution by improved acres since distribution of the individual farms followed no consistent pattern by the two methods.

An attempt to measure productivity differentials by improved acres, using normal yields, would actually measure acres cropland per man as a criterion of labor productivity. The factor of total farm size would be replaced by improved or crop acres as a factor influencing productivity. Variations in productivity between zones and soil types could then be more accurately measured since the proportion of land in production for each group would be replaced by a series of productivities for farms grouped by number of acres improved.

Labor productivities associated with the major products of the industry would be best calculated by analysis of separate samples of farms each producing one of the products in significant quantities. Separate estimates of labor productivity for the various types of mixed farms could then be made in terms of samples from areas where such farms were numerous. Productivities in this instance would necessarily be based on calculations of composite output, requiring some means of aggregating the various kinds of production.

The use of the major product of the industry as the basis for estimating output appeared to be quite satisfactory for calculating productivity trends for the Province and its larger

1. In 1946, 291 farms in the 1280 acres and over group by total area had less than 100 acres improved. Census of Saskatchewan, 1946.

regions represented by respective soil zones. The method proved less satisfactory when calculating productivity differentials for soil class and farm size. The influence of type of farm and the proportion of improved land resulted in distorations of the estimates of labor productivity for certain areas made on the basis of wheat-equivalent output. Satisfactory results would require that farms entering the sample have negligible numbers of livestock or that acceptable estimates of labor time required in the care of livestock be available.

Sample surveys appeared to be the most useful and satisfactory source of necessary data for estimating labor productivity. The main limitations of survey data were the unavoidable dispersion of survey dates over time and the lack of adequate randomization and stratification of farms and areas included in the surveys.

Survey data might have been more fully exploited in productivity analysis if no attempt had been made to combine census and survey data to arrive at Provincial estimates. Classification of farms by size, aside from total area, could not be applied adequately to census data. The farm size groupings in the census were largely unsuitable for productivity analysis. Tabulation of survey data by the same classes as used by the census would have destroyed their usefulness. Division of the survey farms by quarter-section groupings gave the best results for a size classification by total area. Classification by improved area would have materially improved the results.

Suggestions for Further Study

Further study of labor productivity in agriculture should have particular value in providing statistical bases for the demonstration of two theses: (1) that in an agricultural region, effective use of farm labor depends to a large extent on the proportional inputs of land, labor and capital resources, and (2) that agricultural regions in which labor productivities are low may increase the effectiveness of their use of labor by the selective adoption of organizational and management methods used in similar regions where labor productivity has reached high levels.

For such purposes, studies of productivity would be most useful if made for the more specialized types of farm enterprise. Though efficient farm organization depends to some extent on the best combination of enterprises, the level of output per man depends to a much greater extent on the organization of factors of production in each enterprise. Results of studies of labor productivity on mixed farms, though useful for comparative purposes, would not be so directly applicable in the formulation of recommendations for other areas. Methods of production in one farm enterprise do not usually vary greatly between regions or countries. When enterprises are combined on individual farms, the variation in practicable methods and ratios of enterprise combination may be so great as to render comparison difficult and specific recommendations impossible.

Productivity studies can only be justified in a practical sense if the results can be used as the basis for specific recommendations. The present study has tended to confirm the practicality of recommendations generally made regarding optimum farm sizes for Saskatchewan. Since the study based the calculation of output on acres in crop and improved pasture, productivity was underestimated on mixed farms and no estimates were made for livestock farms, as such. The need for further study in this area is indicated. Studies by type of farm, though less vital for Saskatchewan than for areas with more intensive farming, would improve the estimates of productivity for grain farms. They would also give data with respect to some of the farm types which are of considerable importance in several areas of the Province.

General Conclusions

The limited scope and special nature of this study restricted the comparisons which could be made between productivities in Saskatchewan agriculture and in the non-agricultural segment of the economy. Similar productivity estimates for the non-agricultural segment of the Province were not available. Only general comparisons could be made on the basis of net value of output for the two segments of the economy. Comparisons with respect to output per man in Saskatchewan agriculture and other agricultural regions were similarly restricted.

Comparative Value of Output

For the year 1946, the year for which the productivities could be considered the most reliable, the net value of production in Saskatchewan agriculture was 2130 dollars per man-equivalent worker.[2] The net value of production per worker employed in all non-agricultural industries in the Province was 3210 dollars. This indicated a value productivity per worker in industry approximately 50 percent higher than that in agriculture. For that year, average wheat yields were only slightly below the long-time average for the Province so the net value of production reported was close to normal.

The net value of agricultural production was estimated for each soil zone by distributing total net value among the zones in proportion to the estimated relative labor productivities for each zone in 1946. The comparative value productivities then ranged from 1630 dollars per man-equivalent in the Black and Grey Soil Zones to 2535 dollars in the Dark Brown and 2835 dollars in the Brown Zones. This indicated relative productivities of from 51 percent to 88 percent of the average in non-agricultural industries. Similar estimates by size of farm, for the Province as a whole, indicated that productivities in all farm size groups were below productivity

2. Estimates made from data in the Canada Year Book, 1950, and previous estimates of man-equivalent workers in this study.

population were made for the three years by interpolation from census data. The resulting index was adjusted to a 1936 base to give an index for each province as shown in Table 20. The indices indicated the approximate trends of labor productivity in the four provinces. They do not provide satisfactory measure of actual productivity changes because they are based on actual physical production and hence admit the effect of variable production levels for the years concerned. Reliable trend estimates would require more accurate measurement of changes in output through time. They, however, provide a useful comparison of regional differences in the trend of labor productivity.

Over the 10-year period, productivity was shown to have increased most rapidly in Saskatchewan and least rapidly in Quebec. The sharper trend for Saskatchewan, relative to the other provinces, was to be expected in view of the more rapid rate of mechanization in Saskatchewan.

Table 20. Indices of Labor Productivity in Agriculture, Selected Provinces, 1936 to 1946‡

Year	Saskatchewan	Ontario	Quebec	British Columbia
1936	100.0	100.0	100.0	100.0
1941	137.5	127.3	103.0	119.6
1946	195.2	142.1	113.7	154.6

‡ Calculated from census data and from Canada Year Book, 1950.

The estimated trends of productivity may also be compared with trends shown for other areas and other time periods. Such comparisons are not completely valid unless the productivities are expressed in the same terms and for the same time period. Recognizing these limitations, a general comparison with the results of the Barger and Landsberg study[3] for American agriculture is of interest.

In the study quoted, the index of output per gainfully occupied worker in American agriculture rose from 115 (based on 1900 = 100) in 1913 to 176 in 1938, an increase of 53 percent. In the present study, output per man-equivalent worker in Saskatchewan agriculture increased by 120 percent between 1926 and 1951, a period of the same length and one in which the rate of mechanization was similar to that in the United States for the earlier period. The index for Saskatchewan, however, related to one product for which production techniques have changed fairly rapidly. The American study on the other hand gave the productivity trends for the composite output of the industry. It therefore included products for which labor productivity has not increased as rapidly as in the case of cereal grain production.

The most valid comparison offered by the American study is given in the percentage change in labor time per unit of product. The percentage change in labor requirements for wheat production was given for the 25-year period during

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3. Barger, H., and Landsberg, H., American Agriculture, 1899-1939, American Book - Stratford Press, Inc., New York, 1942.

which mechanization of production was largely achieved, approximately from 1910 to 1935.[4] Average labor requirements in wheat production for the United States during this 25-year period declined by 46 percent. In Saskatchewan, for the later 25-year period from 1926 to 1951, labor requirements in wheat production declined by 54 percent. In those areas of the United States in which labor requirements in wheat production were lowest, the decline during the period from 1910 to 1935 was 66 percent. In the Brown Soil Zone of Saskatchewan during the later period, the decline in labor time per bushel was also 66 percent.

The estimated rate of change of productivity for comparable regions were identical though the time periods were not concurrent. Productivity was not reported in physical terms in the American study. Hence, no direct comparisons of labor time per unit of output were possible.

A more recent report provides estimates of labor productivity in agriculture for the United States as a whole for the last 15 years.[5] Indices of output per man-hour for Saskatchewan and for each soil zone were adjusted to a 1936 base and compared with the indices on a 1935-39 base for the United States for the nearest years reported. The comparison is given in Table 21.

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4. Ibid, pp. 257-8.
5. Bureau of Agricultural Economics, The Agricultural Situation, United States Department of Agriculture, Washington 25, D.C., August, 1952.

Table 21. Indices of Output per Man-Hour in Agriculture for Saskatchewan and Soil Zones of Saskatchewan, and the United States, 1936 to 1951

Year	Saskatchewan	Brown Zone	Dark Brown Zone	Black and Grey Zone	United States ‡
1936	100	100	100	100	100 (1935-1939)
1941	111	110	110	114	
1946	158	167	158	156	136 (1945)
1951	188	216	181	190	162

‡ The Agricultural Situation, Bureau of Agricultural Economics, United States Department of Agriculture, Washington 25, D.C., August, 1952, p. 8.

The base periods were not strictly comparable for the Saskatchewan and United States indices but are close enough for general comparison. The American indices were for the whole country and might be expected to show a smaller increase in productivity than would be shown for a specialized producing area like Saskatchewan. The American index, also, was based on actual yields for the individual years. Since crop conditions have been generally more favourable in recent years than in the 1935 to 1939 base period, the productivity increases shown probably reflect an upward bias in terms of above-average yields.

The trend comparison showed the rate of gain in productivity for Saskatchewan to be moderately higher than for the United States. This was true as well for each of the major regions of the Province. In each zone of Saskatchewan the gain exceeded 80 percent for the 15-year period. The comparative gain of 62 percent for the United States may be assumed to represent the increase in productivity for a period of about 14 years, beginning in 1937, the mid year of the base period.

Comparative Productivities in Saskatchewan

The more detailed estimates of the study were limited to productivity trends and differentials within the Province. The results, therefore, are more reliable for comparisons within agriculture and within the Province than for inter-industry or inter-provincial comparisons.

Regional Trends

Estimates were made of the changes in labor productivity in Saskatchewan agriculture for the period from 1926 to 1951. Productivity indices were constructed from these estimates for the Province and the three main Soil Zones (Table 22). The indices indicated an increase of 120 percent in output per man for the Province over the 26-year period. The most rapid increase occurred during the war years although a significantly high rate of increase continued through the post-war period.

The increase in productivity was greatest for the Brown Soil Zone for which the total change in output per man over the period was 195 percent. In this zone the more rapid gains were made first in the period from 1926 to 1931 and then from 1941 to 1951. From a position only 7.4 percent above the Provincial average in 1926, average productivity in the Brown Zone rose to 43.9 percent above the Provincial average in 1951. On this basis, the increase in labor productivity of the Brown Soil Zone had the largest influence on the change in productivity for the Province as a whole.

Table 22. Indices of Labor Productivity on Farms, Saskatchewan and Soil Zones, 1926-1951‡

Year	Saskatchewan	Brown zone	Dark Brown zone	Black and Grey zones
1926	100	100	100	100
1931	110	126	111	105
1936	117	137	127	106
1941	130	151	140	121
1946	185	229	201	166
1951	220	295	230	202

‡ Compiled from census data and Labor Force Survey. Index base 1926 = 100.

For the Dark Brown Soil Zone productivity increased by 130 percent during the period, an average rate of gain of 5.2 percent per year. This was a little higher than the average annual increase of 4.8 percent for the Province. By 1951 the labor time required per bushel of output had declined to an average of 59 minutes for all farms of the Zone. This compared with the Brown Zone average of 47 minutes and the Provincial average of 68 minutes.

The lowest gains in labor productivity were made in the Black and Grey Soil Zones. The total increase over 1926 was 102 percent, an average of about 4 percent per year. Gains were small until after 1941, almost all of the increase occurring in the last ten years.

Productivity Differentials

In the analysis of productivity based on farm business survey data, average productivities were calculated for a total of 128 classifications of farms as summarized in Table 23. Representing comparative productivities for a single short period of time, 1939 to 1941, the calculated outputs per man-year of labor

indicate the broader influences of regional, soil and farm size variations on labor productivity. All the productivities were derived from the same data source so that the differentials were comparable throughout.

The calculations showed a general increase of productivity with better soil and larger size of farm. Productivities were generally highest in the Dark Brown Zone and lowest in the Black and Grey Soil Zones. For all classes of soils average productivity differed only modestly between the Brown and Dark Brown Soil Zones. Productivity on light and heavy soils was somewhat higher in the Dark Brown Zone than in the Brown Zone. On medium soils, on the other hand, productivity in the Dark Brown Zone was somewhat lower than in the Brown Zone. Since the surveys did not constitute a fully representative sample, it could not be concluded that this difference would hold good for the average of all medium soils in the two zones.

The influence of the factors of zone, soil class and size of farm on labor productivity can be assessed approximately by comparing the range of variation in productivities for the Province which was associated with each factor. Productivity varied from 1420 to 2390 bushels per man between the zone with the highest and that with the lowest average labor productivity. This was a range of variation for zones of 970 bushels. The

Table 23. Bushels Output per Man-Equivalent Worker, by Soil Zone, Soil Class and Size of Farm, Saskatchewan, 1939-1941†

Soil Class and Farm Size	Province	Brown Zone	Dark Brown Zone	Black and Grey Zones
Light Soils				
Up to 239 acres	555	692	1355	541
240 - 399	1119	1284	1755	965
400 - 559	1378	1125	1822	1309
560 - 719	1691	1047	2907	1530
720 - 879	1666	1486	2217	1354
880 - 999	1795	2064	3024	1098
1000 and over	1641	1372	2408	1003
All farms	1172	1226	2223	934
Medium Soils				
Up to 239 acres	800	936	881	837
240 - 399	1440	1537	1442	1379
400 - 559	1681	1560	1639	1857
560 - 719	1988	2121	2053	1774
720 - 879	2217	2342	2225	2092
880 - 999	2332	2797	2744	1596
1000 and over	2798	3062	2645	2473
All farms	1700	1957	1834	1442
Heavy Soils				
Up to 239 acres	1453	1483	1491	1446
240 - 399	2161	2059	2654	1968
400 - 559	2775	2901	3241	2531
560 - 719	3823	3980	4402	2319
720 - 879	3531	3596	4417	2927
880 - 999	4493	4536	4758	3773
1000 and over	5706	5227	6650	3911
All farms	3277	3306	4359	2313
All Soils				
Up to 239 acres	820	976	980	799
240 - 399	1527	1655	1703	1367
400 - 599	1789	1732	1798	1822
560 - 719	1909	2382	2764	1810
720 - 879	2373	2514	2546	2078
880 - 999	2871	3624	3443	1736
1000 and over	3371	3362	4124	2293
All farms	1879	2170	2390	1420

† Compiled from data gathered in 11 Farm Business Surveys conducted by the Dominion Economics Division, Department of Agriculture, in co-operation with the Department of Farm Management, University of Saskatchewan, Saskatoon.

variation for soil classes for the Province as a whole was from 1172 to 3277 bushels per man, a range of 2105 bushels. The range of variation for farm size groups for the Province as a whole was 2551 bushels, from 820 to 3371 bushels per man.

The standard deviation about the mean zone productivities was 415 bushels and the coefficient of variation was 20.8 percent. Relative to soil class, the standard deviation was 894 bushels and the coefficient of variation was 43.6 percent. For the size of farm factor, for which the range of variation was greatest, the standard deviation was 1210 bushels and the coefficient of variation was 57.8 percent. Farm size had the greatest influence on productivity of labor, followed by soil type and soil zone.

As an average for all farms in the surveys, productivity of labor increased by over four times from the smallest to the largest farms. This represented an average gain of 425 bushels of output per man with each increase of one quarter-section in farm size. In almost all calculations of productivity differentials by farm size, the greatest gain in productivity was found between farms of one quarter and one half-section in size. The increase between these two groups varied from 50 to 100 percent depending on the class of soil. Gains were greatest between these two size groups on light and medium soils. On these soils gains were usually about 100 percent while for heavy soils the gains were nearer to 50 percent.

General Implications of Labor Productivity

The increase in output per man in Saskatchewan agriculture is primarily indicative of a growing economy in direct labor use on farms. Mechanization over the 25-year period to 1951 has enabled Saskatchewan farmers to expand output by the equivalent of 80 million bushels of wheat while reducing the labor force employed in agriculture by about 100,000 workers.

The value of machinery added to the agricultural industry, in 1935-1939 values, was approximately 100 million dollars. In effect, this capital investment replaced the 100,000 workers on farms, an equivalent exchange of one man for 1000 dollars worth of machinery. Even at a high charge for capital plus depreciation of machinery, say 20 percent per annum, the capital cost of machines compared with the men they replaced would be only 200 dollars per year. Indication of the actual change in over-all efficiency would require study of all items entering into cost for different stages of mechanization. The present indication relates only to the change in human labor time associated with wheat-equivalent output.

Labor productivity increases have been greatest during the last decade when agriculture in Saskatchewan has been relatively prosperous. The increase in productivity for the 15-year period, 1926 and 1941, was 30 percent as compared with 70 percent for the ten-year period from 1941 to 1951. There may be a direct

relationship between prosperity and productivity. It cannot be concluded, however, that productivity increases have been a cause of prosperity though the two phenomena have been concurrent.

Productivity has increased at the highest rate in the Brown Soil Zone where the increase in farm size and the reduction in the number of farm workers have both been greatest. Productivity in the other zones has not increased as rapidly but, in both of these other regions, the increase has averaged over four percent per year from the 1926 base. The rate shows no real signs of slackening in the later years of the period under review. The rate of increase for the last five-year period has been generally higher than the average for the 25 years, although it has been lower than during the war in all zones.

It appears that mechanization and the associated increase in labor productivity have followed the same pattern in the Black and Grey Soil Zones as was followed earlier in the Brown and Dark Brown Soil Zones. Mechanized farming has not been so readily adaptable to northern conditions. However, the productivities realized on the larger farms compared favorably with those for similar-sized farms in the other two zones.

The productivity differentials established by size of farm have the greatest implication for individual farmers. Larger farm units with their resulting higher labor productivity would be advantageous to the whole economy. They hold even greater benefit for the individual farm operator whose returns are

largely limited by his gross output.

Labor productivity for quarter-section farms on all classes of soil and for all zones fell far short of average labor productivity for the Province. In most cases, the comparison between quarter and half-section farms indicated that labor on the smallest farms was utilized at little more than 50 percent of the effectiveness attained on half-section farms. Even assuming standard efficiency of labor use on half-section farms, the labor of the operators of quarter-section farms was only half utilized.

On half-section farms, productivity was below the Provincial average for all farm groupings except those on heavy soils. In order to achieve average productivity per man, farmers required approximately 960 acres of land on light soils, 640 acres on medium soils and 320 acres on heavy soils. Efficiency of labor use, and hence reasonable levels of income for farm operators can only be expected if farm sizes are adjusted at least to these minimums.

At the present time, farm sizes are distributed so that the majority of farms are well below the size required for effective use of farm labor. In the Brown Soil Zone in 1951, nearly half of the farms were 480 acres or less in size. In the Dark Brown Zone, a little over half of the farms were in this size range. The Black and Grey Soil Zones, in turn,

had fully three-fifths of all farms of 320 acres or less in size. All of these sizes of farms, at the average for all soil classes in each zone, had labor productivities below the Provincial average.

As long as substantial proportions of farms are in a size-range which limits labor productivity to a standard represented by a labor input of over 100 minutes per bushel of wheat-equivalent output, real costs of production will remain higher than is warranted by the current stage of technology. Reasonable incomes and living standards on such farms can hardly be attained or maintained without relatively buoyant prices for agricultural products.

APPENDIX "A"

Notes on Correlation Between Acres Cropland Per Man and Size of Farm

Straight line regressions were calculated to determine the general relationships between total farm size and cropland acres per man equivalent on light, medium and heavy soils. The closest correlation was found on heavy soils and the lowest on light soils. The regression line equations and corrected correlation coefficients are given below. Y represents acres of cropland per man and X the number of quarter sections of total farm size. All calculations were based on Farm Business Survey data.

Light Soils - Regression equation: $Y = 74.13 + 30.96X$

Corrected coefficient of correlation:

$$\bar{r}_{xy} = .8806$$

Medium Soils - Regression equation: $Y = 76.40 + 39.83X$

Corrected coefficient of correlation:

$$\bar{r}_{xy} = .9481$$

Heavy Soils - Regression equation: $Y = 84.50 + 59.72X$

Corrected coefficient of correlation:

$$\bar{r}_{xy} = .9687$$

Similar calculations were made to determine the degree of correlation between cropland acres per farm and cropland acres per man-equivalent worker. On all types of soil the correlation found was closer than that between total acres and cropland acres per man. With Y representing acres of cropland per man and X cropland acres per farm, the equations and coefficients were:

Light Soils - $Y = 65.96 + .3715X$
$r_{xy} = .9249$

Medium Soils- $Y = 83.53 + .3451X$

$r_{xy} = .9521$

Heavy Soils - $Y = 94.82 + .3998X$

$r_{xy} = .9732$

Calculations were also made to determine the differences in correlation between cropland acres per farm and cropland acres per man in the different soil zones. Farms on all types of soils were combined for the calculations of zonal differences. The same symbols as above are used in the following equations.

Brown Soil Zone - $Y = 85.6 + .5426X$

$\bar{r}_{xy} = .9890$

Dark Brown Soil Zone - $Y = 93.61 + .4049X$

$\bar{r}_{xy} = .9791$

Black and Grey Soil Zones - $Y = 73.64 + .2558X$

$\bar{r}_{xy} = .9005$

Cropland acres per man increased most rapidly with cropland acres per farm in the Brown soil zone and least rapidly in the Black and Grey zones. Correlation between acres per man and improved acres per farm was also closest in the Brown and least close in the Black and Grey soil zones. All correlation coefficients were quite high.

Correlation Between Farm Size and Output Per Man

Regression equations and correlation coefficients were calculated between farm size in quarter sections and output per man in bushels of wheat for the province as a whole, for each soil type and for each soil zone. With X representing the number of quarter sections in total farm area and Y output per man in bushels, calculated regression equations, on a straight line basis, together with their coefficients of correlation were:

Province - All Soils - $Y = 652.3 + 346.6X$

$\bar{r}_{xy} = .9824$

Brown Soil Zone - $Y = 757.3 + 380.4X$

$\bar{r}_{xy} = .9359$

Dark Brown Soil Zone - $Y = 738.9 + 413.5X$

$\bar{r}_{xy} = .9710$

Black and Grey Soil Zones

$$Y = 992.2 - 169.9X$$

$$\bar{r}_{xy} = .8215$$

Light Soils - Whole Province

$$Y = 764.9 - 158.4X$$

$$\bar{r}_{xy} = .9988$$

Medium Soils - Whole Province

$$Y = 781.1 - 270.7X$$

$$\bar{r}_{xy} = .9741$$

Heavy Soils - Whole Province

$$Y = 1099.0 - 548.7X$$

$$\bar{r}_{xy} = .9771$$

In all calculations the X value for the farm size group of 1000 acres and over was taken to the nearest first place decimal of quarter sections which the farms included in the grouping averaged. For all other X values, the integral number of quarter sections was used. All farm groups averaged within a very few acres of the quarter section point on which the group was centered.

APPENDIX "B"

Soil Classifications

In calculating yields from the data compiled by W. Parkinson, the different soil types for which average yields were reported by municipality were divided arbitrarily into three classes in this study. The soil textures for which yields were reported and the general soil type into which they were placed were as follows:

Light Soils (Sandy Loams to Light Loams)

Sand
Gravelly Sandy Loam
Very Fine Sandy Loam
Very Fine Sandy Loam - Fine Sandy Loam
Very Fine Sandy Loam - Silty Loam
Fine Sandy Loam - Sand
Fine Sandy Loam
Fine Sandy Loam - Light Loam
Fine Sandy Loam - Loam
Light Loam - Gravelly Sandy Loam
Light Loam
Loam - Gravelly Sandy Loam

Medium Soils (Loams to Silty Loams)

Loam - Sandy Loam
Loam - Light Loam
Loam
Loam - Silty Loam
Loam - Clay Loam
Loam - Silty Clay Loam
Silty Loam
Silty Clay Loam
Silty Loam - Clay Loam

Heavy Soils (Clay Loam to Heavy Clay)

Silty Clay Loam - Clay Loam
Clay Loam
Clay Loam - Clay
Clay - Silty Clay Loam
Clay
Heavy Clay - Silty Clay Loam
Heavy Clay - Clay Loam
Heavy Clay

Table 1. Percentage and Number of Acres Surveyed in Each Soil Class by Saskatchewan Soil Survey, by Province and Soil Zones ('000 acres)

Area	Light soils		Medium soils		Heavy soils	
	Area	Percent	Area	Percent	Area	Percent
Brown Zone	2,014	13.37	6,429	42.67	6,624	43.96
Dark Brown Zone	3,589	20.97	8,520	49.78	5,005	29.25
Black and Grey Soil Zones	6,418	25.91	14,956	60.37	3,399	13.72
Province	12,020	21.10	29,905	52.51	15,028	26.39

APPENDIX "C"

Table 2. Estimated Net Numbers of Farms by Province and Soil Zone, for Census Years, 1926-1951

Year	Brown Zone	Dark Brown Zone	Park Region	Province
1926	25,632	34,624	43,210	103,466
1931	27,962	38,948	53,135	120,045
1936	24,841	37,214	60,617	122,672
1941	23,576	36,425	60,175	120,176
1946	21,508	33,471	54,622	109,601
1951	22,295	34,310	55,413	112,018

Table 3. Total Area in Occupied Farms, by Province and Soil Zone, 1926-1951 ('000 acres)

Year	Brown Zone	Dark Brown Zone	Park Region	Province
1926	13,456	17,779	14,711	45,945
1931	17,407	20,517	17,749	55,673
1936	16,925	20,064	19,915	56,904
1941	18,033	20,655	21,273	59,961
1946	18,105	20,613	20,698	59,416
1951	18,198	21,526	21,939	61,663

Table 4. Total Area Improved and Percent of Improved in Crop and Improved Pasture, by Province and Soil Zone, 1926-1951 ('000 acres)

Year	Brown Zone		Dark Brown Zone		Park Region		Province	
	Acres	Percent in crop	Acres	Percent in crop	Acres	Percent in crop	Acres	Percent in crop
1926	8,268	66.8	12,649	70.0	6,798	74.6	27,714	70.2
1931	10,551	67.4	14,411	70.1	8,586	74.6	33,549	70.4
1936	10,189	64.2	13,992	67.1	9,451	73.3	33,632	68.0
1941	10,440	55.1	14,260	56.6	10,877	61.8	35,577	57.7
1946	10,366	61.6	14,174	66.3	11,050	67.2	35,590	65.2
1951	10,753	63.3	15,250	63.9	12,803	67.1	38,807	64.8

Table 5. Total Area Fallow and Idle, by Province and Soil Zone, 1926-1951 ('000 acres)

Year	Brown Zone	Dark Brown Zone	Park Region	Province
1926	2,741	3,794	1,730	8,265
1931	3,443	4,315	2,184	9,941
1936	3,644	4,600	2,524	10,769
1941	4,687	6,186	4,153	15,026
1946	3,978	4,781	3,623	12,382
1951	3,945	5,507	4,208	13,660

Table 6. Total Area in Crop and Improved Pasture, by Province and Soil Zone, 1926-1951 ('000 acres)

Year	Brown Zone	Dark Brown Zone	Park Region	Province
1926	5,526	8,855	5,068	19,449
1931	7,109	10,096	6,402	23,608
1936	6,545	9,392	6,926	22,863
1941	5,753	8,074	6,725	20,551
1946	6,388	9,363	7,426	23,208
1951	6,808	9,744	8,595	25,147

Table 7. Value of Machinery on Farms in Constant Dollars, (1935-39) by Province and Soil Zone, 1926-1951 ($'000)

Year	Brown Zone	Dark Brown Zone	Park Region	Province
1926	45,906	72,681	54,756	173,344
1931	57,525	77,165	60,583	195,274
1936	32,716	45,316	44,219	122,255
1941	34,543	46,105	50,080	130,727
1946	43,656	71,050	73,711	188,417
1951	55,440	98,725	135,582	279,747

Table 8. Value of Livestock on Farms in Constant Dollars, (1935-39) by Province and Soil Zones, 1926-1951 ($'000)

Year	Brown Zone	Dark Brown Zone	Park Region	Province
1926	28,560	44,961	36,050	109,570
1931	23,895	41,459	41,760	107,114
1936	20,959	36,022	45,194	102,175
1941	14,038	24,376	36,795	75,208
1946	13,015	21,819	30,943	65,776
1951	18,257	27,464	39,807	85,540

Table 9. Total Workers in Canadian Agriculture by Survey Dates ('000's)

Year	March	June	August	November
1945				1,058
1946	1,083	1,274	1,317	1,071
1947	931	1,163	1,299	1,068
1948	965	1,186	1,247	986
1949	956	1,123	1,235	1,048
1950	940	1,062*	1,151	969
1951	834	1,016	1,088	825
1952	825			
Average	933	1,137	1,223	1,004

* Includes estimate for Manitoba which was not included in Labour Force Survey for that date due to Red River flood.

Table 10. Man Equivalent Workers Based on 60-Hour Week, by Survey Dates, Canadian Agriculture ('000's)

Year	March	June	August	November
1945				918
1946	904	1,078	1,143	881
1947	718	976	1,098	861
1948	731	1,012	1,079	785
1949	738	959	1,069	843
1950	670	910*	990	793
1951	612	877	937	635
1952	635			
Average	715	969	1,053	817

* Includes estimate for Manitoba by interpolation.

Table 11. Numbers of Persons with Jobs in Agriculture in Prairie Provinces by Survey Dates ('000's)

Year	March	June	August	November
1945				418
1946		506	535	434
1947	383	463	516	431
1948	406	469	504	401
1949	402	438	492	431
1950	385	418*	447	400
1951	342	408	436	370
1952	352			
Average	378	450	488	412

* Includes estimate for Manitoba by interpolation

Table 12. Estimated Numbers of Farm Workers and Man-Equivalent Workers, by Province and Soil Zone, 1926-1951

Area and year	Census hired workers	Wages and board '000's $	Annual wage $	Calculated hired workers	Calculated workers as percent of census	Census hired workers, adjusted to 1941-46 percent	Census total workers	Adjusted total workers *	Calculated man-equivalent workers *
Saskatchewan									
1926	-	32,958	576	57,219	-	82,746	-	253,719	205,005
1931	120,849	23,408	354	66,124	54.7	95,624	304,674	279,449	225,795
1936	132,321	13,205	300	44,015	33.3	63,651	326,096	257,426	208,000
1941	39,067	13,495	497	27,153	69.5	39,067	210,522	210,522	170,102
1946	26,266	17,953	996	18,025	68.6	26,266	166,557	166,557	134,578
1951	-	-	-	-	-	-	-	152,840	123,495
Brown Soil Zone									
1926	-	8,953		15,543	-	21,587	-	59,431	48,020
1931	30,252	5,274		14,899	49.2	20,693	70,218	61,141	49,402
1936	31,148	2,848	as	9,492	30.5	13,183	69,130	51,193	41,364
1941	8,356	2,971	above	5,978	71.5	8,356	40,949	40,949	33,087
1946	4,032	2,932		2,944	73.0	4,032	29,934	29,934	24,187
1951	-	-		-	-	-	-	24,857	20,085
Dark Brown Zone									
1926	-	16,279		28,262	-	37,732	-	97,967	79,157
1931	49,463	10,608		29,966	60.6	40,008	109,891	101,234	81,797
1936	48,897	4,885	as	16,284	33.3	21,740	108,900	81,788	66,085
1941	13,014	4,963	above	9,986	76.7	13,014	63,813	63,813	51,561
1946	9,387	6,771		6,798	72.4	9,287	51,579	51,579	41,676
1951	-	-		-	-	-	-	46,951	37,936
Park Region									
1926	-	7,726		13,413	-	21,023	-	96,321	77,828
1931	41,134	7,526		21,259	51.7	33,321	124,565	117,074	94,596
1936	52,276	5,472	as	18,239	34.9	28,587	148,066	124,445	100,551
1941	17,697	5,561	above	11,190	63.2	11,190	105,760	105,760	85,454
1946	12,847	8,250		8,283	64.5	8,283	85,044	85,044	68,716
1951	-	-		-	-	-	-	81,032	65,474

* Zone totals adjusted proportionally to correspond to provincial totals which were calculated using provincial weighting.

Table 13. Distribution of Farm Sizes in Percent, by Province and Soil Zones, 1926-1951

Area and year	Size of farm in quarter-sections									
	1	2	3	4	5	6	7	8	9	10 & over
Saskatchewan										
1926	28.3	36.2	16.4	10.6	---	6.1	--	---	2.3	---
1931	31.8	34.3	14.3	---	---	---	19.6	---	---	---
1936	34.6	33.4	13.6	---	---	---	18.4	---	---	---
1941	30.7	33.4	15.0	---	---	---	20.9	---	---	---
1946	25.3	33.5	16.3	--	16.7	--	---	4.8	--	--- 3.3 ---
1951	17.7	30.8	19.5	15.0	--11.7	--	---	---	5.0	---2.7 -
By survey*	13.5	30.8	19.5	16.4	8.4	5.8	---	---	7.4	---
Brown Zone										
1926	18.9	42.6	17.1	12.1	---	6.5	--	---	2.7	---
1931	19.3	35.5	16.6	---	---	---	28.6	---	---	---
1936	17.2	35.1	16.9	---	---	---	30.8	---	---	---
1941	15.7	33.1	17.6	---	---	---	33.7	---	---	---
1946	13.3	30.9	17.8	--22.9	--	---	8.0	--	---	7.3 ---
1951	7.6	22.6	18.9	18.3	--	16.8	--	---	9.1	---6.7
By survey*	3.7	25.9	19.0	19.9	11.3	8.8	---	---	11.4	---
Dark Brown Zone										
1926	18.6	35.2	19.2	14.4	---	9.0	--	---	3.5	---
1931	21.5	35.2	17.0	---	---	---	26.2	---	---	---
1936	22.1	35.7	17.0	---	---	---	25.1	---	---	---
1941	19.0	34.4	18.3	---	---	---	28.2	---	---	---
1946	15.3	32.2	18.8	--	22.8	--	---	6.8	---	---4.1--
1951	8.6	23.7	20.9	19.5	--	16.7	--	---	7.4	---3.2
By survey*	7.7	30.3	22.2	18.0	8.8	5.2	---	---	7.8	---
Park Region										
1926	42.5	32.9	13.6	6.4	---	3.4	---	---	1.2	---
1931	47.0	32.9	10.9	---	---	---	9.1	---	---	---
1936	50.7	31.2	9.8	---	---	---	8.4	---	---	---
1941	45.0	32.8	11.7	---	---	---	10.6	---	---	---
1946	37.6	35.7	13.9	--	9.8	--	---2.1	---	---	.9 --
1951	27.5	33.8	18.8	10.9	--	6.5	--	---	1.9	--- .7
By survey*	30.2	30.8	17.0	11.0	4.8	3.4	---	---	2.8	---

* 16 Farm Business Surveys, 1939 to 1949.

APPENDIX "D"

The Farm Business Surveys used as the basis for the study are listed in the following table. Those marked "*" were not used in the calculations by soil type.

Table 14. Survey Areas, Year of Surveys and Numbers of Farm Records in Each Survey, by Soil Zone

Zone and year	Area	Number of farm records
Brown Soil Zone		
1939	R.M. Pittville, No. 169	116
1940	Eyebrow - Lacadena	434
1946	Govenlock - Eastend - Maple Creek	317 *
1947	Fox Valley - Eston - Kindersley	419 *
Total records		1,286
Dark Brown Zone		
1940	R.M. Bratt's Lake	106
1941	Weyburn - Estevan	268
1941	Blucher - Colonsay	136
1943	Cory - Asquith - Langham	492 *
1949	Elbow - Saskatoon	328 *
Total records		1,330
Park Region		
1939	Saltcoats - Churchbridge	200
1939	Lashburn - Paynton	133
1940	Balgonie - Qu'Appelle	84
1940	Melfort	103
1940	Pleasantdale	71
1941	Albertville - Garrick	304
1948	Moosomin - Carlyle	328 *
Total records		1,223
Total Farm Records for Saskatchewan		3,839

Table 15. Distribution of Farm Sizes, Improved Acres and Labor Inputs, by Province and Soil Zone, by 16 Farm Business Surveys, 1939-1949

Region and farm size (quarter-sections)	Number of farms	Per-cent of total	Total area (acres)	Improved area (acres)	Per-cent of total improved	Improved acres per farm
Saskatchewan						
1	520	13.5	82,451	46,699	56.6	90
2	1,186	30.8	352,384	256,670	72.8	216
3	750	19.5	356,378	255,803	71.8	341
4	632	16.4	400,595	299,640	74.8	474
5	322	8.4	254,392	182,819	71.9	568
6	224	5.8	213,519	157,527	73.8	703
7 & over	285	7.4	385,869	280,668	72.7	985
Brown Soil Zone						
1	48	3.7	7,589	6,456	85.1	135
2	333	25.9	105,396	89,959	85.4	270
3	244	19.0	116,719	93,021	79.7	381
4	256	19.9	161,185	131,836	81.8	515
5	145	11.3	113,922	88,066	77.3	607
6	113	8.8	108,093	85,409	79.0	756
7 & over	147	11.4	197,767	148,035	74.9	1,007
Dark Brown Zone						
1	103	7.7	16,614	12,938	77.9	126
2	406	30.3	128,209	101,033	78.8	249
3	298	22.2	141,010	106,587	75.6	358
4	241	18.0	153,853	123,475	80.3	512
5	118	8.8	93,617	69,852	74.6	592
6	70	5.2	66,620	53,594	80.4	766
7 & over	104	7.8	143,503	111,696	77.8	1,074
Black & Grey Zones						
1	369	30.2	58,248	27,305	46.9	74
2	377	30.8	118,779	65,678	55.3	174
3	208	17.0	98,649	56,195	57.0	270
4	135	11.0	85,557	44,329	51.8	328
5	59	4.8	46,853	24,901	53.1	422
6	41	3.4	38,806	18,524	47.7	452
7 & over	34	2.8	44,599	20,937	46.9	616

Table 15. (Cont'd) Distribution of Farm Sizes, Improved Acres and Labor Inputs, by Province and Soil Zone, by 16 Farm Business Surveys, 1939-1949

Region and farm size (quarter-sections)	Man equivalent workers	Man equivalent workers per farm	Improved acres per man-equivalent	Man-equivalents per 1000 improved acres
Saskatchewan				
1	606.03	1.165	77	12.99
2	1,413.48	1.192	182	5.49
3	1,068.77	1.425	239	4.18
4	967.74	1.531	310	3.23
5	535.06	1.662	342	2.92
6	410.62	1.833	384	2.60
7 & over	559.15	1.962	502	1.99
Brown Soil Zone				
1	52.42	1.092	123	8.13
2	379.66	1.140	237	4.22
3	302.17	1.238	308	3.25
4	341.62	1.334	386	2.59
5	204.35	1.409	431	2.32
6	170.84	1.512	500	2.00
7 & over	244.17	1.661	606	1.65
Dark Brown Zone				
1	115.28	1.119	112	8.93
2	510.41	1.247	198	5.05
3	434.02	1.456	246	4.06
4	357.95	1.485	345	2.90
5	204.07	1.729	342	2.92
6	139.77	1.997	383	2.61
7 & over	215.51	2.072	518	1.93
Black & Grey Zones				
1	438.33	1.188	62	16.13
2	523.41	1.388	125	8.00
3	332.58	1.599	169	5.92
4	268.17	1.986	165	6.06
5	126.64	2.146	197	5.08
6	100.01	2.439	185	5.41
7 & over	99.47	2.926	210	4.76

Table 16. Distribution of Farm Sizes, Improved Acres and Acres in Crop, by Soil Class and Soil Zone, Saskatchewan, by 11 Farm Business Surveys, 1939-1941

Region and farm size (quarter-sections)	Number of farms	Total area (acres)	Improved area (acres)	Net crop acres	Percent of total acres in crop
Light Soils					
Brown Zone					
1	8	1,280	1,050	668	52.2
2	19	6,060	4,860	3,181	52.5
3	12	5,700	3,750	1,661	29.1
4	9	5,500	3,570	1,484	27.0
5	7	5,560	3,530	1,610	29.0
6	2	1,920	1,440	730	38.0
7 & over	7	8,620	5,280	1,851	21.5
Dark Brown Zone					
1	1	160	160	130	81.3
2	13	4,120	3,590	2,780	67.5
3	13	6,030	4,380	3,130	51.9
4	10	6,310	5,010	3,189	50.5
5	7	5,650	4,080	2,500	44.2
6	3	2,830	2,250	1,860	65.7
7 & over	6	7,710	5,110	3,630	47.1
Black & Grey Zones					
1	121	18,890	7,320	5,880	31.1
2	69	21,430	9,830	6,769	31.6
3	39	18,480	9,070	6,407	34.7
4	17	10,640	5,500	3,861	36.3
5	8	6,330	2,370	1,530	24.2
6	5	4,590	1,720	1,045	22.8
7 & over	5	6,740	1,620	1,030	15.3
Saskatchewan					
1	130	20,330	8,530	6,678	32.8
2	101	31,610	18,280	12,730	40.3
3	64	30,210	17,200	11,198	37.1
4	36	22,450	14,080	8,534	38.0
5	22	17,540	9,980	5,640	32.2
6	10	9,340	5,410	3,635	38.9
7 & over	18	23,070	12,010	6,511	28.2

Table 16 (Cont'd). Distribution of Farm Sizes, Improved Acres and Acres in Crop, by Soil Class and Soil Zone, Saskatchewan, by 11 Farm Business Surveys, 1939-1941

Region and farm size (quarter-sections)	Number of farms	Total area (acres)	Improved area (acres)	Net crop acres	Percent of total acres in crop
Medium Soils					
Brown Zone					
1	19	3,010	2,590	1,693	56.2
2	116	36,830	30,020	18,150	49.3
3	80	38,260	30,190	16,531	43.2
4	65	41,260	33,190	18,830	45.6
5	33	26,220	19,970	10,394	40.0
6	22	21,060	16,400	9,611	45.6
7 & over	25	30,580	23,850	13,785	45.1
Dark Brown Zone					
1	15	2,490	2,020	1,140	45.8
2	110	34,910	27,940	16,000	45.8
3	104	49,250	38,450	20,595	41.8
4	69	44,220	32,420	17,922	40.5
5	36	28,550	21,110	11,053	38.7
6	16	15,190	11,890	6,680	44.0
7 & over	11	14,300	10,750	6,380	44.6
Black & Grey Zones					
1	197	31,120	14,430	11,539	37.1
2	159	50,280	26,110	18,525	36.8
3	73	34,610	19,410	13,514	39.0
4	50	31,800	15,150	10,230	32.2
5	24	19,220	10,530	6,816	35.5
6	16	15,260	5,940	3,993	26.2
7 & over	9	11,250	6,110	4,211	37.4
Saskatchewan					
1	231	36,620	19,040	14,372	39.2
2	385	122,020	84,070	52,675	43.2
3	257	122,120	88,050	50,740	41.5
4	184	117,280	80,760	46,982	40.1
5	93	73,990	51,610	28,263	38.2
6	54	51,510	34,230	20,284	39.4
7 & over	45	56,130	40,710	24,376	43.4

Table 16 (Cont'd). Distribution of Farm Sizes, Improved Acres and Acres in Crop, by Soil Class and Soil Zone, Saskatchewan, by 11 Farm Business Surveys, 1939-1941

Region and farm size (quarter-sections)	Number of farms	Total area (acres)	Improved area (acres)	Net crop acres	Percent of total acres in crop
Heavy Soils					
Brown Zone					
1	4	640	590	490	76.6
2	48	15,350	13,500	9,405	61.3
3	20	9,640	8,450	5,905	61.3
4	23	14,680	13,400	9,480	64.6
5	10	7,960	7,050	4,970	62.4
6	9	8,520	7,890	5,910	69.4
7 & over	12	15,500	13,650	9,570	61.7
Dark Brown Zone					
1	2	320	310	220	68.8
2	29	9,180	8,900	6,930	75.5
3	9	4,320	4,170	2,990	69.2
4	36	23,000	22,470	16,260	70.7
5	6	4,800	4,630	3,540	73.8
6	10	9,570	9,390	6,770	70.7
7 & over	14	20,010	19,580	14,900	74.5
Black & Grey Zones					
1	24	3,990	3,130	2,220	55.6
2	36	10,990	8,850	6,164	56.1
3	20	9,530	7,150	4,842	50.8
4	10	6,190	4,250	2,680	43.3
5	7	5,390	4,290	2,686	49.8
6	3	2,700	2,310	1,570	58.1
7 & over	3	4,420	3,390	2,010	45.5
Saskatchewan					
1	30	4,950	4,030	2,930	59.2
2	113	35,520	31,250	22,499	63.3
3	49	23,490	19,770	13,737	58.5
4	69	43,870	40,121	28,420	64.8
5	23	18,150	15,970	11,196	61.7
6	22	20,790	19,590	14,250	68.5
7 & over	29	39,930	36,620	26,480	66.3

Table 17. Labor Inputs and Animal Units by Farm Size and Soil Class, Saskatchewan and Soil Zones, by 11 Farm Business Surveys, 1939-1941

Region and farm size (quarter-sections)	Man equivalent workers	Man equivalent workers per farm	Improved acres per man equivalent	Number of animal units	Animal units per 100 acres crop	Animal units per man equivalent
Light Soils						
Brown Zone						
1	9.00	1.125	117	66	9.88	7.3
2	23.11	1.216	210	258	8.11	11.2
3	13.77	1.148	272	120	7.22	8.7
4	13.23	1.470	270	158	10.65	11.9
5	10.11	1.444	349	123	7.64	12.2
6	3.30	1.650	436	57	7.81	17.3
7 & over	12.59	1.779	419	173	9.35	13.7
Dark Brown Zone						
1	1.00	1.000	160	8	6.15	8.0
2	16.51	1.270	217	159	5.72	9.6
3	17.90	1.377	245	252	8.05	14.1
4	11.43	1.143	438	174	5.46	15.2
5	11.75	1.679	347	157	6.28	13.4
6	6.41	2.137	351	70	3.76	10.9
7 & over	15.71	2.618	325	207	5.70	13.2
Black & Grey Zones						
1	143.64	1.187	51	932	15.85	6.5
2	92.71	1.344	106	920	13.59	9.9
3	64.73	1.660	140	882	13.77	13.6
4	33.35	1.962	165	449	11.63	13.5
5	14.94	1.868	159	181	11.83	12.1
6	12.58	2.516	137	152	14.55	12.1
7 & over	13.58	2.716	119	219	21.26	16.1
Saskatchewan						
1	153.64	1.182	56	1,006	15.06	6.5
2	132.33	1.310	138	1,337	10.50	10.1
3	96.40	1.506	178	1,254	11.20	13.0
4	58.01	1.611	243	781	9.15	13.5
5	36.80	1.673	271	461	8.17	12.5
6	22.29	2.229	243	279	7.68	12.5
7 & over	41.88	3.327	287	599	9.20	14.3

Table 17 (Cont'd). Labor Inputs and Animal Units by Farm Size and Soil Class, Saskatchewan and Soil Zones, by 11 Farm Business Surveys, 1939-1941.

Region and farm size (quarter-sections)	Man equivalent workers	Man equivalent workers per farm	Improved acres per man equivalent	Number of animal units	Animal units per 100 acres crop	Animal units per man equivalent
Medium Soils						
Brown Zone						
1	21.30	1.121	122	125	7.38	5.9
2	139.07	1.199	216	1,003	5.53	7.2
3	124.81	1.560	242	941	5.69	7.5
4	104.59	1.609	317	879	4.67	8.4
5	52.28	1.584	382	526	5.06	10.0
6	40.48	1.840	405	278	2.89	6.9
7 & over	53.04	2.122	450	470	3.41	8.9
Dark Brown Zone						
1	16.18	1.079	125	149	13.07	9.2
2	138.67	1.261	201	1,334	8.34	9.6
3	157.10	1.511	245	1,724	8.37	11.0
4	109.14	1.582	297	1,230	6.86	11.3
5	62.10	1.725	340	730	6.60	11.8
6	30.43	1.902	391	378	5.66	12.4
7 & over	30.15	2.741	357	324	5.08	10.7
Black & Grey Zones						
1	235.00	1.193	61	1,575	13.65	6.7
2	228.95	1.440	114	2,205	11.90	9.6
3	124.01	1.699	157	1,442	10.67	11.6
4	98.26	1.965	154	1,306	12.77	13.3
5	55.52	2.313	190	656	9.62	11.8
6	42.62	2.664	139	485	12.15	11.4
7 & over	29.01	3.223	211	331	7.86	11.4
Saskatchewan						
1	272.48	1.180	70	1,849	12.87	6.8
2	506.62	1.316	166	4,542	8.62	9.0
3	405.92	1.579	217	4,107	8.09	10.1
4	311.99	1.696	259	3,415	7.27	10.9
5	169.90	1.827	304	1,912	6.77	11.3
6	113.53	2.102	302	1,141	5.63	10.1
7 & over	112.20	2.493	363	1,125	4.62	10.0

Table 17 (Cont'd). Labor Inputs and Animal Units by Farm Size and Soil Class, Saskatchewan and Soil Zones, by 11 Farm Business Surveys, 1939-1941.

Region and farm size (quarter-sections)	Man equivalent workers	Man equivalent workers per farm	Improved acres per man equivalent	Number of animal units	Animal units per 100 acres crop	Animal units per man equivalent
Heavy Soils						
Brown Zone						
1	4.08	1.020	145	12	2.45	2.9
2	56.41	1.175	239	326	3.47	5.8
3	25.14	1.257	336	125	2.12	5.0
4	29.42	1.279	455	168	1.77	5.7
5	17.07	1.707	413	106	2.13	6.2
6	16.09	1.788	490	75	1.27	4.7
7 & over	22.61	1.884	604	156	1.63	6.9
Dark Brown Zone						
1	2.00	1.000	155	12	5.45	6.0
2	35.38	1.220	252	141	2.03	4.0
3	12.50	1.389	334	61	2.04	4.9
4	50.05	1.390	449	195	1.20	3.9
5	10.86	1.810	426	26	.73	2.4
6	19.28	1.928	487	78	1.15	4.0
7 & over	30.36	2.169	645	88	.59	2.9
Black & Grey Zones						
1	29.66	1.236	106	264	11.89	8.9
2	60.51	1.681	146	483	7.84	8.0
3	36.96	1.848	193	351	7.25	9.5
4	22.33	2.233	190	232	8.66	10.4
5	17.73	2.533	242	157	5.85	8.9
6	8.04	2.680	287	67	4.27	8.3
7 & over	9.93	3.310	341	50	2.49	5.0
Saskatchewan						
1	35.74	1.191	113	288	9.83	8.1
2	152.30	1.348	205	950	4.22	6.2
3	74.60	1.522	265	537	3.91	7.2
4	101.80	1.475	394	595	2.09	5.8
5	45.66	1.985	350	289	2.58	6.3
6	43.41	1.973	451	220	1.54	5.1
7 & over	62.90	2.169	582	294	1.11	4.7

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