AGRICULTURAL LABOUR INPUT ALLOCATION AND EFFICIENCY

AGRICULTURAL LABOUR INPUT ALLOCATION AND EFFICIENCY IN NORTH GRIMSBY TOWNSHIP

By

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SCOPE AND CONTENTS:

This thesis examines the allocation and relative efficiency of the agricultural labour input in North Grimsby Township. The relative efficiency of the labour input is determined by the construction of an Index of Labour Efficiency, in which the actual labour input is compared with the labour input requirement for the farm as determined from studies undertaken by the Ontario Department of Agriculture. Certain normative hypotheses are tested, relating elements of the farm economic structure and the physical environment to the Labour Efficiency Index.

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CHAPTER I

INTRODUCTION

> "Labour is one of the major inputs on modern commercial farms. It follows that efficient management and use of labour is necessary for the successful management of today's farms."[1]

1.1 Definition of the Problem.

The purpose of this study is to throw some light on one of the aspects of farm management in Ontario, the agricultural labour input. The labour input can be regarded as the most important input in the farm-firm. In 1949, labour accounted for 67% of the total agricultural income in the United States of America. The other input factors, land and capital received 25% and 8% respectively.[2]

In order to conduct a meaningful study of the agricultural labour input it is necessary to make some assessment of the relative efficiency[3] of the labour input in each farm enterprise and to determine the factors influencing labour efficiency. The relative efficiency of the labour input will be determined by the construction of a Labour Efficiency Index in which the total labour input on a

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[1] Castle, E.N. and Baker, M.H. Farm Business Management, New York: Macmillan, 1962.

[2] Heady, E.O. and Jenson, H. Farm Management Economics, (Englewood Cliffs: Prentice-Hall, 1954), p. 400.

[3] For the purposes of this study, efficiency is defined in terms of inputs, with no specific reference to levels of output. This concept is further explained in the review of literature, Chapter 1.3 and in the definition of the Labour Efficiency Index, Chapter 5.5.

holding is compared with the theoretical labour requirements for an efficient farm of that type in the province.

Factors influencing the relative efficiency of the labour input in the farm-firm are both numerous and diverse. They may be classified under three main headings; physical, social and economic. Physical factors include the ease with which the soil may be cultivated, topographic controls on the efficiency of machinery usage and the influence of climatic factors. Social factors include the ability of the operator as an entrepreneur and the effectiveness of the farm operator, his family and any hired labour in supplying the labour input required on the holding. Economic factors include elements of farm structure, such as enterprise type, investment in machinery and layout of buildings as well as macro-economic influences from the national or regional economy in the form of minimum wage legislation and compulsory marketing schemes.

It is not possible in this study to consider all the variables described above. Of the physical factors climate, and topographic controls on machinery usage were omitted, the former because of a lack of sufficiently detailed climatic data for the study area, and the latter because no satisfactory method for quantifying surface roughness could be devised. Quantification problems also prevented the inclusion of entrepreneurial skill, layout of farm buildings and the macro-economic influences from the regional and national economy.

It is postulated that the remaining variables will influence the Labour Efficiency Index in one of two ways. Firstly, by

influencing the quality of the labour input. Factors examined in this category are the age of the farm operator and the structure of the farm labour input. Secondly, by influencing the effectiveness of a given labour input. The factors within this group may be further sub-divided into physical and economic variables. The physical variable examined will be soil workability and the economic variables will include various measures of farm size, capitalisation, mechanisation and the diversity of the farm operation.

The association between these variables and the Labour Efficiency Index will be determined by the testing of normative hypothesized relationships between the L.E.I. and the selected variables. The nature of the relationships is predicted from existing theory.

The area selected for the study is North Grimsby, a township in Lincoln County, Ontario. The township contains a wide variety of farm types, ranging from the relatively small, specialised tree fruit farms of the Lake Ontario Plain to the larger mixed enterprises, with an emphasis on livestock, in the area to the south of the Niagara Escarpment. The original aspects of this study will be its use of generalisation and the attempt to correlate the Labour Efficiency Index with elements of farm structure and the physical environment. Generalisation is used at two levels. Firstly, in the use of Census data as the main data source instead of a detailed farm management survey. The use of census data necessitates grouping of farms and trends are therefore diluted. Secondly, the Labour Efficiency Index is used in a multi-enterprise environment instead of in the analysis of the single farm-firm for which it was designed, and a certain amount of detail is lost in this process of generalisation.

The study may be regarded as a preliminary step in the examination of spatial variations in Labour Efficiency, for its purpose is to test the methodology and to ascertain which factors play a significant rôle in determining the efficiency of labour input use and which factors may be ignored in future studies in the area.

1.2 Summary of objectives.

The study has the following objectives:

(a) to determine and describe spatial trends in the structure of the agricultural labour force.

(b) to determine the relative efficiency of the agricultural labour input by the construction of a Labour Efficiency Index for farm enterprise-types in the area.

(c) to test certain normative hypothesized relationships between the Labour Efficiency Index and selected elements of the farm structure and physical environment.

1.3 Review of Literature.

The Research Method

The research method in Geography has been examined in a sequential model by McCarty[4] and expanded by Haggett[5] into a series of "regression cycles".

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[4] McCarty, H.H. The use of certain statistical procedures in geographical analysis. Annals of the Association of American Geographers (1956) 46, p. 263.

[5] Haggett, P. Locational analysis in Human Geography (London: Edward Arnold 1965), p. 279.

The basic sequence is one where problems are defined, hypotheses applied and tested, and new hypotheses developed to explain discrepancies.

General Studies of Work and Labour input in Agriculture

A comprehensive study of Work in agriculture has been made by Duckham.[6] The emphasis of approach is on the effective seasonal use of the agricultural labour input. To accomplish this end, a detailed examination is made of Dating Control Theory, a framework in which the dating of farm operations could be explained and measured on a "scientific basis". Improvements in Dating Control Theory would:

(1) Help the individual farmer to improve efficiency.

(a) biologically, by better dating of husbandry actions

(b) economically, by better use of farm resources

(2) Help agricultural economists and farmers in budgeting and in linear and other forms of program planning of changes in farming systems.

(3) Help scientists and economists by pin-pointing research problems, e.g., need to breed sugar beet with greater drilling or greater harvest date tolerance.

An examination is also made of overall work load on the agricultural holding. Methods of aggregation and integration of different work phases are examined and a consideration is made of the interactions between work load, cropping and stocking programs, specialisation, mechanisation and the functional mobility of different classes of seasonally used farm equipment.

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[6] Duckham, F.N., The Farming Year (London: Chatto and Windus, 1963), p. 326.

The Nature of Labour

The nature of labour has been examined in its economic context by Chryst and Back.[7]

> "We define labour as the application of human effort, manual or mental. We include in this definition, decision making, management or entrepreneurship as labour, since they are all human inputs in the production process and can be hired as such".

Labour is not homogeneous. It is a human input and hence varies in quality with the capacity and motivation of its supplier. Labour has been divided into its basic components by Black, et al.[8] Three basic types are defined; operator's labour, which varies in quality with its supplier, and is a combination of physical labour and entrepreneurship, or decision making. Family labour is similar to operator's labour in capacity, but has different motivations. For example, as children grow older their attitudes towards work and hence their effectiveness at performing tasks can alter considerably. Hired labour varies in capacity, motives, and hence efficiency. The hired labourer is interested in his wages, the security that his job provides, and the prospects available for future advancement. The problems of defining labour simply as an hourly figure are thus exposed.

The importance of the labour input in Agriculture

The importance of labour in the agricultural economy has been

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[7]Chryst, W.E., & Back, W.B., Methods for Land Economics Research (Lincoln: University of Nebraska Press, 1966), p. 6.

[8]Black, J.D., et al, Farm Management (New York: MacMillan Co., 1947), pp. 546-547.

examined by Heady and Jensen.[9] In 1949 labour accounted for 67% of the total agricultural income in the United States of America. The other factors, land and capital received 25% and 8% respectively. Proper understanding and application of the principles underlying the planning and conduct of work is, according to Sturrock,[10] at least as important as the knowledge of the seasonal impact of economics and science.

Brayshaw[11] found that on nearly half the farm holdings in a sample taken in the northern counties of Great Britain, efficient labour use was the most important single factor influencing profitability. Those farmers who combined the forward planning of work with good day to day control were most effective in reducing labour costs.

Nix[12] has examined the importance of labour in the farm cost structure:

> "Excluding small and highly intensive farms, the fixed costs, (i.e., regular labour, power and machinery, rent and general overheads) usually comprise between 50% and 60% of Gross Output. Labour and Machinery together normally account for nearly threequarters of the fixed costs or between 35% and 40% of Gross Output."

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[9] Heady, E.O. & Jensen, H., Farm Management Economics (Englewood Cliffs, Prentice-Hall, 1954), p. 400.

[10] Sturrock, F.G., Planning Farm work. Bull. 172, Minist. Agric., Fish., Ed. (1960), H.M.S.O. London, p. 96.

[11] Brayshaw, G.H., Attitudes to farm labour economy. Agriculture, 67 (1961), p. 619.

[12] Nix, J., Labour Organisation on the Farm. Agriculture (London: 1968), p. 59.

Labour Efficiency

The measurement of the efficiency of labour use on farms has received much attention recently. It has been examined in terms of time spent in agricultural activities on the holding by Guither.[13] In Guither's study, actual labour inputs were determined by interviews with a selected population of farm operators in Illinois. The total labour employed on the holding was compared with the theoretical requirements for an efficient farm of that type, employing the standard labour requirements for a unit of crops or livestock derived from farm management research findings. When Day-Units of labour required were equal to the actual labour employed, it was assumed that the labour was fully occupied; if the figure showed a deficit, the labour was overemployed, if a surplus, it was underemployed. Refinements in this technique have been made by Scoville[14] in which allowance was made in the calculations for the age of the labour input.

Nix[15] reviewed a similar method of determining the efficiency of labour input use in the United Kingdom. Nix holds the view that labour efficiency can be measured in either physical or financial terms, or a combination of the two. Net output per £100 of labour

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[13]Guither, H.D. "Factors Influencing Farm Operators Decisions to Leave Farming", Journal of Farm Economics, 45, (1963), p. 567.

[14]Scoville, O.J.,"Relationship Between Size of Farm and Utilisation of Machinery and Equipment." U.S.D.A. Tech. Bull. 1037, Washington, D.C.

[15]Nix, J., Op. cit., p. 60.

and machinery is the most commonly used measure of efficiency, but financial output is influenced by many factors, both environmental and managerial, that have little or no relation to the efficiency of labour use. In Nix's view, the ideal way to overcome this problem is the use of a measure such as the Labour Efficiency Index (L.E.I.) or the Man-Work Unit Index, which is similar to the method described by Guither.[16]

Nix[17] is cautious about the use of such measures of efficiency:

> "In terms of economic theory it is easy to criticise these measures. In particular, they are primarily ratios depicting average relationships, whereas it is what happens at the margin that is useful in business decision making. Nevertheless, they can be a useful starting point for an investigation of labour efficiency, providing they are interpreted sensibly....."

The use of standard labour requirements from farm management sources has been examined briefly by Coppock[18] who used the technique in the classification of farm enterprises. Ideally, standard labour inputs should relate exactly to local physical conditions, since the same cultivation tasks on different soils rarely require the same labour input. Nix[19] proposes the use of a Gang-Work System for analysing labour efficiency in an attempt to overcome this problem. Gang-Work rates vary with the soil and topographic conditions in the area being studied.

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[16] Guither, H.D., Op. cit., p. 572.

[17] Nix, J., Op. cit., p. 60.

[18] Coppock, J.T., An Agricultural Atlas of England and Wales (London: Faber, 1964), p. 196.

[19] Nix, J., Op. cit., p. 60

The factors influencing the efficiency of labour use on agricultural holdings have been examined by Heady and Jensen.[20] A number of general factors are discussed, such as the enterprise combination system used on the holding, the diversification of production and the farm layout.

The influence of climate and soils on farm operations has been extensively reviewed by Duckham.[21] Farm activities are controlled by the trafficability and cultivability of the soil. Trafficability is defined as the capacity of a soil, on a given day, to provide adequate wheel grip for tractors and to bear the weight of farm machinery. Cultivability is the capacity of a soil on a given day to provide adequate wheel grip for tractors, and to permit such soil moving operations as ploughing, rotovating, seedbed preparation, drilling and crop lifting. Good trafficability generally demands a harder surface and a more compacted soil than cultivability. Duckham combines cultivability and trafficability as a single factor - soil workability. Workability is closely related to the moisture status of the soil.

Soil workability has been examined in a study of farms in the south west of the United Kingdom by Morris.[22] He determined that

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[20] Heady, E.O., & Jensen, H., Op. cit., p. 400.

[21] Duckham, A. N., 1963. Op. cit., p. 186.

[22] Morris, S.T., 1961. Tractor operating Costs on a Sample of Farms in South West England. Report 121. Dept. Agric. Econ. Univ. Bristol.

operations requiring field trafficability and cultivability occupied eighty percent of total tractor-hours. The remaining tractor-hours were utilised by operations such as road haulage which required neither trafficability nor cultivability.

The problems of labour use on farms of various types have been examined by Black, Claisson, Sayre and Wilcox.[23] It is their opinion that family farms are liable to be less efficient in their use of labour inputs than other types of enterprise, since there is usually a greater availability of unpaid labour. Family labour availability runs in a cycle, with the farm enterprise structured accordingly.

The transfer of labour resources from farm to non-farm employment has been examined by numerous workers. The writings of Bishop,[24] Brandow,[25] Schultz,[26] Heady,[27] Fox,[28] and Tauber[29]

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[23]Black et al., Op. cit., p. 560.

[24]Bishop, C.E., "The Mobility of Labour", Policy for Agriculture Joint Econ. Comm. 85th Congress, (Washington, D.C., U.S. Govt. Print. Off.) 437.

[25]Brandow, "Alternatives to Orthodox Programs and Goals of Agricultural Adjustment". J. Farm Econ. 29 (1957), p. 1634.

[26]Shultz, T.W., "Omission of Variables, Weak Aggregates and Fragmentation in Policy and Adjustment Studies" (Ames: Iowa State College, 1959).

[27]Heady, E.O., "Adjustment in Production to a Growing Economy", J. Farm Econ. 37 (1955), p. 1061.

[28]Fox, K.A., "Guiding Agricultural Adjustments". J. Farm Econ. 39, (1957), p. 1099.

[29]Tauber, C., "Economic and Social Implications of Internal Migration in the United States". J. Farm Econ. 41, (1949), p. 1146.

provide examples of the causes, need for, and aggregate effects of shifting farm labour into non-farm employment. Guither[30] has analysed part-time and full-time farming in an area of the state of Illinois. One of the main factors in the withdrawal of farmers from agriculture was the fact that many were chronically under-employed on their present holdings. However, these holdings still remained too large to operate as part-time enterprises where the opportunities in employment, not requiring attendance five days per week, were limited.

Bishop[31] has shown how family income on the small overemployed holdings may be raised substantially by programming that unit as a part-time operation.

Farm Enterprise Classification

Problems associated with the classification of farm enterprise types have been examined by Chisholm.[32] Any idea that a classification can be objective, in the sense used by Birch,[33] is dismissed.

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[30]Guither, H.D., Op. cit., p. 567.

[31]Bishop, C.E., Programming Farm-Non Farm Allocation of Farm Family Resources. J. Farm Econ. 38 (1956), 396-407.

[32]Chisholm, M., 'Problems in the Classification and Use of farming-type regions'. Trans. Institute British Geographers, 35 (1964), p. 91.

[33]Birch, J.W., 'Observations on the delimitation of farming-type regions, with special reference to the Isle of Man'. Trans. Institute British Geographers, 20 (1954), pp. 141-158.

All classifications involve two elements of judgement.

(1) In the choice of critical limits.

(2) In the combination of disparate phenomena not classified in common units.

Chisholm[34] continues by examining various methods by which these problems may be overcome. In the case of the choice of critical limits, examples are given of studies by Board,[35] in which quartiles and octiles are used, and the use of the Weaver[36] technique by Thomas[37] and Coppock.[38]

In the latter example, the farm enterprise combination is matched against a theoretical one crop, two crop, "n" crop combination, and the combination selected which shows the best "least-squares" fit.

The problem of combining disparate phenomena is examined with an example of Weaver's[39] use of standard man Days. A contrast may be made between the results obtained by this method and those of

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[34]Chisholm, Op. cit., p. 92.

[35]Board, C., "Some methods of mapping farm-type areas", Unpublished contribution to a 1963 symposium.

[36]Weaver, J.C., Crop combinations in the Middle West, Geographical Review, 44 (1954), pp. 175-200.

[37]Thomas, D., 'Agriculture in Wales during the Napoleonic Wars' (Cardiff: University of Wales, 1963).

[38]Coppock, J.T., 'Crop Livestock, and enterprise combinations in England and Wales' Economic Geography, 40 (1964), pp. 65-81.

[39]Weaver, J.C., Op. cit., pp. 175-200.

Hartshorne and Dickens,[40] who attempted to delimit enterprise regions, in an area in which both livestock and field crops were important, on the sole basis of crop acreages.

Literature describing the study area

Finally, it is necessary to examine some of the work that has been carried out in recent years in the study area, North Grimsby Township, and in the Niagara region in general.

The economic aspects of farming in the Niagara region have been examined in reports published by the Ontario Department of Economics and Development. The general Structure of Agriculture in 1961 was examined in the Niagara Region Economic Survey,[41] and brought up to date in 1966 with the publication of Niagara 1966.[42] The physical and economic aspects of mixed farming in the Niagara Peninsula have been examined by Reeds[43] in a two-part survey designed to cover the entire field of agriculture within the region.

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[40]Hartshorne, R. & Dickens, S.N., A classification of the Agricultural regions of Europe and North America on a uniform statistical basis. Annals of the Association of American Geographers, 25 (1935), pp. 99-120.

[41]Ontario Department of Economics and Development, Niagara Region Economic Survey (Toronto: Ontario Dept. of Economics and Devel. 1963).

[42]Ontario Department of Economics and Development. Niagara 1966 (Toronto: Ontario Dept. of Economics and Devel. 1963).

[43]Reeds, L.G., Niagara Region Agricultural Research Report, Part I: Mixed Farming, (McMaster University, Hamilton, March 1968).

The physical characteristics of the region were examined by Chapman and Putnam[44] in their work on the physiography of Southern Ontario. Wicklund and Matthews[45] have described the soils of Lincoln County, Ontario, in the Soil Survey Series produced for the Ontario Department of Agriculture.

The climate of Southern Ontario has been examined by Chapman and Putnam,[46] and the climate of the Niagara Fruit Belt has received much attention from Mercier and Chapman,[47] who concentrated their study on the influence of climate on the distribution of tree fruits.

On a smaller scale, Krueger[48] has investigated land-use change in the Fruit Belt, with special reference to the loss, by urbanisation, of the "tender fruit soils".

Irving[49] and team investigated the factors liable to affect land-use in Louth Township, in an attempt to produce a methodology for future land-use studies. The report emphasised the physical controls of land use and tended to neglect the major problem of the

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[44]Chapman, L.J. & Putnam, D.F., The Physiography of Southern Ontario, (Toronto: University of Toronto Press, 1951).

[45]Wicklund, R.E., & Matthews, B.C., Soil Survey of Lincoln County, Report No. 34 Ontario Soil Survey (Ottawa: Canada, Dept. of Agriculture, and Ontario Agricultural College 1963).

[46]Chapman, L.J., & Putnam, D.F., The climate of Southern Ontario. Scientific Agriculture 18.8, 1938, pp. 401-446.

[47]Mercier, R.G., & Chapman, L.J., Peach Climate in Ontario, Report. Horticultural Experiment Station, Vineland, 1955-56 (Vineland, Ontario, 1956).

[48]Krueger, R.R., Land use change in the Niagara Fruit Belt. Geog. Bull. 14 (1960), pp. 5-24.

[49]Irving, R.M., Factors affecting land-use in a selected area in Southern Ontario. (Ontario Dept. of Agriculture, 1957, Toronto).

area: the loss of good agricultural land to residential and industrial development.

Finally, a general study of agricultural land use in North Grimsby Township was made by McLeod[50] in 1953.

1.4 The study area.

Location of the Area under Investigation

North Grimsby Township is situated some fifteen miles east of the City of Hamilton on the northern Lake Ontario shore of the Niagara Peninsula. The location of the township is shown in figure 1.

The township extends south from the lake shore beyond the Niagara Escarpment and thus provides a cross-section of conditions in the northern Niagara Peninsula.

The township had a population of 5,757 in 1961, an increase of 51.0% in a decade.[51] This increase reflects the rapid development of the area, the result not only of an increase in industry and related services in the township, but of the function of the township as a dormitory for commuters to the City of Hamilton. Rapid growth has had a marked effect on agriculture. The main result has been an increase in land values associated with urban encroachment, particularly in areas adjacent to the Town of Grimsby on the Lake Ontario Plain.

The following sections describe the physical factors influencing agriculture; landforms, climate and soils.

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[50] MacLeod, D.M., North Grimsby Township. Unpublished B.A. Dissertation, McMaster University, Hamilton, 1953.

[51] Dominion Bureau of Statistics. Census of Canada 1961 Population (Ottawa: Queen's Printer, 1962).

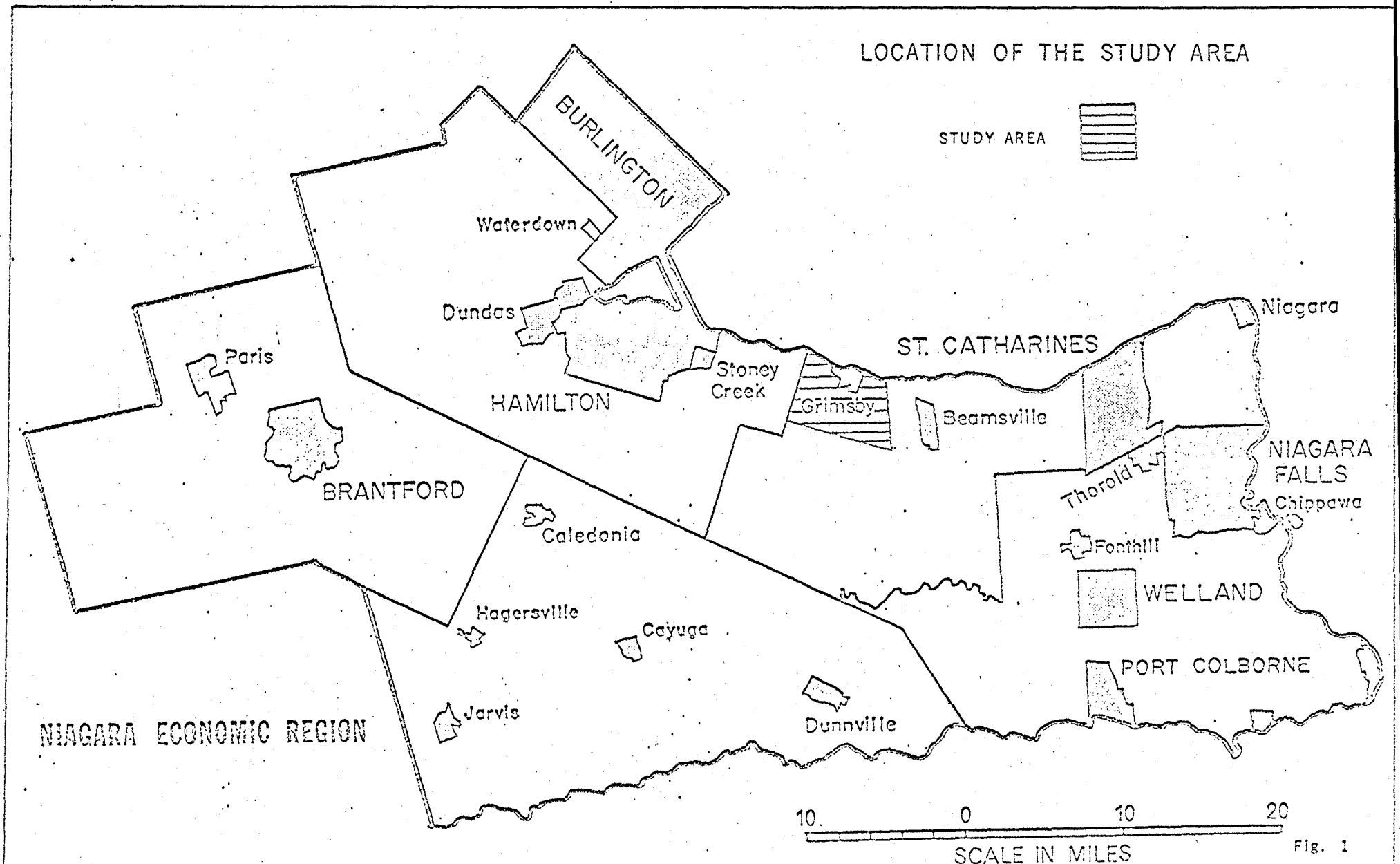
LOCATION OF THE STUDY AREA
STUDY AREA
BURLINGTON
Waterdown
Dundas
Paris
HAMILTON
Stoney Creek
Grimsby
ST. CATHARINES
Niagara
Beamsville
NIAGARA FALLS
Thorold
Chippawa
Fonthill
WELLAND
BRANTFORD
Caledonia
Hagersville
Cayuga
PORT COLBORNE
Jarvis
Dunnville
NIAGARA ECONOMIC REGION
10 0 10 20
SCALE IN MILES

Fig. 1

Landforms

On the basis of physical features, it is possible to divide North Grimsby Township into three main subdivisions as shown in Figure 2.

(a) Iroquois or Lake Ontario Plain

The Iroquois Plain was formed by the waters of glacial Lake Iroquois, the proto Lake Ontario, and slopes from a height of 350 ft. A.M.S.L. at the base of the Niagara Escarpment to the Lake Ontario shoreline at 250 ft. A.M.S.L. Slopes average 2%, but are greater where the plain is crossed by creeks draining into the Lake.

(b) Niagara Escarpment

The Niagara Escarpment is the most outstanding physical feature in the township, rising 150 ft. above the Lake Ontario Plain. It extends across the township from east to west. The slopes are wooded and the face is quarried to provide construction materials.

(c) Haldimand Clay Plain

The Haldimand Clay Plain stretches from the Escarpment brow to the southern boundary of the township. The landscape is rolling in the area of till moraine immediately south of the Escarpment but becomes smoother towards the southern boundary of the township.

Climate

Climate has been one of the most important factors contributing to the growth and development of the Niagara Fruit Belt.[52] The superiority of the area below the escarpment for the growth of tender fruit crops has long been recognised.

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[52]Irving, Op. cit.

NORTH GRIMSBY TOWNSHIP

MAIN PHYSIOGRAPHIC SUBDIVISIONS

SCALE: ONE INCH TO ONE MILE

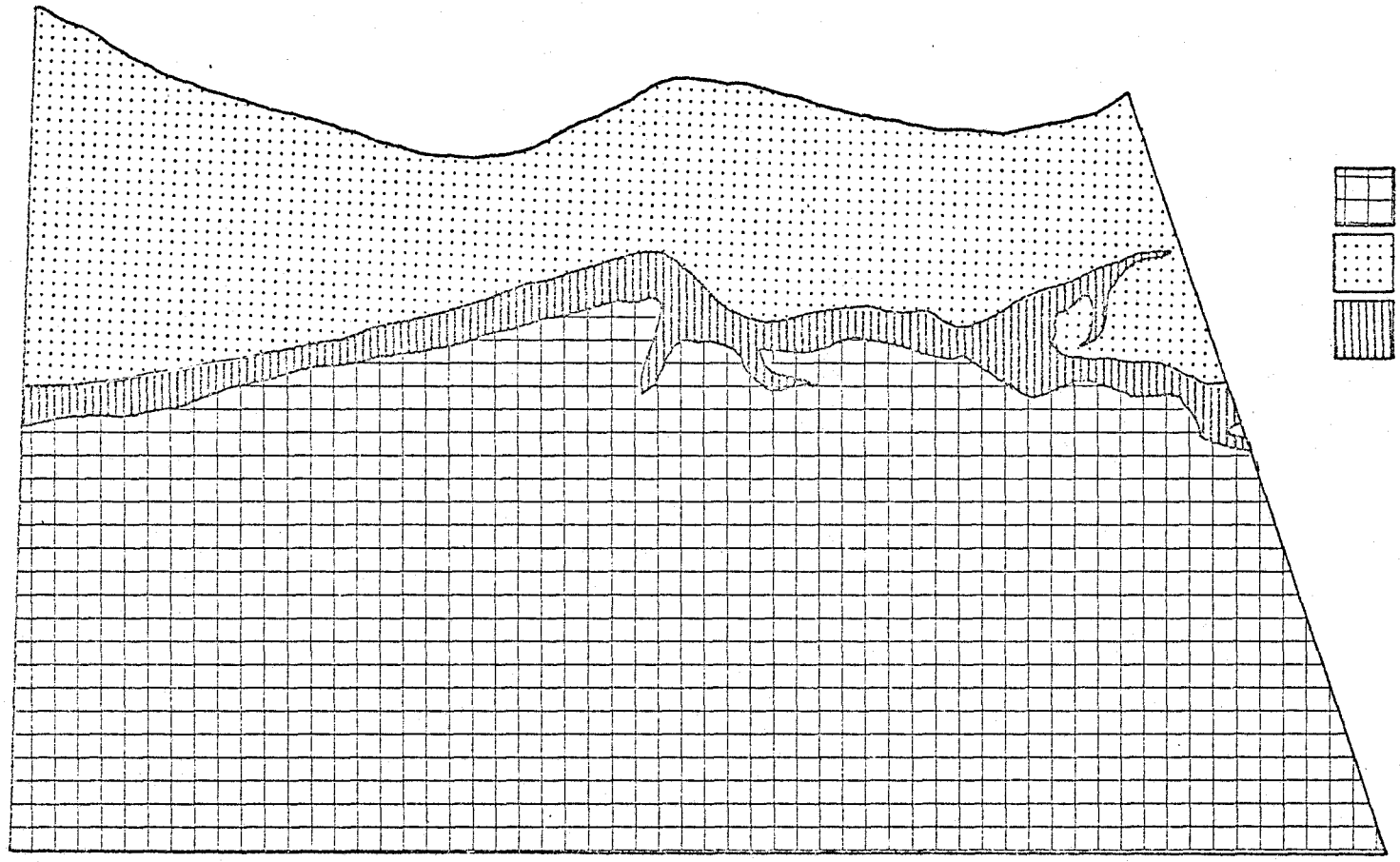

Fig. 2

Climate has been examined by Mercier and Chapman,[53] who found that the chances of low temperature damage to fruit trees were five times less on holdings located below the Escarpment than on holdings located elsewhere in the area.

The Niagara region has a climate with warm summers, temperatures in July averaging 70°F, and a growing season extending from early April to early November. The region experiences 3-50 degree days with the temperature exceeding 42°F.[54] Annual precipitation fluctuates between 30 ins and 34 ins, 14 ins of this falling during the period from May to September.

Soils

The distribution of the main soil types in the township is shown in Figure 3, and described in detail by Wicklund and Matthews[55] and Reeds.[56] The main soil types may be divided into three classes. Those developed on clays, soils developed on sands and a group of miscellaneous soils.

(1) Soils developed on clay parent materials.

The largest group of soils in the township fall into this category. The soils are developed upon glaciolacustrine or lacustrine clays and silts. Although these soils have a high plant nutrient content, continuous cropping has severely reduced the mineral content

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[53] Mercier, R.A., and Chapman, L.J., Op. cit.

[54] Reeds, L.G., Op. cit.

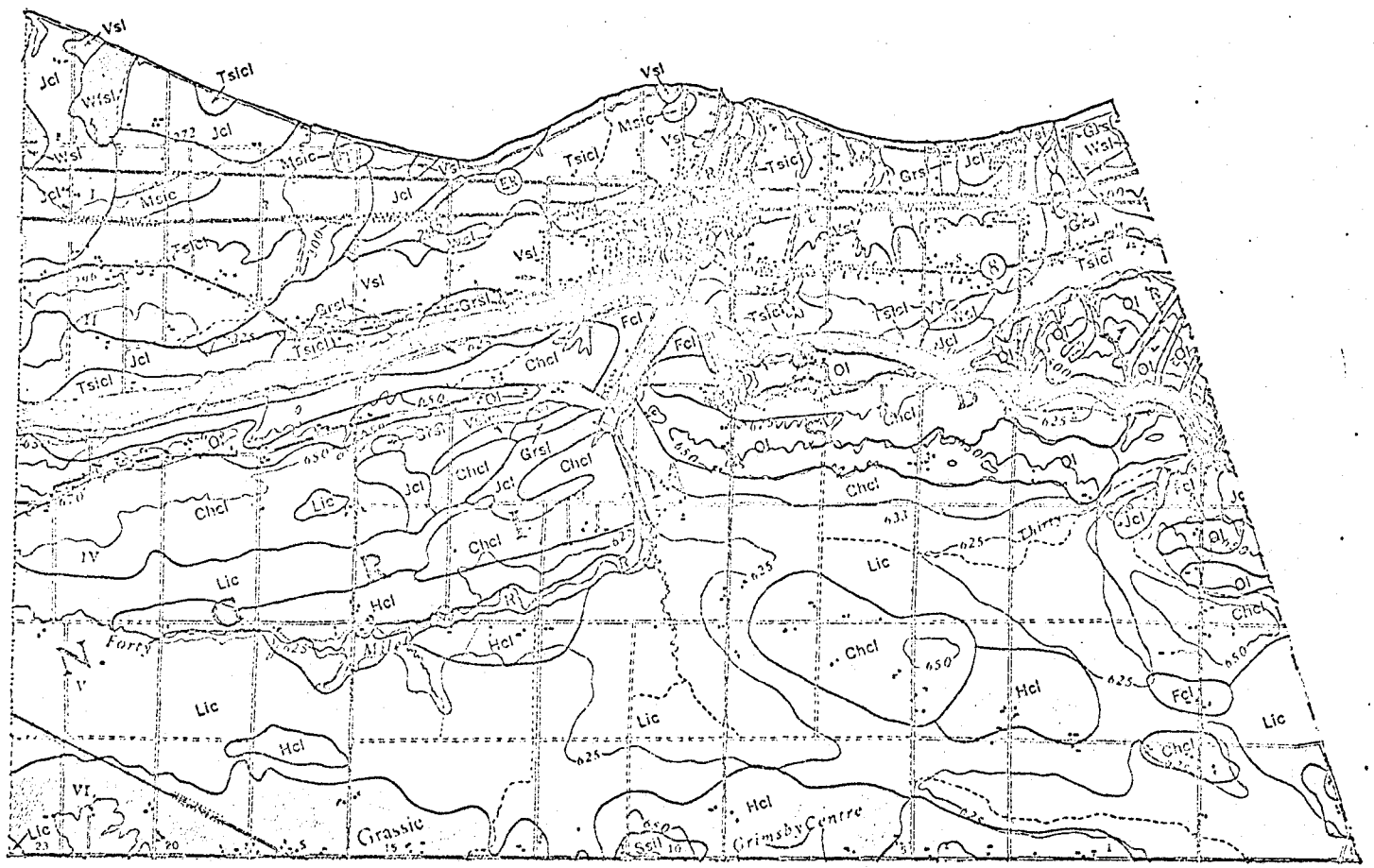
[55] Wicklund, R.E., and Matthews, B.C., Op. cit.

[56] Reeds, L.G., Niagara Region Agricultural Research Report Part 1: Mixed Farming, McMaster University, Hamilton, Ontario, March 1968.

NORTH GRIMSBY TOWNSHIP

MAIN SOIL TYPES

SCALE: ONE INCH TO ONE MILE



FOR LEGEND SEE OVER

Fig. 3

LEGEND

MAP SYMBOL	SOIL SERIES	TYPE	PARENT MATERIAL	DRAINAGE
Chcl	Chinguacousy	clay loam	Clay till	Imperfect
Fcl	Farmington	clay loam	Thin deposits on limestone bedrock	Imperfect
Grsl	Grimsby	sandy loam	Deltaic sand deposits	Good
Grfsl	Grimsby	fine sandy loam	Deltaic sand deposits	Good
Hcl	Haldimand	clay loam	Clay till	Imperfect
Hsicl	Haldimand	silty clay loam	Clay till	Imperfect
Hsil	Haldimand	silt loam	Clay till	Imperfect
Jcl	Jeddo	clay loam	Clay till	Poor
Jst	Jeddo	stony loam	Clay till	Poor
Lic	Lincoln	clay	Clay till	Poor
Msic	Morley	silty clay loam	Silty clay loam till	Poor
Ol	Oneida	loam	Clay till	Moderately Good
Sl	Smithville	loam	Clay till	Moderately Good
Ssil	Smithville	silt loam	Clay till	Moderately Good
Ssicl	Smithville	silty clay loam	Clay till	Moderately Good
Tsicl	Trafalgar	silty clay loam	Silty clay loam till	Imperfect
Vsl	Vineland	sandy loam	Deltaic sand deposits	Imperfect
Vfsl	Vineland	fine sandy loam	Deltaic sand deposits	Imperfect
Wsl	Winona	sandy loam	Deltaic sand deposits over clay till	Imperfect
Wfsl	Winona	fine sandy loam	Deltaic sand deposits over clay till	Imperfect
R	Ravines			
Esc	Escarpment			

in some areas. The main agricultural activities on these soils are the production of grain crops and cultivated hay.

Well drained clay soils

Soils of this type occur in the moraine area to the south of the Niagara Escarpment. The soils are deep, well drained and rate amongst the best in the Niagara region for the growth of grain and forage crops.

Imperfectly drained clay soils

This soil group, of which the Haldimand Clay covers the largest area is found to the south of the Niagara Escarpment. The clays are fine-textured, preventing free drainage and causing the soils to be sticky and hard to work in the spring, and to dry out too quickly in the summer. The soils are used for the growing of grapes, hay, pasture and some grains.

Poorly drained clay soils

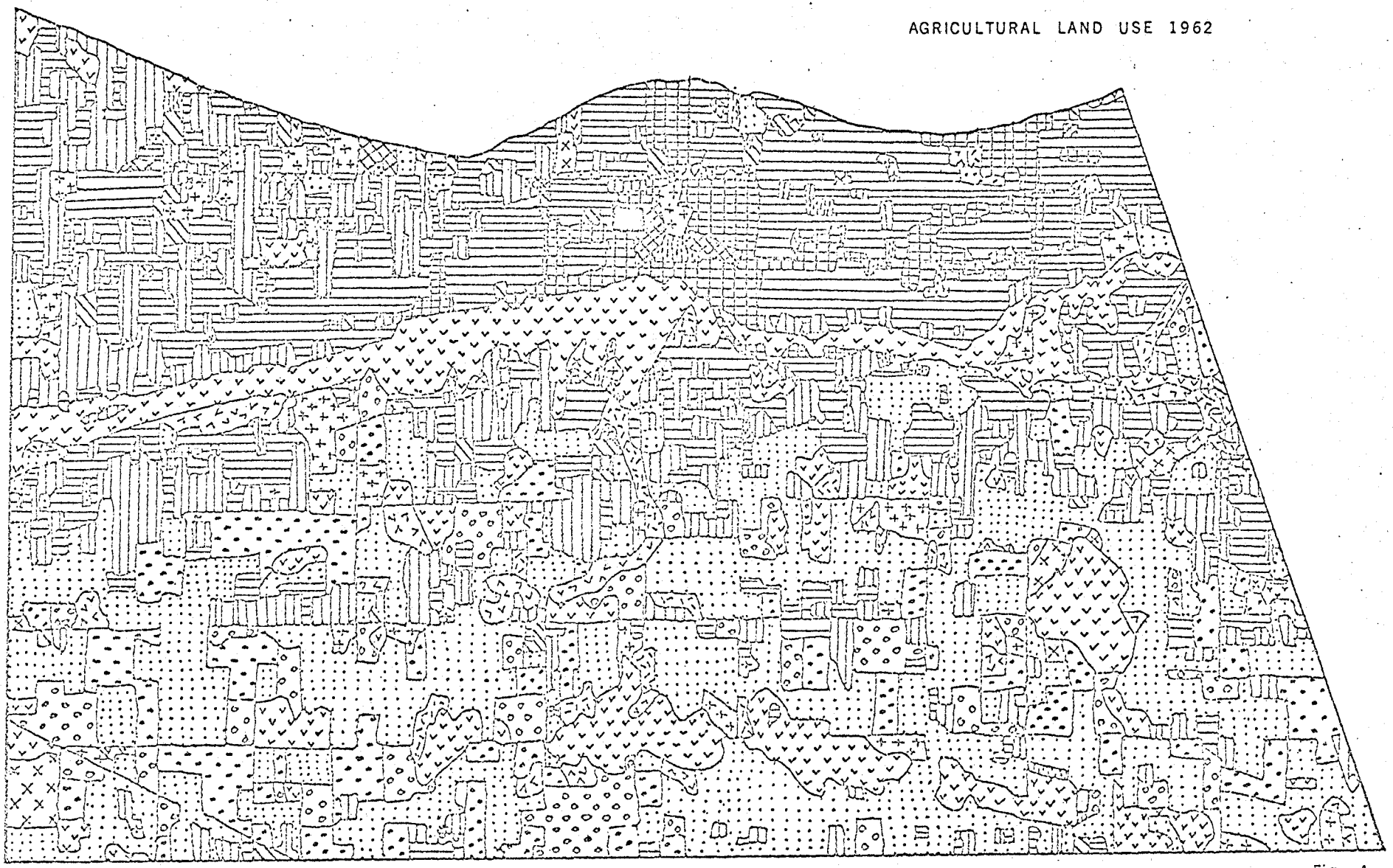
Soils of this type can be found on the Lake Ontario Plain and in certain parts of the Haldimand Clay Plain. Restricted drainage results in these soils being used for woodland and pasture south of the escarpment. Below the escarpment, on the Lincoln and Jeddo Series, these soils are utilised for the cultivation of grapes, pears and plums.

(2) Soils derived from sandy parent materials.

Although sandy soils occupy a much smaller area than the clay soils, the former are of greater economic significance since they provide the basis for the "good fruit soils" of the Niagara Fruit Belt.

NORTH GRIMSBY TOWNSHIP

AGRICULTURAL LAND USE 1962



FOR LEGEND SEE OVER

Fig. 4

LEGEND


INDUSTRIAL AREAS


RESIDENTIAL & COMMERCIAL


ASSOCIATED URBAN AREAS


HAY


GRAIN


HORTICULTURE


VINEYARDS


TREE FRUITS


IMPROVED PASTURE


OPEN GRASSLAND


SCRUB GRASSLAND


WOODLAND


OPEN WOODLAND


SCRUB WOODLAND

Well-drained and imperfectly-drained sandy soils

Krueger[57] refers to these soils as the 'tender fruit soils'. They are derived from deltaic sand deposits. West of the town of Grimsby, the sands are very thin and are underlain by clays. To the east, the sands are between 2 ft. to 3 ft. thick and their value for the growth of tree fruits, especially peaches, increases.

(3) Miscellaneous Soils.

In this group are included soils developed on the Escarpment where slopes are too great for normal soil development.

Agricultural Land-Use.

The agricultural land use in North Grimsby township is shown in Fig. 4. Three basic zones trending east-west may be defined.

In the northern area of the township on the Lake Ontario Plain, the main agricultural activities are the cultivation of grapes and tree fruits, the majority of grapes being grown on the heavier soils in the west of the township. The areas of grassland bordering highway 8 and the Queen Elizabeth Way are mostly idle, and can be thought of as speculative land.

Immediately south of the escarpment, land use is a mixture of grapes, hay and grains with tree fruits important in the eastern area near the Clinton township boundary. In the southern area of the township, hay and pasture predominate with small areas of grapes and an increased area of woodland.

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[57] Krueger, R.R., Land Use changes in the Niagara Fruit Belt. Geog. Bull. 14, (1960), pp. 5-24.

CHAPTER II

DATA & METHODOLOGY

2.1 Data Requirements

The general problem of data requirements for a study of this nature has been examined by Duckham[1] and Nix[2], and reviewed in a previous section. The data required is of three basic types:

(1) Information on the present labour allocation, farm structure crop acreages, livestock numbers, and income and expenditure statistics of the individual farms, or groups of farms within the study area.

(2) Standard labour requirements for a crop or livestock unit expressed in Standard Man Hours, for the crop and livestock types present in the township, adjusted to suit local conditions.

(3) Information on the area and characteristics of soil types on each farm group or farm in the study area.

Data Sources.

(1) Information on present farm structure and Labour allocation

Nix[3] is of the view that it is rarely possible to obtain satisfactory information on farm structure, in the form of income

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[1]Duckham, A.N., The Farming Year, (London: Chatto and Windus, 1963), pp. 323-420.

[2]Nix, J.S., Labour Organisation on the Farm, Agriculture, London: 1968, p. 61.

[3]Nix, J.S., Op. cit., p. 61.

and expenditure figures, crop and livestock statistics and information or labour inputs, from the farm operator in sufficient detail for this type of analysis. Personal experience by the author in farm surveys conducted in the United Kingdom tended to support this view. Recent work by Darnel[4] has suggested that in one area of the Niagara Peninsula, at least, a survey of this type can be successful, and adequate co-operation can be obtained from farm operators. The process is, however, time consuming since most interviews with operators require at least two hours. It was therefore decided, for the purposes of the present study, to utilise a secondary source of statistics, the Canada Census of Agriculture[5], as the main source of information. Although the last census was taken in 1966, tabulated results were not available in the form required at the time that the present study commenced, and so the previous census taken in 1961 was utilised as the main data source.

The Census of Agriculture for 1961 consisted of a four page questionnaire, requiring answers to over 180 questions on the structure of the individual farm unit. The census questionnaire is reproduced as Appendix Two.

Normally, tabulated results of the census are published only on a township, county or provincial basis. For the purposes of this study, a special tabulation was utilised in which the 335 farms in the township were reduced to 94 averaged farm groups, on the basis

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[4]Darnel, Wolfe, 1968. Personal Communication.

[5]Dominion Bureau of Statistics. 1961 Census of Canada: Agriculture, Ontario. Bulletin 5.2 (Ottawa: Queen's Printer 1963).

of size and proximity of location. The number of component farms in each group ranged from three to five. This technique is a refinement of the "super block" method of analysis of farm data used by Irving[6] and Mage.[7]

The 168 questions on the census questionnaire were reduced to forty-four variables for the purposes of initial analysis.

Problems associated with the use of secondary data sources.

The implications of dependence on secondary sources have been examined by Haggett.[8] Three basic problems are discussed.

(1) Data obtained from the census or any other secondary source is collected primarily for non-geographical purposes and hence has a tendency to be oblique to the direct needs of a geographical study. Haggett[9] cites studies by Gregor[10] and Coppock[11] as examples of this problem.

An example of this problem in the case of the Census of Agriculture data may be seen in the method of determining present farm labour inputs. These are given on the basis of the number of

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[6]Irving, R.M., Factors affecting land-use in a selected area in Southern Ontario. (Toronto: Ontario Dept. of Agriculture, 1957).

[7]Mage, J.A., Land Use - Edaphic relationships in two selected areas of Woolwich Township. Unpublished M.A. thesis, McMaster University, 1967.

[8]Haggett, P., Locational Analysis in Human Geography. (London: Edward Arnold 1965), p. 186.

[9]Haggett, P., Op. cit., p. 186.

[10]Gregor, H.F., Agricultural Region and Statistical Region: A Dilemma in California Geography. California Geography, 3, (1962), p. 27-31.

[11]Coppock, J.T., The Relationship of Farm and Parish Boundaries: A Study in the use of Agricultural statistics. Geographical studies 2, (1955), pp. 12-26.

days worked off the farm by the farm operator, and in weeks worked on the farm by hired and unpaid labour. Considerable variation exists in the length of the working day or week of most categories of farm labour, and in the length of the working day or week at the various seasons of the year. This can introduce a possible source of error into the investigation.

(2) The research worker is dependent upon the accuracy of the original survey, a factor beyond his personal control. This level of accuracy has proved to be low in several cases. Haggett[12] has cited a study by Morgenstern[13] as an example of this problem.

Recent studies in the Niagara Peninsula have raised the question of the accuracy of Census of Agriculture data. Darnel[14] suggests that census returns are relatively accurate in their estimate of the units of crops and livestock on a holding. Problems exist, however, where the operator is confused by the census definition of a particular agricultural activity, or chooses for personal reasons to enter an incorrect figure on the census questionnaire.

Reeds[15] has indicated that financial information on the census return may show considerable variation from the actual figure. It is his estimate that the value of production statistics could be up to 30% below their actual value.

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[12]Haggett, P., Op. cit., p. 186.

[13]Morgenstern, O., On the Accuracy of Economic Observations (Princeton 1963).

[14]Darnel, W., 1968, Personal Communication.

[15]Reeds, L.G., 1968, Personal Communication.

(3) The final problem associated with the use of secondary data is its form of release, which may generate problems of interpretation and mapping. Haggett[16] cites work by Duncan, Cuzzort and Duncan[17] as an example of this problem. The data for the present study was made available, with the co-operation of the Dominion Bureau of Statistics, in the form of a special tabulation. Since the confindential nature of the original data had, by law, to be maintained, the data was released in grouped form, the size of the group ranging from three to five farm holdings. The groups were chosen on the basis of proximity of location, similarity of enterprise and size of the component farm units. This grouping has unavoidably introduced a degree of subjectivity in the sampling of the original data.

(2) Information on standard labour inputs in man hours for crops and livestock.

In order to examine the relative efficiency of labour input allocation in the farm firm, it is necessary to obtain data on the average work inputs in standard man hours per year, for each crop or livestock activity undertaken on the farm enterprises. Several points have been made by Duckham[18] about the use and interpretation of such data.

(1) Much of this type of data has been gathered by Provincial Agricultural Departments from surveys made for other

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[16] Haggett, P., Op. cit., p. 196.

[17] Duncan, O.D., Cuzzort, R.P. & Duncan, B., Statistical Geography (Glencoe: Free Press 1961).

[18] Duckham, A.N., The farming year (London: Chatto and Windus 1963), p. 397.

purposes, (e.g. farm management surveys and enterprise cost studies). According to Duckham, this will not invalidate the accuracy of the data, but may obscure important points which would come to light had the survey been specifically directed towards labour use.

(2) The figures for man hours are weighted averages and do not take into account variations in work times on specific enterprises. Apart from year to year differences attributable to weather and economic varistions, these averages cannot take into account the effect of geographical location, differences resulting from a variety of farming systems, differences due to the personal preferences of the farmer or differences in carrying out a specific job.

(3) The rate of technical change, and to a lesser extent, economic change is now so rapid that some of the standard factors are inevitably out of date.

(4) Perhaps of greatest importance is the fact that the data represents the labour input used by a number of operators for a specific purpose during a particular year. It does not necessarily reflect what input should have been required or even what input the entrepreneur desired. Even on the best run farms there are many factors which may upset an entrepreneur's plans, such as weather, machinery breakdowns, manpower shortages, day to day mistakes in organisation, and competition between various enterprises.

(5) Although these data on man hours are most often described as

Work Requirements, they would generally best be described as Work Inputs. Such inputs can frequently be either (a) excessive, a result of the limits of present mechanical development, the farmer's lack of knowledge of the quickest method of doing a job, or even due to overstaffing, or (b) deficient because there is often not enough time for doing a job properly.

In summary, published records of farm operations are not necessarily the best guides as to what should be done on a given farm. Nevertheless, Duckham[19] is of the opinion that such records are of considerable use in creating an average picture of an average year. They are, in fact, the only authenticated records available.

The source of standard labour input data for this study was the Farm Business Management Handbook of the Ontario Department of Agriculture and Food.[20] This volume contains a variety of information on farm management practices, average production costs, returns, etc., in the Province of Ontario.

The statistics contained in this volume are derived from two main sources. Firstly, farm surveys conducted by the Ontario Department of Agriculture, or other agencies, within the Province, and secondly, statistics derived from surveys taken in regions outside the province and modified to suit the agricultural conditions in Ontario.

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[19]Duckham, A.N., Op. cit., p. 97.

[20]Ontario Department of Agriculture and Food. Farm Business Management Handbook for Extension Workers. (Toronto: Ontario Dept. of Agriculture and Food, 1966-1968).

Surveys in Ontario.

The surveys conducted in the Province of Ontario represent a range of studies carried out over a number of years. The number of farm holdings and enterprise characteristics examined in the surveys varies considerably. It must be noted that in many of the cost of production reports published by the Ontario Department of Agriculture,[21] farms were selected on the basis of the willingness of the farm operator to co-operate with the survey, rather than on the basis of the farm being part of a representative sample.

The number of farms examined in the survey also casts doubts on the validity of the statistics presented. In one case, vegetable production costs, supposedly representative of the whole province, are tabulated from a survey of only nine holdings.[22]

Sources from other surveys

Many of the statistics in the Ontario Farm Management Handbook[23] are derived from studies undertaken in areas where production conditions, both physical and economic, differ markedly from those experienced in the Niagara Peninsula. An example of this is to be found in the Standard Labour Input statistics for livestock, which were derived from the Farm Budgeting Reference Manual, produced by

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[21] Examples of such reports are to be found in: Ontario Dept. of Agriculture and Food. Farm Business Management Handbook, (Toronto: Ontario Dept. of Agriculture and Food, 1966-1968).

[22] Ontario Department of Agriculture and Food. Op. cit., p. 250. 821.

[23] Ontario Department of Agriculture and Food. Op. cit., p. 420. 450.

the United States Department of Agriculture and Cornell University.[24] The validity of the inclusion of such statistics in this study is dependent upon the adjustments made to the statistics by the Ontario Department of Agriculture in order to make them applicable to conditions in the Province.

(3) Information on the area and characteristics of soil types in the study area.

Information on the area and characteristics of the soil types on each farm or group of farms was obtained from Wicklund and Matthews.[25] The area of a particular soil type or each farm-group was obtained from the soil map accompanying the report. The area was measured by polar planimetry and checked by re-measurement using one m.m. square graph paper. The percentage of the farm area occupied by each soil type was calculated and used as a basis for analysis.

Other data sources

Several other sources of data were utilised during the course of the study. The nature and relative accuracy of these minor data sources is examined in the relevant section of the text.

Data storage and processing

The data obtained from the Census of Agriculture in Ottawa, in the form of group averages was transferred to punched cards to

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[24] United States Department of Agriculture. Farm Budgeting Reference Manual, (Washington, D.C.: United States Department of Agriculture.)

[25] Wicklund, R.E. and Matthews, B.C., Soil Survey of Lincoln County. Rept No. 3.4 Ontario Soil Survey. (Ottawa: Canada Department of Agriculture, 1963).

facilitate analysis. Data processing for the study was carried out on the I.B.M. 7040 computers at the McMaster University Data Processing Centre and in the Computer Centre at the University of Western Ontario, London, Ontario.

Methodology

The initial problem encountered in the study was the collection of the data, on farm enterprise structure, from the Census of Agriculture in Ottawa. Data was obtained from the census ennumeration forms and combined into farm groups, on the basis of proximity of location and size of holding. The farm groups were then averaged, and the mean data for each group transferred to punched cards to facilitate analysis.

The first part of the analysis consisted of the delimitation of the main enterprise types in the township, since these would provide the framework within which the detailed analysis of labour inputs and their relative efficiency would be tackled. To achieve this end, the farm group totals of crop acreages and livestock numbers were reduced to the common denominator of standard man hours employed in each activity. This was accomplished by the use of standard man-hours factors for each activity, obtained from the Ontario Farm Business Management Handbook.

Farms were grouped into Specialised, General or Mixed Enterprises on the basis of the percentage of the total labour input devoted to the various enterprises being carried on within the farm group. Distinction was made between part-time and full-

time[26] holdings on the basis of the number of days worked by the operator off the holding during the course of the year. A further subdivision of enterprises was made based on the leading crop or activity, e.g., cattle, tree fruit, grapes, etc., determined by the percentage of total labour input in each farm group devoted to the crop or activity.

The three main levels of analysis, Township, Enterprise Type and Leading Activity, together with their respective subdivisions are shown in Table 1.

Once the Enterprise Type and Leading Activity Subdivisions were delimited, analysis of the labour input structure of the township was possible. This was accomplished in three main stages. Stage one consisted of the determination of actual labour inputs by farm groups from the data on farm structure obtained from the Census of Agriculture, utilising Standard Working Week and Work-Day factors obtained from the Canada Department of Labour.[27]

Labour input by component type, e.g., Operator's Labour, Hired Labour, etc., was examined at all levels of the analytical hierarchy. In addition, an attempt was made to describe general and local spatial trends in labour type at the Township scale by means of Trend Surface Analysis

The second stage of analysis was an attempt to determine the relative efficiency of use of the 1961 agricultural labour input

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[26]Full definitions of all such terms employed in the study are contained in Appendix 1.

[27]Canada Department of Labour. Trends in the Agricultural Labour Force in Canada. (Ottawa: Department of Labour, 1960), 66.

TABLE I

LEVELS OF ANALYSIS ADOPTED FOR USE IN THE STUDY AREA.

TOWNSHIP (All Farms)

Full Time Farms	Part Time Farms

ENTERPRISE TYPE

SPECIALISED	GENERAL	MIXED
Full Time Farms	Full Time Farms	Full Time Farms
Part Time Farms	Part Time Farms	Part Time Farms

LEADING ACTIVITY

Tree Fruits	Tree Fruits	Tree Fruits
	Cattle	Cattle
	Grapes	Grapes

in the township. The technique utilised was the Labour Efficiency Index, in which an average labour input level for each farm, derived from the Standard Labour Input factors utilised by Ontario Dept. of Agriculture Extension Service workers,[28] was compared to the actual 1961 labour input. The result is expressed in a decimal index, in which a figure of 1.00 is regarded as conforming to an average level of input efficiency on a Provincial basis.

The final stage of the analysis was to determine which of certain selected economic and socio-economic elements of farm structure and elements of the physical environment showed a significant association with the Labour Efficiency Index at each of the levels of analysis. It was proposed that a particular type of linear relationship existed between these variables and the L.E.I. The hypothesized relationships were tested by means of the Pearson Product-Moment correlation coefficient.

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[28] Ontario Department of Agriculture and Food. Farm Business Management Handbook for Extension Workers. (Toronto, Ontario Dept. of Agriculture. 1966)

CHAPTER III

THE CLASSIFICATION OF FARM ENTERPRISE TYPES

The purpose of this chapter is to describe the techniques used to divide the farm groups in the township into farm enterprise types, showing similarities of enterprise structure, in order to facilitate further investigation of labour input allocation and efficiency.

3.1 Enterprise Classification.

The subject of farm enterprise classification has been extensively reviewed in a previous section. According to Chisholm,[1] two elements of choice are involved in making any classification. The first involves the combination of disparate phenomena, such as units of crops and livestock, and the second involves the choice of the critical limits between classes.

The Combination of Disparate Phenomena

Farms have been classified on the basis of land use, labour requirements, or value of sales of farm products.[2] In view of the importance of livestock on many farms, it is difficult to employ land use alone as a basis for classification. In the absence of data

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[1] Chisholm, M., "Problems in the Classification and Use of Farming Type Regions". Trans. Institute of British Geographers, 35, (1965), p. 91.

[2] Coppock, J.T., An Agricultural Atlas of England and Wales. (London: Faber, 1964).

on sale of products or of the actual input labour used in farm activities, it is possible to use standard labour factors or sales factors derived from farm management studies. Since sales data in the census proved unsatisfactory for the type of classification desired, standard labour requirements had to be used as the basis for the enterprise-type classification, despite the fact that they are relatively unsatisfactory.

Standard labour requirements used as a basis for enterprise classification are open to criticism. Variations in the degree of mechanisation, in farm and field size, and in terrain make their use questionable in many cases. Such differences are, however, more likely to affect the absolute rather than the relative importance of the various farm activities.[3] In spite of their limitations, the standard labour factor approach has been utilised in the United Kingdom as the basis of a government scheme to aid small farmers and in the calculation of minimum sizes of enterprises for other schemes of assistance.[4]

Enterprise Types

To simplify calculation, the agricultural activities of the township were grouped into fourteen activity types. The activity classes are shown in Table 2 together with their component crop and livestock activities. Hay and pasture were regarded as separate

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[3]Coppock, J.T., An Agricultural Atlas of England and Wales. (London: Faber, 1964), p. 20.

[4]Ministry of Agriculture, Fisheries and Food, Development of Agriculture, (London: H.M.S.O., 1965), p. 4.

TABLE 2.

AGRICULTURAL ACTIVITY CLASSES AND COMPONENT ACTIVITIES.

(1) GRAIN CROPS

Spring Wheat

Durham Wheat

Winter Wheat

Oats

Barley

Mixed Grains

Fall Rye

Spring Rye

Buck wheat

Dry Peas

Dry Beans

Grain Corn

(2) HAY AND FODDER CROPS

Corn for Ensilage or Fodder

Alfalfa

Tame Hay

Oats (cut green)

Other Fodder Crops

(3) POTATOES AND ROOTS

Potatoes

Turnips

(4) OTHER CROPS

Sugar Beet

Other Field Crops

(5) STRAWBERRIES

(6) RASPBERRIES

(7) GRAPES

(8) CATTLE

Dairy Cattle

Beef Cow-Calf

Purchased Calves

Purchased Yearlings

(9) PIGS

Conventional Swine

Weanling Pigs

Feeder Hogs

(10) POULTRY AND BROILERS

(11) TREE FRUITS

Apples

Pears

Plums

Cherry - Sweet

Cherry - Sour

Peaches

Apricots

TABLE 2. Contd.

(12) VEGETABLES

Asparagus

Beans

Beets

Broccoli

Cabbage

Carrots

Cauliflower

Celery

Cucumbers

Green Peas

Lettuce

Onions

Spinach

Sweet Corn

Tomatoes - Processing

Tomatoes - Early Market

(13) IMPROVED PASTURE

(14) UNIMPROVED PASTURE

(15) WOODLOT

activities if no livestock was recorded in the farm group. Since these groups are similar to those used in the farm efficiency index, detailed discussion of the derivation of the factors will be included in a later chapter.

Method

Each acreage of crops and unit of livestock is multiplied by its relevant man-hours factor to obtain a figure for the number of man-hours claimed by that activity during a year. The totals were then summed to obtain the total number of man-hours used on the holding during the year.

Choice of Critical Limits

The second problem involved in the classification process is the choice of critical limits for each farm enterprise type. This could be done on the basis of a Weaver[5] type classification in which the percentage of the total labour inputs supplied by one to 'n' individual activities on the farm are compared to the ideal distribution amongst one to 'n' activities. The extent of the deviation of the actual case from the one crop, two crop, three crop, 'n' crop / activity from the ideal model, is measured by squaring the differences between the percentage shares of the actual case, and those of the ideal distribution. Each farm group will then be classed by the grouping which shows the least sum of squared deviation from the 'ideal' model.

A simple classification of farm enterprise types has been

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[5]Weaver, J.C., Crop Combinations in the Middle West. Geog. Review, XLIV, 2 (1954), pp. 175-200.

Type of Farm Classification TABLE 3.

Type	Criteria
Specialized Fluid Milk	Over 75 per cent of the gross income from the dairy enterprise and the main dairy product was fluid milk.
General Fluid Milk	Between 50 and 75 per cent of the gross income from the dairy enterprise, and the main dairy product was fluid milk.
Specialized Non-fluid Milk	Over 75 per cent of the gross income from the dairy enterprise and the main dairy product was manufactured milk and/or cream.
General Non-fluid Milk	Between 50 and 75 per cent of the gross income from the dairy enterprise and the main dairy product was manufactured milk and/or cream.
Specialized Beef Cows	Over 75 per cent of the gross income from the beef enterprise and no dairy products sold.
General Beef Cows	Between 50 and 75 per cent of the gross income from the beef enterprise and no dairy products sold.
Specialized Steer	Over 75 per cent of the gross income from feeder cattle enterprises.
General Steer	Between 50 and 75 per cent of the gross income from a feeder cattle enterprise.
Specialized Swine	Over 75 per cent of the gross income from swine enterprises.
General Swine	Between 50 and 75 per cent of the gross income from swine enterprises.
Specialized Poultry	Over 75 per cent of the gross income from poultry enterprises.
General Poultry	Between 50 and 75 per cent of the gross income from poultry enterprises.
Specialized Cash Crop	Over 75 per cent of the gross income from cash crop enterprises.
General Cash Crop	Between 50 and 75 per cent of the gross income from cash crop enterprises.
Mixed Farms	Not more than 50 per cent of the gross income from any single enterprise.

TABLE 4.

ENTERPRISE CLASSIFICATION ADAPTED FOR THE STUDY AREA FROM A CLASSIFICATION DEVISED BY THE ONTARIO DEPARTMENT OF AGRICULTURE

SPECIALISED HOLDINGS	Farm groups with over 75% of the total annual labour requirement engaged in one activity.
GENERAL HOLDINGS	Farm groups with between 50% and 75% of the total annual labour requirement engaged in one activity.
MIXED HOLDINGS	Farm groups with no one activity requiring more than 50% of the total annual labour requirement.

developed by the Ontario Department of Agriculture.[6] In this classification, the farm enterprises were classified by the percentage of their gross income obtained from a specific activity. If the figure is over 75% for one activity, the farm is described as Specialised. General farms are units obtaining between 50% and 75% of their gross income from one activity, and Mixed farms have no one enterprise contributing more than 50% of the total gross income.

The classification is further subdivided by the main activity on the holding, e.g. milk, hogs, poultry, cash crops, etc. The classification is reproduced in Table 3.

It was decided to utilise in part this less complex classification as a basis for this study. Farm groups were allocated to three main enterprise types, Specialised, General and Mixed, according to the percentage of labour hours allotted to each activity, and a further subdivision made on the basis of the leading activity.

The structure of the enterprise classification adopted for the study area is shown in Table 4.

3.2 Spatial Distribution of Main Enterprise-Types.

Enterprise-type Scale

The distribution of the three enterprise types Specialised, General, and Mixed is shown in Figure 5. Specialised holdings are concentrated in the north-east of the township in one of the tender-fruit soils. Further west on the Lake Ontario Plain, the soils are

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[6] Ontario Department of Agriculture and Food, Farm Business Management Handbook, (Toronto: Ontario Department of Agriculture, 1966), p. 818.

SPECIALISED-OVER 75% TOTAL MAN HOURS IN ONE ACTIVITY

GENERAL-50% - 75% MAN HOURS IN ONE ACTIVITY

MIXED-NO ONE ACTIVITY OVER 50% TOTAL MAN HOURS

NORTH GRIMSBY TOWNSHIP

FARM ENTERPRISE TYPES

SCALE : ONE INCH TO ONE MILE

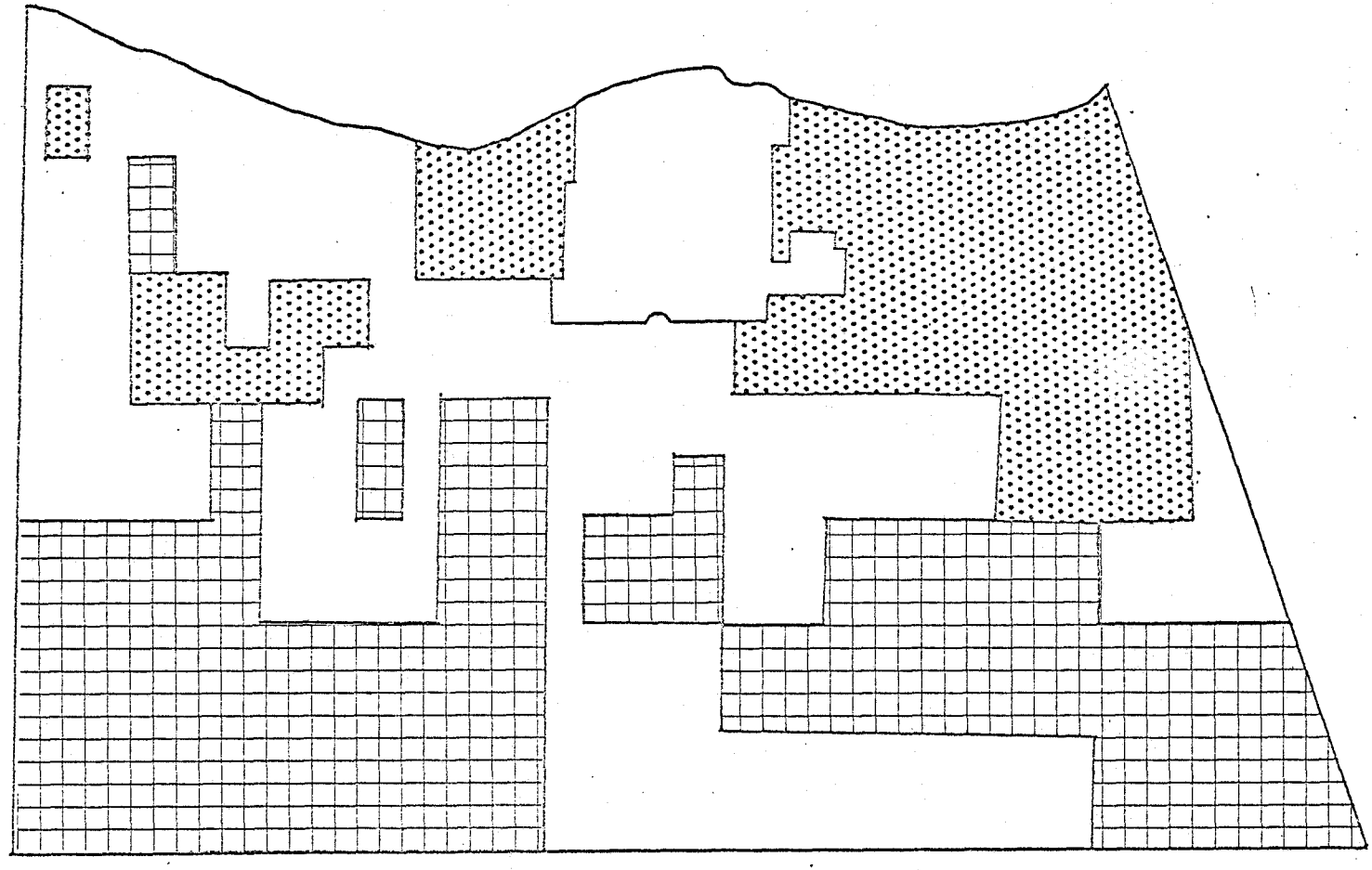

Fig. 5

NORTH GRIMSBY TOWNSHIP

LEADING FARM ACTIVITY

SCALE : ONE INCH TO ONE MILE

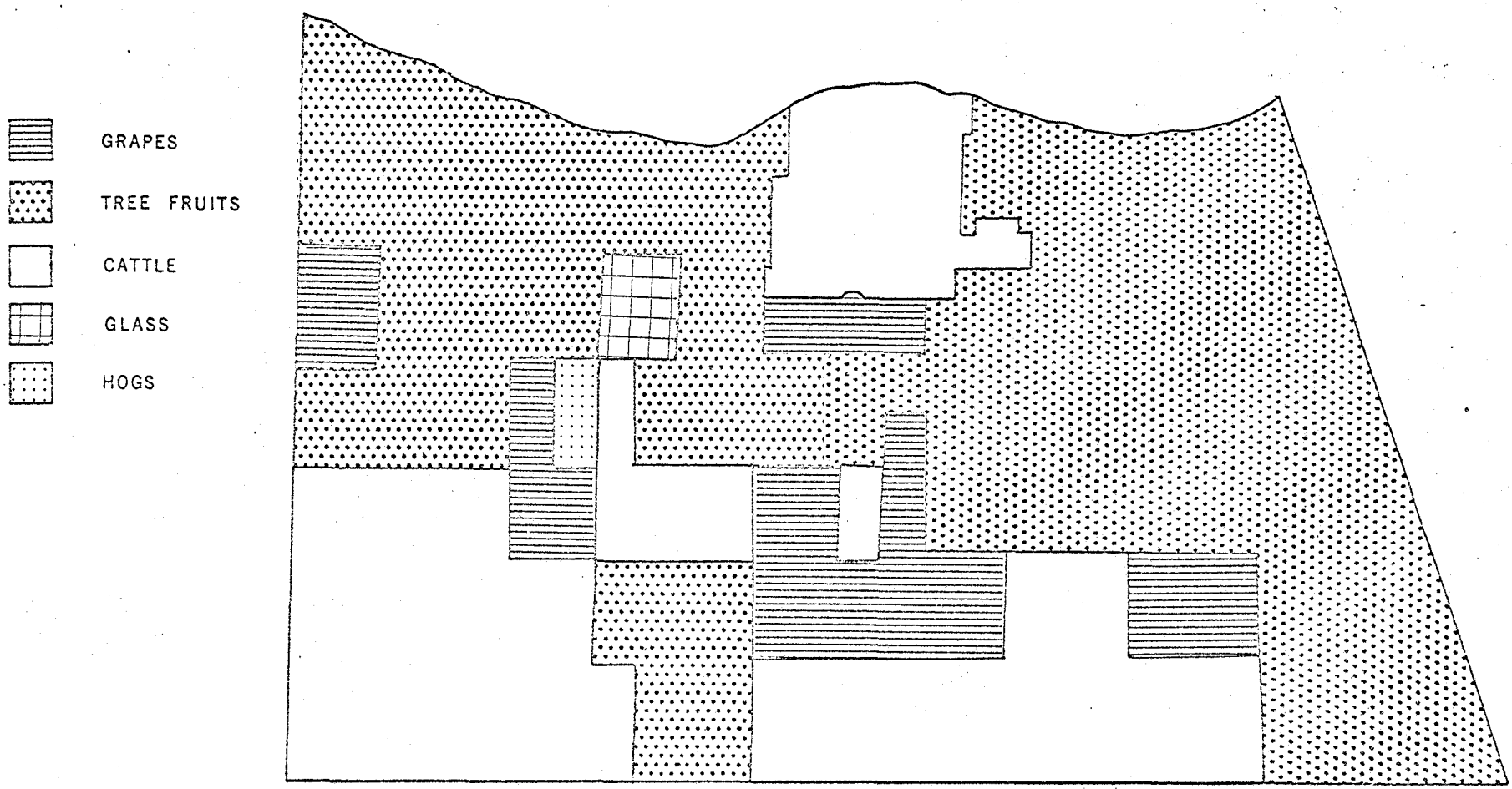

Fig. 6

heavier and a General type of farming predominates, although there are groups of specialised holdings on the lighter soils.

To the south of the escarpment, there is a band of General farms on the lighter soils of the moraine area whilst the heavier clay soils support Mixed enterprises.

Leading Crop/Activity Scale

The distribution of leading activities is shown in Figure 6. Tree fruits enterprises of various types dominate the northern and eastern areas of the township in terms of labour input utilisation. Grapes are found in isolated areas both above and below the escarpment. The southwest and southern portions of the township are dominated by cattle-oriented enterprises; generally these types of farming are located on the heavier soils.

CHAPTER IV

ANALYSIS OF THE ECONOMIC STRUCTURE OF FARM HOLDINGS IN NORTH GRIMSBY TOWNSHIP

This chapter will examine selected elements of the economic structure of the farm-firm at the township, enterprise-type and leading activity scales.

Variables examined are, in many cases, related to the size of the farm operation, and it is hypothesized that some of these variables are associated with the efficiency of use of the labour input as defined by the Labour Efficiency Index. Formal testing of these hypotheses is contained in a later section, but description of the variables is included at this stage in the study in order to provide an economic framework within which the labour input structure may be placed in perspective.

4.1 Definition of Variables.

The variables under consideration may be grouped into four general categories.

(a) Direct Measures of the Size of the Enterprise

The size of the farm units is usually defined in terms of acreage. It will become apparent in the later stages of analysis that acreage is not a good measure of farm size, but merely a measure of the input factor, land.

A better measure of farm size, one that has been considerably neglected in geographical studies, is that of total capital investment. This would include the current value of land, buildings, machinery and livestock.

It was not possible to include livestock statistics in the present study, and so total capital investment is defined as the value of land, buildings and machinery.

(b) Mechanization

The level of mechanization employed by a holding is a measure of the extent to which capital in the form of machinery is substituted for other inputs. Two measures of the level of mechanization are employed. The first is the ratio of the value of machinery to the value of the labour input, an indication of the level of substitution of machinery for labour. The second measure is the ratio of the value of machinery to the total value of capital on the holding, as defined in the previous section. The latter may be regarded as an indication of the relative importance of mechanization in the farm-firm.

(c) Productivity

Three measures of the productivity of the holding are examined. The productivity in dollars per acre is used as an indicator of the intensity of production of the farm-firm.

The productivity of labour inputs in dollars per dollar of labour used is calculated in order to determine the relative productivity of this input in the farm-firm. Finally, the productivity of capital in dollars per dollar invested is used to assess the return to the farm operator on his overall investment.

(d) The Diversity of the Enterprise

The diversity of activities on the holding is measured by means of a Diversity Index based on the percentage of total labour input utilized in the various component activities that make up the farm operation. The method used to derive the index is that used by Weaver[1] to determine crop combination regions in the Mid-western U.S.A.

4.2 Analysis of Selected Elements of Farm Economic Structure

(1) Township Scale

Selected elements of farm economic structure at the township scale are shown in Table 5.

(a) Farm Size

The mean acreage of all holdings in the township was 41.6 acres. This figure is substantially lower than the mean figure for Lincoln County. It would seem likely that this is a result of the large number of small tree fruit farms in the township. The mean acreage of full-time holdings is 4.6 acres larger than that of the part-time farms.

Capitalization on all farms in the township amounted to over $800 per acre. The figure is almost twice the average for the Niagara Peninsula and nearly four times the provincial average. It is thought that the township mean value of capital statistics are greatly influenced by the large number of specialized tree fruit holdings with abnormally high land values, the result both of the

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[1] Weaver, J.C., "Crop Combinations in the Middle West". Geog. Rev., XLIV, 2 (1954), pp. 175-200.

SELECTED ELEMENTS OF FARM ECONOMIC STRUCTURE I96I TABLE 5.

TOWNSHIP SCALE	ALL FARMS		FULL TIME		PART TIME	
VARIABLE	MEAN	S/D	MEAN	S/D	MEAN	S/D
Mean Acreage[I]	4I.65	38.88	43.86	44.38	39.22	49.I9
Total Capital Value[2]	33086.00	I4654.87	34997.73	2598.38	28395.70	30786.68
Machinery/Capital Ratio[3]	0.II	0.06	0.II	0.06	0.I2	0.I2
Machinery/Labour Ratio[4]	0.79	0.5I	0.68	0.5I	0.94	I.05
Productivity per Acre[5]	224.00	295.65	250.78	323.62	I67.47	288.60
Productivity of Capital[6]	0.I7	0.20	0.I7	0.I5	0.I7	0.30
Productivity of Labour[7]	I.06	I.06	0.93		I.34	
Diversity Index[8]	2.90	2.09	3.04	2.05	3.00	3.66

[I]Average Size of Farm in Acres.

[2]Total Value of Land , Buildings and Machinery.

[3]Value of Machinery divided by the Total Value of Capital.

[4]Value of Machinery divided by the Total Labour Input.

[5]Value of Production in Dollars per Acre.

[6]Value of Production Divided by the Total Value of Capital.

[7]Labour Productivity in Dollars per Dollar Input of Labour.

[8]Diversity of farm enterprise .

nature of the soils, the mature orchards on these holdings, and the influence of land-use competition from non-agricultural uses in certain parts of the township.

(b) Mechanization

The values of the machinery-labour ratio indicate a wide variation in the levels of substitution of machinery for labour. The statistics indicate a higher level of machinery substitution on part-time holdings. This could be the result of the need to substitute machinery for the labour input to compensate for the increased level of off-farm employment, but may also be due to an underestimation by the census of part-time or unpaid labour. No significant variation exists in the value of the machinery/capital ratio at this scale.

(c) Productivity

Wide variations exist about the mean value of all measures of productivity, which severely limits any conclusions that may be drawn from them.

Productivity per acre is substantially greater on full-time holdings, whereas with labour productivity the reverse is true. It is possible that this is the result of underestimation of the part-time labour input. No significant variations exist at this level in the productivity of capital.

(d) Diversity

At the township level, variation about the mean value of this variable make comparisons between groups insignificant.

4.3 Enterprise-type Scale

Selected elements of farm economic structure at the Enterprise-type scale are shown in Tables 6, 7, and 8.

(a) Farm Size

Large variations about the mean values as indicated by the standard deviations make detailed analysis of mean values of these variables unreliable. Mean acreages of farm units range from 16.98 acres for specialized holdings to over 70 acres in the case of mixed farms. The inadequacy of acreage data as an indicator of farm size is apparent if the figures for total capital value are examined. If all farms are considered, there is little difference in the amount of total capital investment on either Specialized or General holdings. As might be expected, the more extensive full-time holdings have a larger level of capital investment than their smaller part-time counterparts.

(b) Mechanization

The level of machinery-labour substitution is highest on the Specialized and Mixed holdings. The high value in the former group was unexpected because of the extensive use of labour in picking operations on this predominantly tree-fruit oriented group. All part-time holdings appear to have a higher level of machinery-labour substitution. It could be argued that this is the result of having to substitute more machinery to compensate for the off-farm employment of the operator, or that the extra income derived from the off-farm employment is used in part to provide more capitalization in

SELECTED ELEMENTS OF FARM ECONOMIC STRUCTURE I96I — TABLE 6.

ENTERPRISE-TYPE SCALE- SPECIALISED HOLDINGS

	ALL FARMS		FULL TIME HOLDINGS		PART TIME HOLDINGS	
VARIABLE	MEAN	S/D	MEAN	S/D	MEAN	S/D
Mean Acreage	I6.98	I5.88	I5.62	II.30	I8.I8	20.7I
Total Capital Value	$35560.26	$I3I29.9I	$35659.78	$I2077.7I	$3467I.2I	$I6486.67
Machinery/Capital Ratio	0.I0	0.06	0.I0	0.07	0.07	0.03
Machinery/Labour Ratio	0.88	0.6I	0.77	0.67	0.94	0.50
Productivity per Acre	28I.05	276.70	360.88	3I5.I8	I70.I6	II9.86
Productivity of Capital	0.09	0.09	0.I2	0.II	0.05	0.04
Productivity of Labour	0.78	0.60	0.8I	0.64	0.74	0.56
Diversity Index	I.53	I.46	I.39	I.27	I.50	I.60

SELECTED ELEMENTS OF FARM ECONOMIC STRUCTURE I96I — TABLE 7.

ENTERPRISE TYPE SCALE - GENERAL HOLDINGS

	ALL FARMS		FULL TIME		PART TIME	
VARIABLE	MEAN	S/D	MEAN	S/D	MEAN	S/D
Mean Acreage	49.07	34.56	47.3I	34.68	43.98	30.66
Total Capital Value	34060.67	I6853.23	37880.46	I9733.65	28034.34	6I78.7I
Machinery /Capital Ratio	0.II	0.07	0.08	0.04	0.I3	0.06
Machinery /Labour Ratio	0.72	0.42	0.55	0.39	0.94	0.35
Productivity per Acre	232.46	370.78	23I.I8	382.09	220.70	366.70
Productivity of Capital	0.23	0.26	0.I7	0.I4	0.23	0.33
Productivity of Labour	I.22	I.3I	I.I3	0.99	I.42	I.75
Diversity Index	3.84	I.99	3.47	I.64	4.07	2.20

SELECTED ELEMENTS OF FARM ECONOMIC STRUCTURE I96I — TABLE 8.

ENTERPRISE TYPE SCALE - MIXED HOLDINGS

VARIABLE	ALL FARMS MEAN	ALL FARMS S/D	FULL TIME MEAN	FULL TIME S/D	PART TIME MEAN	PART TIME S/D
Mean Acreage	7I.78	45.95	9I.97	54.20	54.97	35.4I
Total Capital Value	260I4.I4	II567.9I	30II6.29	I4843.7I	23I87.77	7763.58
Machinery Capital Ratio	0.I3	0.05	0.I3	0.02	0.I4	0.07
Machinery Labour Ratio	0.82	0.50	0.65	0.28	0.96	0.56
Productivity per Acre	96.72	I09.59	II6.64	I28.29	III.73	I09.06
Productivity of Capital	0.20	0.I7	0.25	0.I7	0.2I	0.26
Productivity of Labour	I.23	I.09	I.I2	0.66	I.24	I.34
Diversity Index	3.95	I.80	4.09	I.72	4.07	2.I3

the form of machinery on the farm. However, the lack of variation in the machinery-capital ratio between full-time and part-time farm groups could indicate again that the labour input for part-time holdings is underestimated.

(c) Productivity

Productivity per acre is greatest on the small, very intensive specialized holdings and least in the extensive mixed farm group. In all cases, the productivity per acre of full-time farms exceeds that of part-time holdings. However, if productivity is measured in terms of returns to capital invested on land, buildings and machinery, specialized holdings have the lowest return of any enterprise type. Labour productivity is lowest on the specialized holdings, probably because of the large unpaid labour input, which has been charged as an opportunity cost in this analysis. The highest returns to labour occur on part-time farms, but as in the analysis at the township level, part of this return could be accounted for by an underestimation of the unpaid labour input.

(d) Diversity of Enterprise

Since enterprise-types at this level are defined in terms of relative diversity of operation, there is no need to examine this variable in detail. It would appear, however, on analysis of part-time holdings, that these farms are marginally more diverse than their full-time counterparts. This may be the result of an attempt to spread the labour input requirement more evenly over the year to enable the operator to work off the holding for a longer period.

SELECTED ELEMENTS OF FARM ECONOMIC STRUCTURE I96I TABLE 9.

LEADING ACTIVITY SCALE - TREE FRUITS

VARIABLE	SPECIALISED MEAN	SPECIALISED S/D	GENERAL MEAN	GENERAL S/D	MIXED MEAN	MIXED S/D
Average Acreage	I7.02	I5.73	38.I2	3I.65	93.27	56.36
Total Capital Value	35656.37	I3840.98	39798.20	I64I0.78	32726.72	I3I57.7I
Machinery Capital Ratio	0.09	0.06	0.I0	0.04	0.I4	0.05
Machinery Labour Ratio	0.86	0.60	0.79	0.34	0.93	0.55
Productivity per Acre	255.98	223.I7	I46.I7	85.22	I08.39	97.77
Productivity of Capital	0.08	0.08	0.II	0.06	0.27	0.27
Productivity of Labour	0.77	0.60	0.79	0.37	I.37	0.57
Diversity Index	I.36	I.34	3.34	I.72	3.37	I.56

4.4 Analysis of Selected Elements of Farm Structure of the Leading Activity Scale.

Tree Fruits

Selected elements of farm economic structure of farms with tree fruits as the dominant crop are shown in Table 9.

(a) Farm Size

Mean acreages of this farm group range from 17 acres in specialized holdings to over 92 acres for the mixed farm group. Total capital value indicates, however, that levels of investment in the holding are much the same for all farm types.

(b) Mechanization

The level of mechanization appears highest on the more extensive mixed farms according to all measures of this variable examined.

(c) Productivity

As expected, productivity per acre was highest on the intensive specialized holdings and lowest on the mixed holdings where the diversity of production was greatest.

Grapes

Selected elements of farm structure of holdings with grapes as the leading crop are shown in Table 10.

(a) Farm Size

The usual trend in the township of mixed holdings being more extensive than general or specialized farms is reversed in the case

SELECTED ELEMENTS OF FARM ECONOMIC STRUCTURE I96I TABLE IO.

LEADING ACTIVITY SCALE - GRAPES

	SPECIALISED		GENERAL		MIXED	
VARIABLE	MEAN	S/D	MEAN	S/D	MEAN	S/D
Mean Acreage	No Observations		58.59	I3.43	36.43	32.83
Total Capital Value			$34385.48	$2I496.I8	$I9608.20	$65I3.55
Machinery/Capital Ratio			0.II	0.04	0.I2	0.08
Machinery/Labour Ratio			0.65	0.29	0.59	0.I5
Productivity per Acre			$I24.77	$I09.72	$I37.38	$I58.72
Productivity of Capital			$0.22	$0.I9	$0.I5	$0.2I
Productivity of Labour			$0.9I	$0.76	$0.73	$0.68
Diversity Index			2.83	0.98	3.50	I.87

of holdings with grapes as the leading crop. Mixed holdings are virtually half the size of general farms both in acreage and value of land, buildings and machinery.

(b) Mechanization

The machinery-labour ratio indicates a greater reliance on mechanization in the more extensive mixed holdings. No significant variation in the relative importance of mechanization in terms of total capital investment could be detected on the two groups of holding.

(c) Productivity

Productivity per acre is highest on the smaller mixed holdings. A similar trend is found with tree fruit, the other crop which uses labour intensively at harvest time, although in the case of tree fruits it is the specialized farms which possess the smallest mean acreage.

Productivity in terms of capital investment is highest on the mixed farms, with their higher level of investment. Labour productivity is higher on the larger general farms although the level of productivity for both farms is very low. The low level of labour productivity results from the extensive use of unpaid, family labour on these farm-types.

Cattle

Selected elements of economic structure of farm-holdings with cattle as the dominant crop are shown in Table 11.

(a) Farm Size

Mixed holdings possess the largest mean acreage and value of

SELECTED ELEMENTS OF FARM ECONOMIC STRUCTURE 1961 TABLE II.

LEADING ACTIVITY SCALE - CATTLE

VARIABLE	SPECIALISED MEAN	SPECIALISED S/D	GENERAL MEAN	GENERAL S/D	MIXED MEAN	MIXED S/D
Mean Acreage	No. Observations		71.32	38.86	73.16	31.93
Total Capital Value			19579.22	4648.49	23801.79	9931.15
Machinery Capital Ratio			0.13	0.08	0.14	0.03
Machinery Labour Ratio			0.66	0.63	0.88	0.54
Productivity per Acre			53.02	30.47	103.39	109.48
Productivity of Capital			0.17	0.08	0.24	0.18
Productivity of Labour			1.36	1.45	1.39	1.36
Diversity Index			5.85	1.77	4.87	2.29

capital, although there is more variation within this group than in the general holdings.

(b) Mechanization

The machinery/labour ratio indicates a greater reliance on labour on the more extensive mixed holdings. No significant variation can be determined in the machinery capital ratios.

(c) Productivity

Productivity per acre is lowest on the general farms, although the standard deviation indicates more variation within this group than on mixed holdings. Productivity of the labour input at $1.35 per dollar of labour input is substantially greater than labour productivity figures observed in holdings with grapes as the leading crop.

Productivity of capital is seven per cent higher on the mixed holdings, a reflection of the higher level of investment.

CHAPTER V

AGRICULTURAL LABOUR INPUT STRUCTURE IN NORTH GRIMSBY TOWNSHIP

The aim of this chapter is to describe the component structure of the agricultural labour input in North Grimsby Township in 1961. Analysis is conducted at the township, enterprise-type and leading activity scales. In addition, an attempt is made to isolate regional and local components in the spatial distribution of agricultural labour types at the township scale by means of trend surface analysis.

5.1 Labour Force Structure

Labour is a human input and hence varies in quality with the capability and motivation of its supplier. It is essential in any analysis concerning labour to separate the labour force into components, showing similarity of capability and motivation. Black, Clawson, Sayre and Wilcox[1] have divided agricultural labour into three components, operator's labour, unpaid labour and hired labour. Further distinction as regards capability of labour types has been attempted by Scoville with the introduction of a table of adjustments to be made to work capability figures, depending upon the age of the worker. In the present study, labour is divided into operator's labour, unpaid labour and hired labour for the purposes of analysis. No attempt was made to adjust standard labour hours worked by any of the labour types

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[1] Black, J.D. et al, Farm Management. (New York: Macmillan 1947), p. 500.

using Scoville's[2] tables, because information on age was available only for operator's labour from the 1961 census.

Types of Labour

(a) Operator's Labour

Operator's labour is a combination of both physical labour and the functions of the entrepreneur. The farm operator not only controls the operation of the holding but in many cases supplies a substantial part of the total labour required for its operation. The operator's capability in either of these two rôles can substantially affect the net income of the holding.

The age of the operator will have some bearing on the decisions he makes as entrepreneur, as well as his capacity for physical labour. Although as mentioned above, age of operator is not used to modify the standard man hours factors for operator's employment, it is included in the analysis as a separate entity so that comparison between labour structure and operator's age can be made.

(b) Unpaid Labour

Unpaid labour forms a substantial portion of the total labour used on many holdings. It is generally derived from the operator's immediate family, although other relations and non-family personnel are sometimes utilised at times of peak labour demand.

According to Black et al,[3] unpaid labour shares many of the

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[2]Scoville, O.J., "Relationship Between Size of Farm and Utilisation of Machinery and Equipment". U.S.D.A. Technical Bulletin 1037. Washington, D.C.

[3]Black, J.D., et al., Op. cit., p. 500.

characteristics of Operator's labour, so far as motivation is concerned. In many cases, the supervision of the holding is in the joint control of the operator and senior members of his family. Unpaid labour is not directly motivated by thought of immediate economic gain and can thus be isolated from other forms of farm labour. Unpaid labour, by definition receives no direct monetary reward. A result of this is a lack of awareness on the part of the Operator, and to a certain extent, on the part of the Unpaid labour, of the true or opportunity cost of this type of labour input.

(c) Hired Labour

Since Hired labour is working for direct economic gain, it possesses its own characteristic capabilities and motivations.

In terms of capability, Hired labour can equal or exceed that of the farm operator with regard to specific activities on the holding. An experienced herdsman is often more knowledgeable in his own specialisation than the operator of a large dairy enterprise.

Motivations of hired workers have been the subject of considerable study by economists, sociologists and psychologists. A study of agricultural workers in Ontario by Lane and Campbell[4] found that three main factors were considered important by the worker and thus could influence his efficiency in performing tasks. Reasonable and regular hours were considered of prime importance, good food and living accommodation ranked second and good wages third.

The study is concerned not with the characteristics of individual labour types in farm structure, but with their overall

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[4]Lane, S.H., and Campbell, D.R., Farm labour in Ontario. (Guelph: Ontario Agricultural College, 1952), p. 62.

efficiency in the farm holding. Consequently, it is the percentage of the total labour used on the farm supplied by each labour type that is considered rather than actual hours worked.

5.2 Data Sources

Information on labour use in 1961 was obtained from the Census of Agriculture[5] in the form of the answers to questions 142, 144 and 145 of sections XVI and XXII of the enumeration form. (See Appendix two). These questions include the number of days worked off the farm by the operator during the past twelve months, and the number of weeks worked during the past twelve months by paid and unpaid family workers.

5.3 Standardisation of Labour Statistics

The variety of forms in which labour was reported had to be standardised to standard-man-hours so that comparison could be made with the optimum crop factors.

Various conversion factors for the standard agricultural working week are available. In reality, the working day and week vary from farm to farm and any attempt at standardisation severely reduces the accuracy of the study. Castle and Baker[6] recommend the use of a ten hour working day for farm labour studies, but this statistic is based on experience in the western United States.

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[5] Dominion Bureau of Statistics. Census of Canada. Bulletin 5.2 Agriculture; Ontario. (Ottawa: Queen's Printer, 1963).

[6] Castle, E.N., & Baker, M.H., Farm Business Management, New York: Macmillan, 1962.

Conversion factors representative of Canadian agricultural conditions were obtained from the Canada Department of Labour.[7] In 1958, the average working week on agricultural holdings in Canada amounted to fifty-four hours or a nine hour day, six days per week. These figures were utilised as conversion factors for the purposes of the present study.

There are indications that the factors used are a conservative estimate. Other studies have shown a high percentage of agricultural labour (over 58%) working over 55 hours per week[8] and this has been confirmed by work in the mixed farming area of the Niagara Peninsula.[9]

5.4 Spatial Analysis of Labour Force Structure.

The aim of this section is to analyse the spatial pattern of labour structure in North Grimsby Township at the Township scale.

The analysis could be conducted in two ways. The components of labour force structure, operator's, unpaid and hired labour, could be treated as a series of discrete quantities with point locations. The alternative is to treat the percentage of each component as a continuous surface. In the latter case, the surface can be thought

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[7]Canada Department of Labour. Trends in the Agricultural labour force in Canada. (Ottawa: Queen's Printer, 1962).

[8]Dominion Bureau of Statistics, 1958. D.B.S. Reference Paper No. 58. 1958 Revision. (Ottawa: Queen's Printer, 1958).

[9]Darnel, Wolfe. Personal communication, April 1968.

of as a response surface in which height (i.e. percentage of total labour supplied by a particular component) varies as a response to controlling factors.[10]

The major problem in the analysis of spatial distributions and surfaces is that of scale components. A method of analysis must be used that will separate high scale or regional trends from the lower scale or local components. One method which allows the mapping of regional and local components of spatial distributions is Trend Surface Mapping.

Trend Surface Mapping

Krumbein and Graybill[11] have provided a definition of Trend Surface Mapping.

> "Trend surface analysis may be defined as a procedure by which each map observation is divided into two or more parts: some associated with the "large scale" systematic changes that extend from one map edge to another and the others associated with "small scale" apparently non-systematic fluctuations that are superimposed on the large scale patterns".

Most trend surface analysis involves the fitting of polynomial surfaces to data by means of the general linear model. Thus techniques as presently developed can be described as least squares-linear model techniques.

Trend can be defined as a polynomial surface that may contain all or parts of the linear, quadratic or higher terms,[12] although in

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[10]Haggett, P., and Chorley, R.J., "Trend Surface Mapping in Geographical Research". Transactions and Papers of the Institute of British Geographers, (1965), p. 47-67.

[11]Krumbein, W.C., & Graybill, F.A., Statistical Models in Geology (New York: McGraw-Hill, 1965), p. 321.

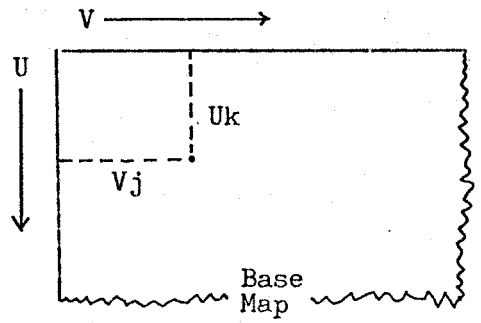
[12]Krumbein, W.C. & Graybill, F.A., 1965, Op. cit., p. 321.

practice, because of computational problems and the increasing complexity of resultant surfaces in what is designed to be a simplification procedure, the trend seldom exceeds the third or fourth order surface.[13]

Computation Procedure for Trend Surfaces

Krumbein and Graybill[14] describe the computation process involved in the fitting of trend surfaces.

The single map observation is designated T(UiVj) in a two-dimensional field with co-ordinates (UkVj).



The general linear model used in the computation takes the form:-

$$T(UiVj) = (UiVj) + ij$$

where T(UiVj) is the observable mappable variable, and is equal to the trend, (JiVj), plus a random component ij. The trend has unknown parameters and may be expressed as:-

$$r(U,V) = \alpha_{00} + \alpha_{10}U + \alpha_{01}V + \ldots + \alpha\, pqUpVq$$

the α's in the above expression being the polynomial coefficients in the general linear model. Thus the general model for the linear or first degree surface is:-

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[13] Haggett, P., 1965, Op. cit., pp. 47-67.

[14] Krumbein, W.C., & Graybill, F.A., Op. cit., p. 322.

$$T(UiVj) = \alpha_{oo} + \alpha_{o1} Ui + \alpha_{o1} Vj + ij$$

In the case of this study, the third order or cubic surface was the highest order surface fitted.

From the resulting values a contour map of the surface may be drawn. Deviations between the values of the original map and the fitted surface are known as residuals and can be regarded as the 'local' components of the original distribution.

Significance of Surface

The significance of a fitted surface is evaluated by means of analysis of variance in which:-

$$F = \frac{S_1^2}{S_2^2} \quad \text{or} \quad \frac{S_2^2}{S_1^2} \quad \text{(whichever is larger)}$$

where S1 and S2 are the two sample standard deviations. This test assumes that the two populations have roughly the shape of the normal distribution.[15] All surfaces described were significant at the 5% level.

Program Utilised in the Present Study

Many programs have been written for trend surface analysis. This present analysis was conducted with a program written by David Ingram[16] in Fortran IV for the I.B.M. 7040 computer. The program attempts to fit linear, quadratic and cubic surfaces to irregularly spaced data and results are shown in tabular and contour map form, together with a map of the residuals for each surface.

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15 Freund, J.E., Modern Elementary Statistics, (Englewood Cliffs., N.J., Prentice-Hall, 1965)

16 Department of Geography, McMaster University, Hamilton, Ontario.

Regional and Local Components in Labour Force Structure at the Township Scale.

(a) Operator's labour

A map showing the spatial distribution of the percentage of operator's labour employed on the farm groups in the township is shown in Fig. 7. A contour map of the third order surface fitted to the above data is shown in Fig. 8.

Regional Trends

The general trend is for a high percentage of operator's labour to be found in the north and south of the township with maximum values near the southern boundary of the township in the Mixed farming area. Values decrease sharply in the west of the township and in the east. The decrease coincides generally with the area of tree fruit holdings. The town of Grimsby appears to have little influence on the spatial trend, although the sharp decline in the west of the township could be indicative of an increase in off-farm employment as a result of the influence of the City of Hamilton.

Local Trends

Positive and negative residuals from the third order surface fitted to the percentage of operator's labour are shown in Fig. 9.

Positive residual distribution, indicating a higher level of operator participation in farm operations tend to be associated with Mixed farming areas in the south of the township and with areas dominated by specialised and General tree fruit holdings in the east of the township. Another positive zone in the General Tree Fruit enterprise area is found west of the town of Grimsby.

NORTH GRIMSBY TOWNSHIP

PERCENTAGE OF OPERATORS LABOUR

ORIGINAL MAP

SCALE : ONE INCH TO ONE MILE

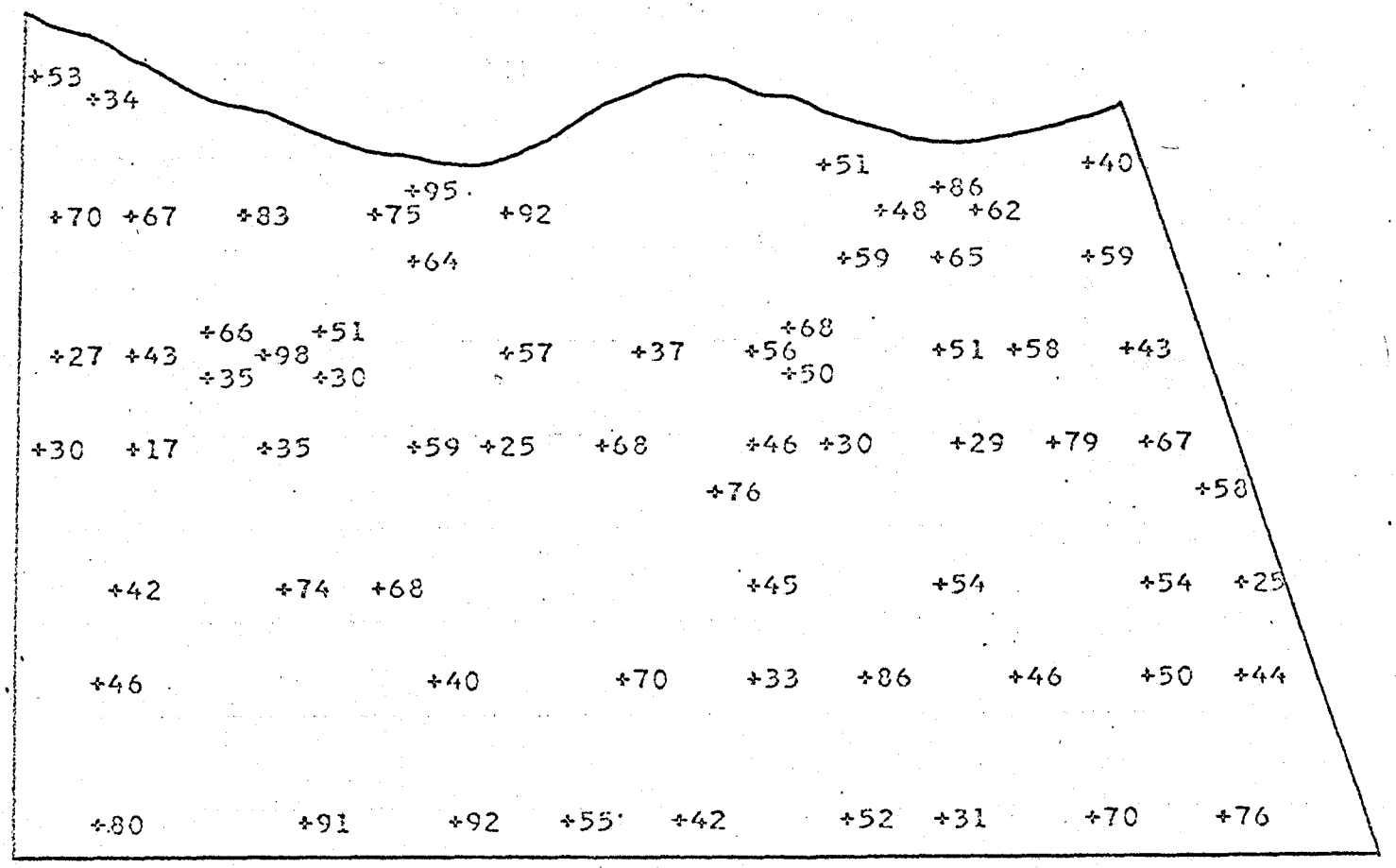

Fig. 7

NORTH GRIMSBY TOWNSHIP

PERCENTAGE OF OPERATORS LABOUR

THIRD ORDER TREND SURFACE

SCALE: ONE INCH TO ONE MILE

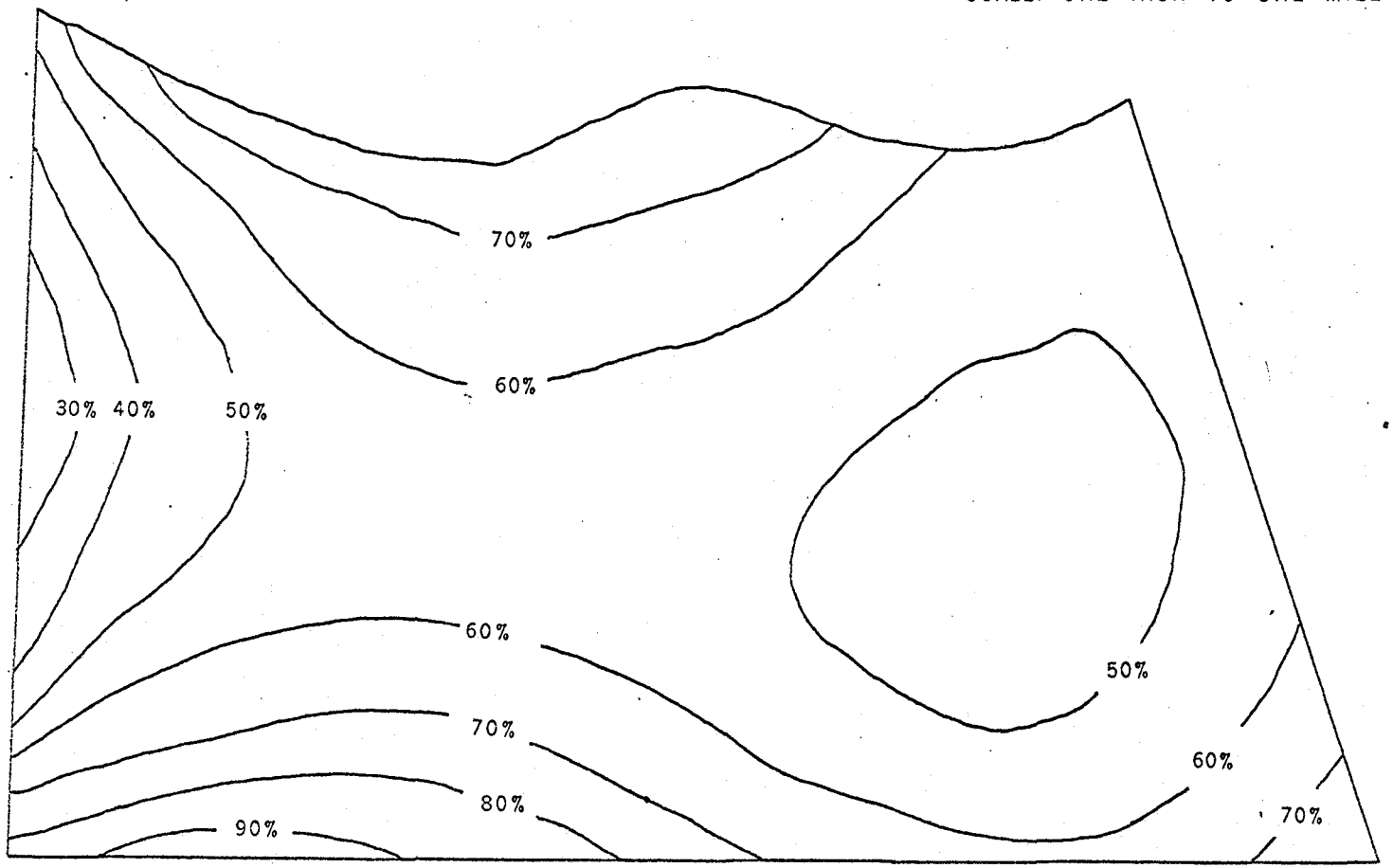

Fig. 8

POSITIVE RESIDUAL

NEGATIVE RESIDUAL

NORTH GRIMSBY TOWNSHIP

PERCENTAGE OF OPERATORS LABOUR

RESIDUALS FROM THIRD ORDER SURFACE

SCALE: ONE INCH TO ONE MILE

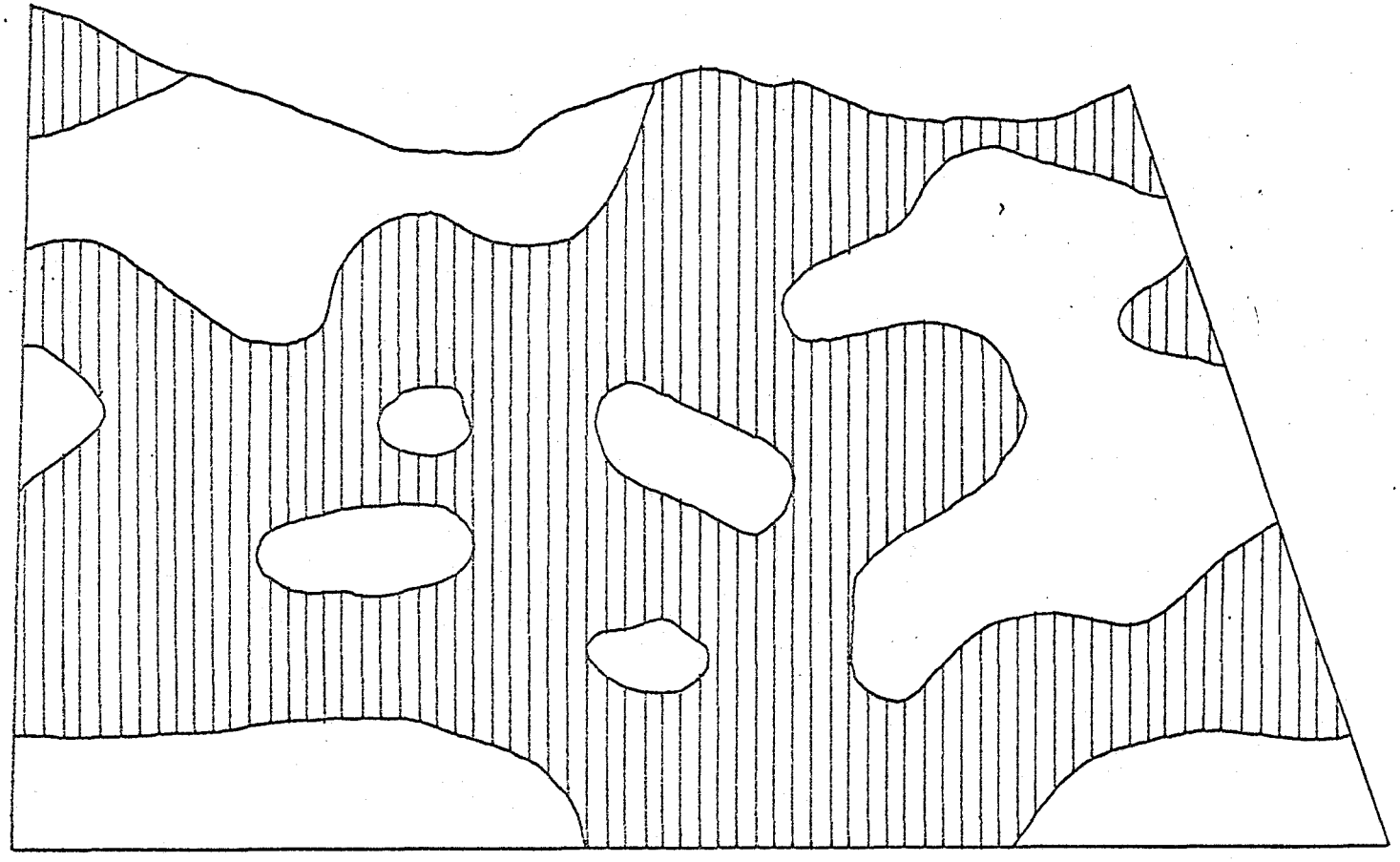

Fig. 9

(b) Paid Labour

A map showing the data to which the second order surface was fitted is reproduced in Fig. 10. A second order surface was found to be significant at the 5% level and a contour map of this surface is shown in Fig. 11.

Regional Trend

Maximum values were obtained in the western area of the township where general farming predominates. Values decrease north and south of the central area of the township which is also dominated by general farms. In the eastern portion of the township, the 20% contour closely follows the boundary of the tree-fruit farms. Minimum values are obtained in the southern area of the township in a zone dominated by mixed holdings.

Local Trends

The pattern of residuals from the second order trend surface fitted to the percentage of paid labour utilised on holdings is shown in Fig. 12.

The areas of positive residuals tend to be associated with the zone of the lighter clay soils, especially in the moraine area immediately south of the Niagara escarpment. The farms on these soils relatively extensive and yet are dominated by crop rather than the livestock activities found on heavier soil to the south. Hence the labour requirement, on an annual basis, for these holdings is higher.

(c) Unpaid Labour

The original map to which the surface was fitted is shown in

NORTH GRIMSBY TOWNSHIP

PERCENTAGE OF PAID LABOUR

ORIGINAL MAP

SCALE: ONE INCH TO ONE MILE

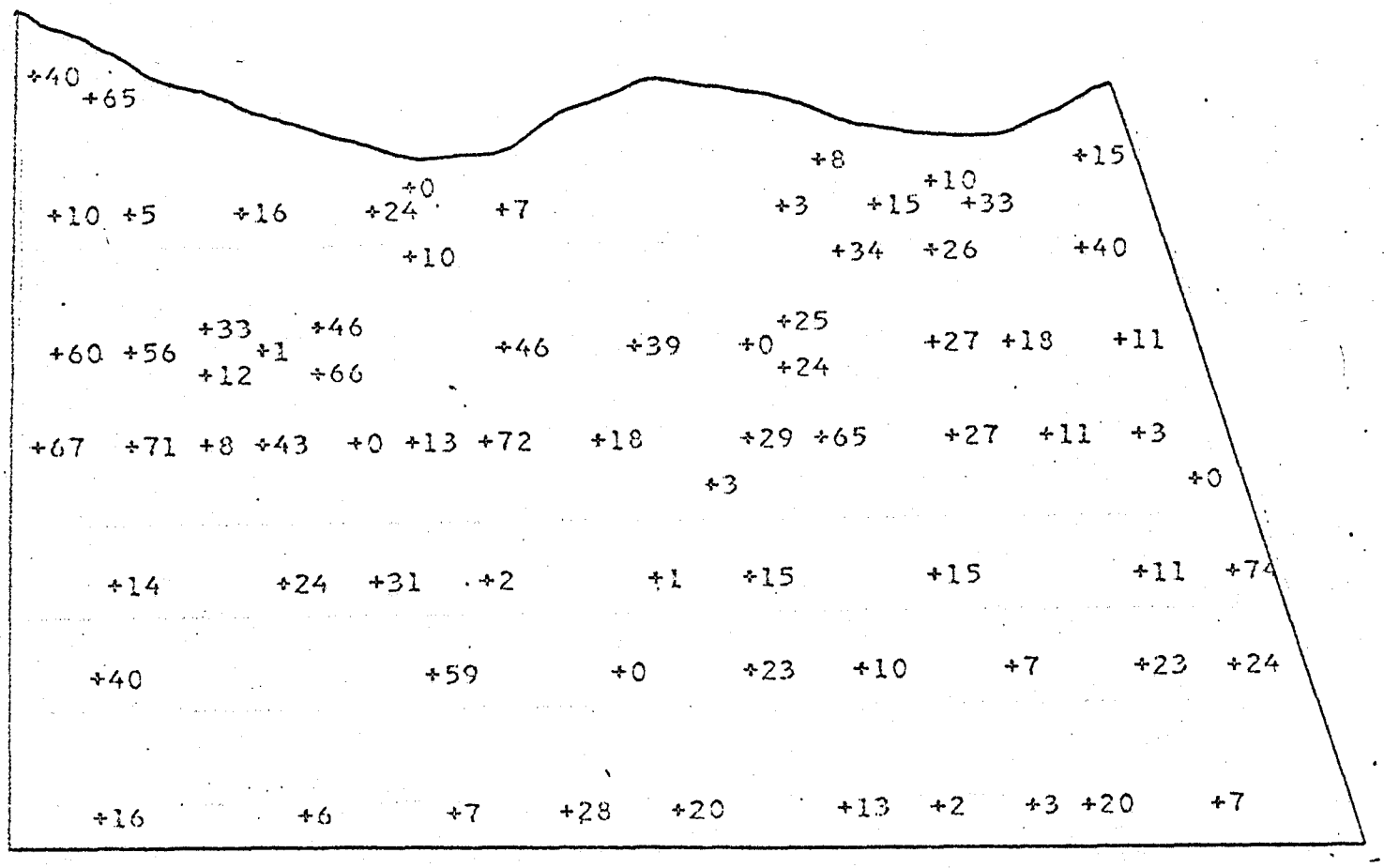

Fig. 10

NORTH GRIMSBY TOWNSHIP

PERCENTAGE OF PAID LABOUR

SECOND ORDER TREND SURFACE

SCALE: ONE INCH TO ONE MILE

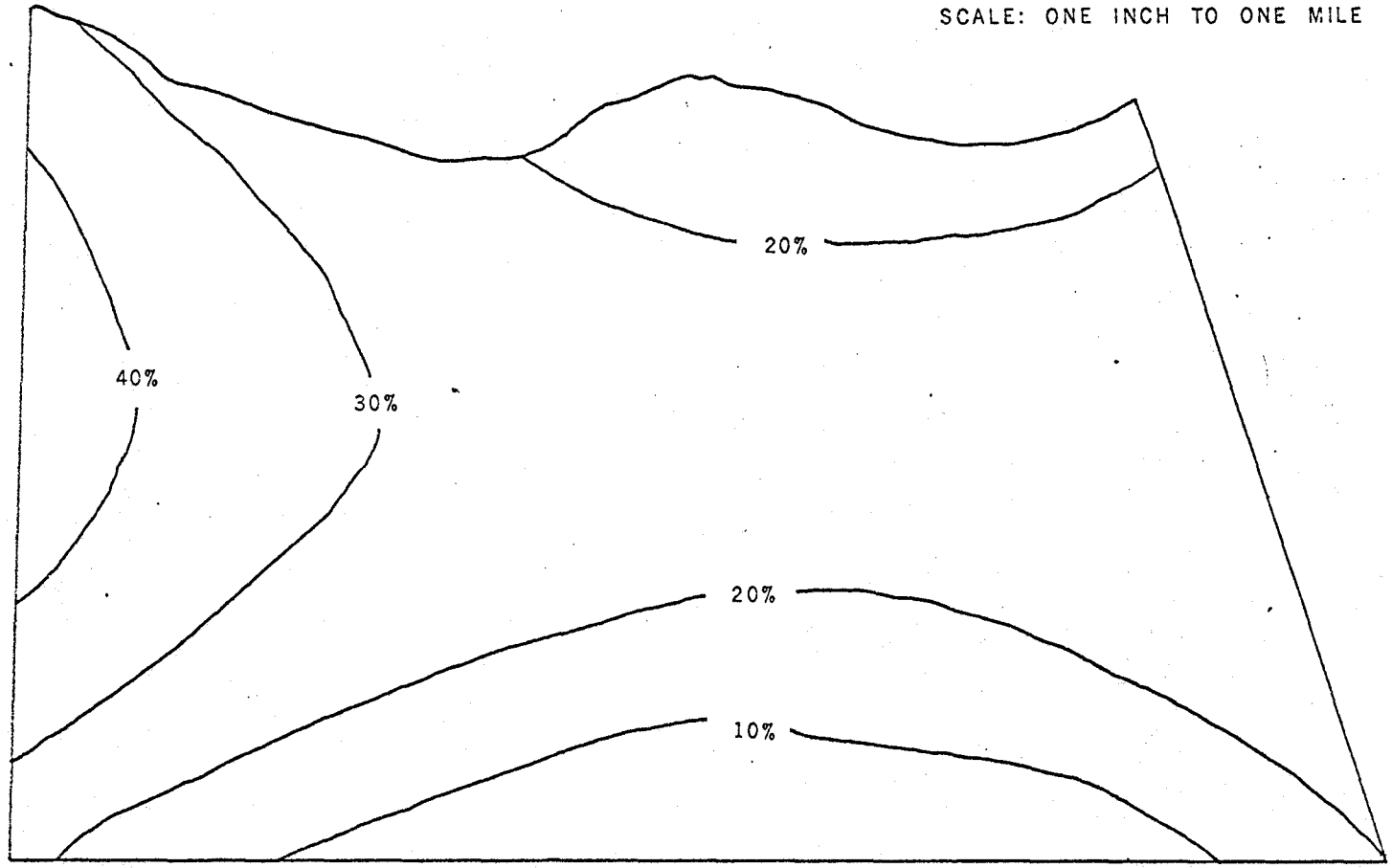

Fig. 11

POSITIVE RESIDUAL

NEGATIVE RESIDUAL

NORTH GRIMSBY TOWNSHIP

PERCENTAGE OF PAID LABOUR

RESIDUALS FROM SECOND ORDER SURFACE

SCALE: ONE INCH TO ONE MILE

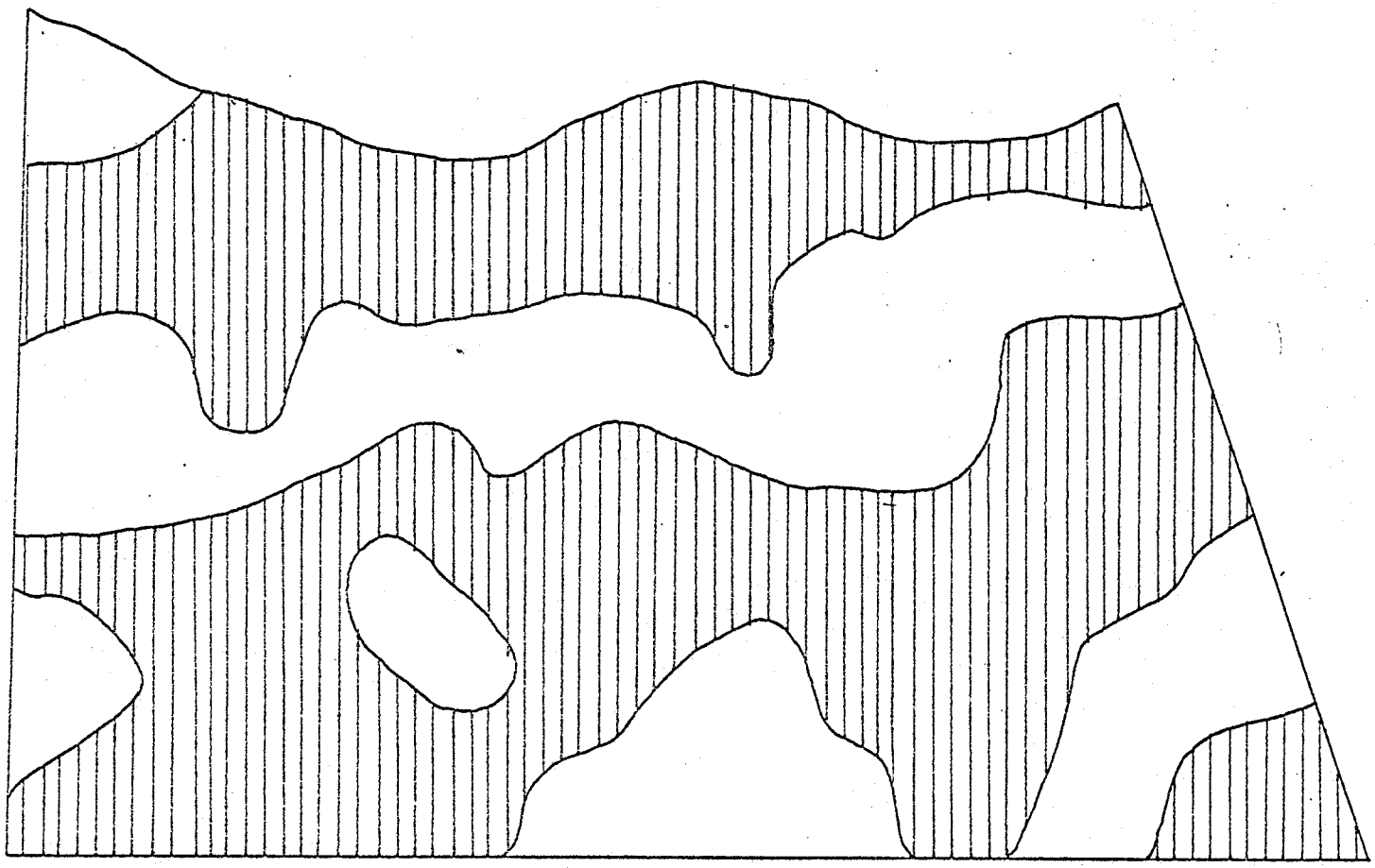

Fig. 12

Fig. 13. The third order surface was found to be significant at the 5% level, and a contour map of this surface is shown in Fig. 14.

Regional Trend

The third order surface fitted to the percentage of unpaid labour had a maximum value of 30% in the south-east of the township in the area of Mixed and General holdings. High values are generally associated with tree-fruit dominated holdings, although they do include an area with Mixed cattle enterprises in the south-east of the township. Minimum values are located in the south-west, where mixed cattle enterprises are predominant. Another area of minimum values is located in the north-west of the township in an area which contains many general holdings with tree-fruits as the leading crop.

Local Trends

The residuals of the third order surface fitted to the percentage of Unpaid labour are reproduced in Fig. 15.

There would appear to be no distinct connection between the residual pattern produced from the third order surface and the enterprise-type distribution, although there are some indications that the pattern is associated with soil types.

Areas of positive residuals are found both above and below the Escarpment, especially on areas of the Jeddo and Lincoln clay. Both these soil types rate poorly for the cultivation of the principal crops and the indication is that returns per acre on these enterprises do not permit efficient production under present operating constraints.

NORTH GRIMSBY TOWNSHIP

PERCENTAGE OF UNPAID LABOUR

ORIGINAL MAP

SCALE: ONE INCH TO ONE MILE

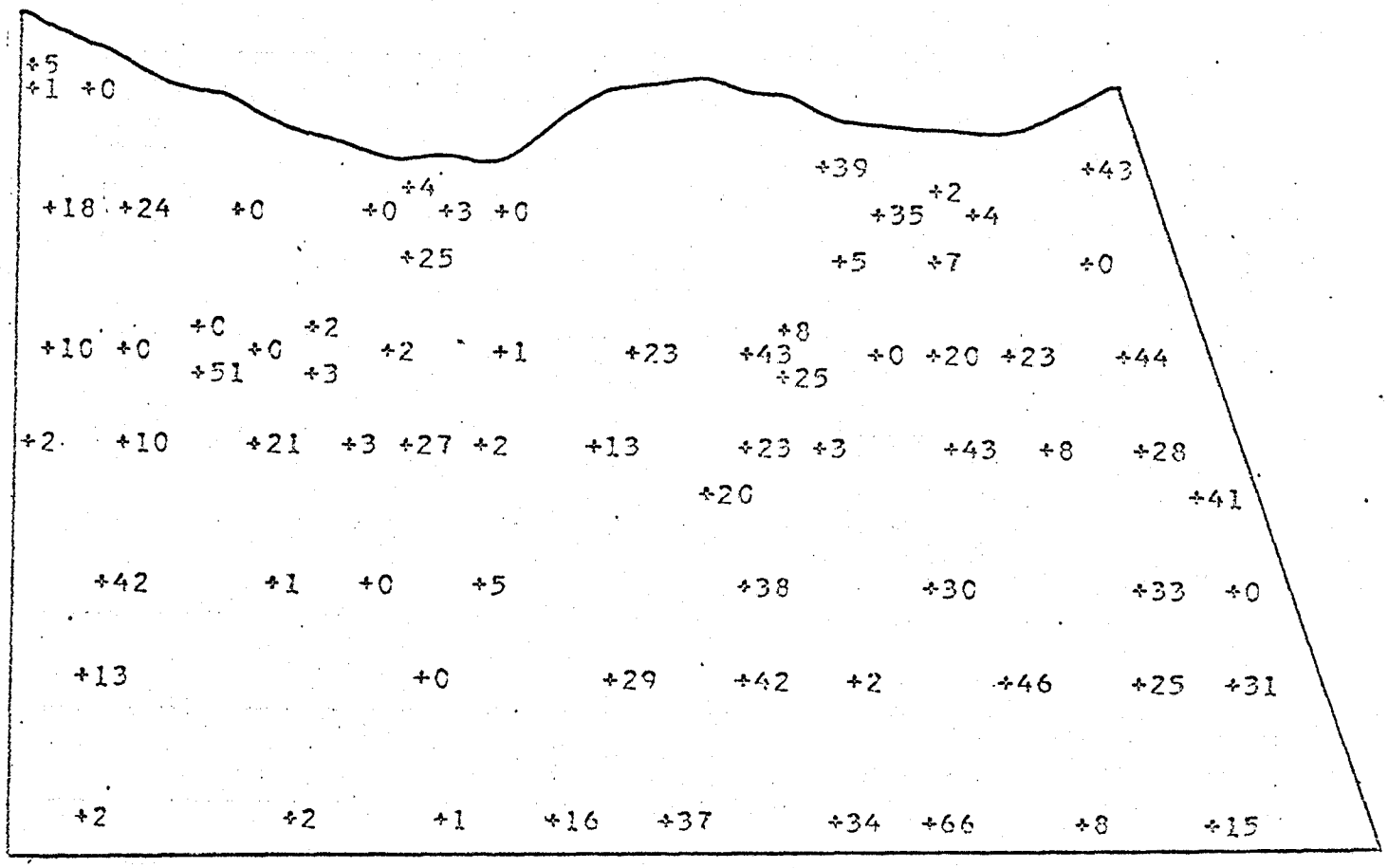

Fig. 13

NORTH GRIMSBY TOWNSHIP

PERCENTAGE OF UNPAID LABOUR

THIRD ORDER SURFACE

SCALE : ONE INCH TO ONE MILE

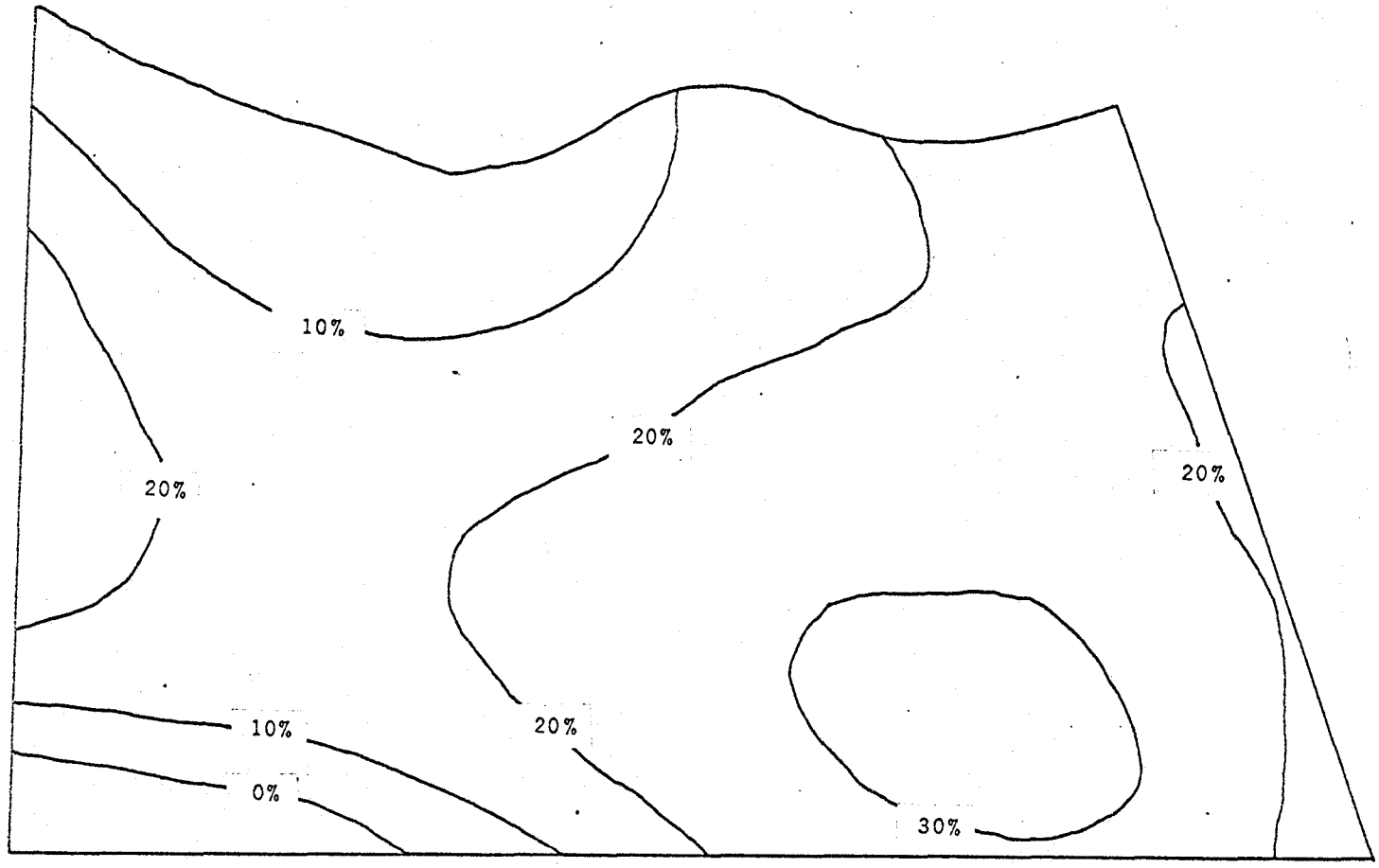

Fig. 14

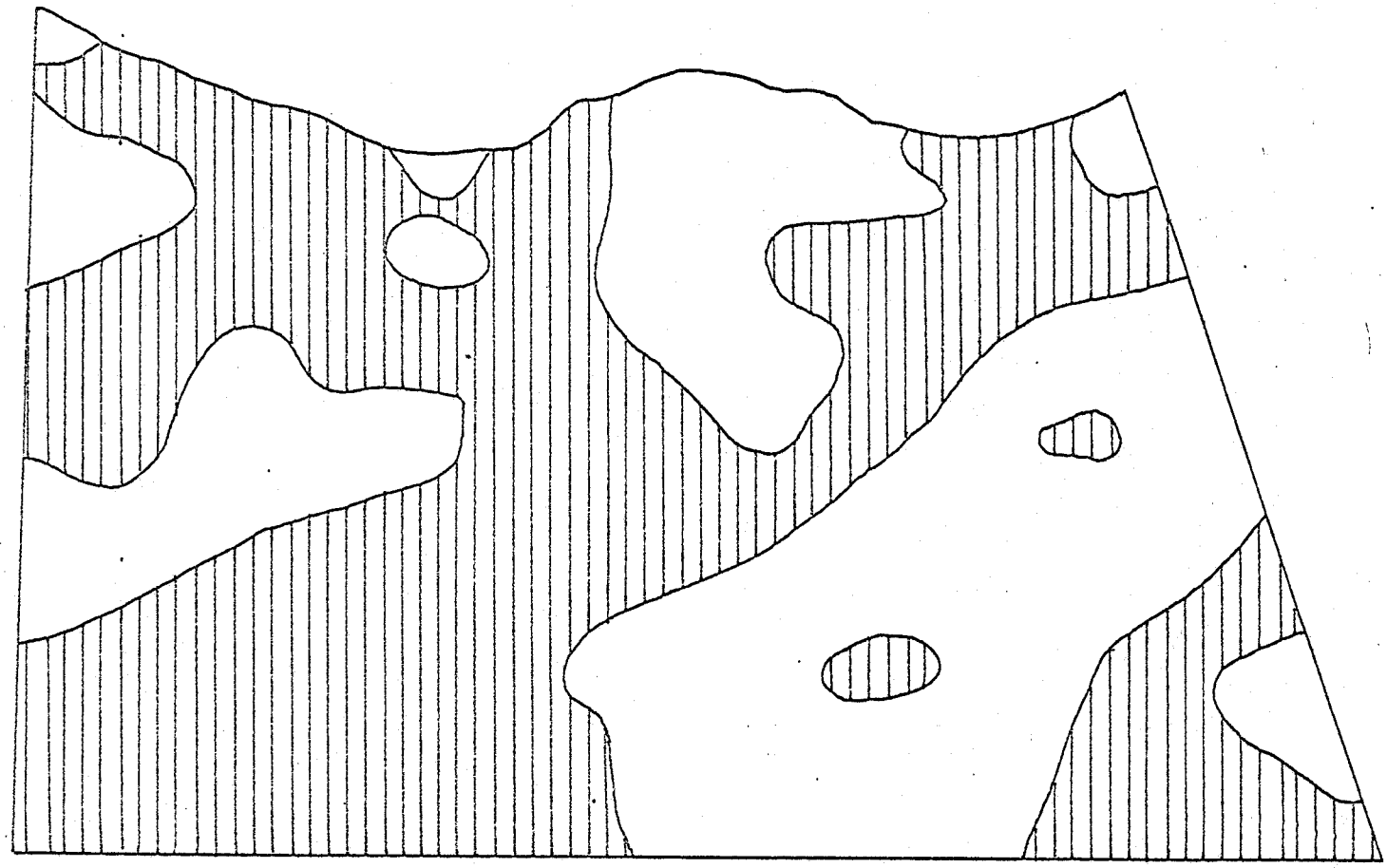
POSITIVE RESIDUAL
NEGATIVE RESIDUAL
NORTH GRIMSBY TOWNSHIP
PERCENTAGE OF UNPAID LABOUR
RESIDUALS FROM THIRD ORDER SURFACE
SCALE: ONE INCH TO ONE MILE

Fig. 15

Under these conditions, Unpaid participation in the operation of the holding would be necessary to reduce operating expenses to a minimum.

5.5 Analysis of Labour Input Structure by Farm-Type

This section will describe the structure of the agricultural labour input in the township at the township, enterprise-type and leading activity scales. Analysis is also conducted of the labour input structure of part-time and full-time holdings at the scales at the township and enterprise-type scales.

1. Township scale.

(a) Age of operator

The average age of farm operators in North Grimsby Township is 51.08 years. Full-time operators, whose average age is 52 years are some four years older than their part-time counterparts.

It is to be expected that as the operator increases in age he is able to accumulate more capital and possibly increase the size of his holding. This would result in a reduced need for off-farm employment to increase the total farm family income.

(b) Total hours worked

The mean total labour input for the township as a whole amounted to 4901 hours per holding in 1961. Larger full-time holdings have an annual mean input of 5858.7 hours in contrast to the part-time input of 3466.0 hours.

(c) Component labour structure

The importance of the family unit in the operation of the holding is evident from the statistics on the structure of the labour

LABOUR STRUCTURE 1961 NORTH GRIMSBY TOWNSHIP TABLE 12.

TOWNSHIP SCALE

VARIABLE	ALL FARMS MEAN	ALL FARMS S/D	FULL TIME MEAN	FULL TIME S/D	PART TIME MEAN	PART TIME S/D
Age of Operator[1]	51.08	38.50	52.93	12.80	48.05	49.11
Total Hours Worked[2]	4901.00	2418.09	5858.71	2598.38	3466.40	3650.45
Percentage of Operators Labour[3]	57.0%	19.21	57.1%	18.1%	58.7%	62.15
Percentage of Unpaid Labour[4]	18.0%	16.08	18.0%	16.3%	19.0%	24.76
Percentage of Family Labour[5]	75.0%	20.15	75.6%	20.2%	77.0%	80.11
Percentage of Hired Labour[6]	24.0%	16.08	24.0%	20.2	19.0%	24.76

[1]Age of the Farm operator in years

[2]Total annual labour input on the farm in 1960

[3]Percentage of the total labour input supplied by the operator.

[4]Percentage of the total labour input supplied by unpaid labour.

[5]Percentage of the total labour input supplied by family labour (sum of 3&4)

[6]Percentage of the total labour input supplied by hired labour.

input. Family labour accounts for some 75% of the total labour input of all farms in the township. The average operator supplies over one-half of the total farm labour input and unpaid labour accounts for the remaining 18%.

Part-time operators tend, on average, to undertake a greater percentage of the total labour input than their full-time counterparts, and employ a lower percentage of Hired labour.

2. Enterprise-type Scale.

Labour characteristics of farm groups at the enterprise-type scale are summarised in Tables 13, 14, and 15.

(a) Age of operator

The average operator on specialised and general holdings is 53 years of age whereas mixed farmers are, on average, ten years younger. Many factors could account for this variation, but it seems probable that this farm group, with its substantially lower mean value of land and buildings, contains a larger proportion of younger operators who have commenced farming operations only recently.

The average age of general farm operators shows the least amount of variation about the mean value, an indication that tenure within this group is more stable.

Full-time operators are, in general, older than their part-time counterparts, except in the case of General holdings where the difference in mean values is not significant. This trend can probably be attributed to the need of the younger part-time operator to earn a larger income to support a growing family and to accummulate capital for investment in the holding.

LABOUR STRUCTURE I96I NORTH GRIMSBY TOWNSHIP TABLE I3.

ENTERPRISE TYPE SCALE - SPECIALISED HOLDINGS

	ALL FARMS		FULL TIME		PART TIME	
VARIABLE	MEAN	S/D	MEAN	S/D	MEAN	S/D
Age of Operator	54.20	II.90	57.I2	II.62	47.54	I2.25
Total Labour Input	4I25.37	II32.50	5I80.97	I254.45	2926.56	I0I4.6I
Percentage of Operators Labour	6I.0%	I7.2%	58.0%	I5.I%	65.2%	I9.2%
Percentage of Unpaid Labour	I7.0%	I6.3%	2I.I%	I4.2%	I4.2%	I6.3%
Percentage of Family Labour	78.0%	I6.7%	79.2%	I7.I%	79.4%	I6.3%
Percentage of Hired Labour	2I.4%	I6.7%	20.7%	I7.I%	20.5%	I6.3%

LABOUR STRUCTURE I96I NORTH GRIMSBY TOWNSHIP TABLE I4.

ENTERPRISE TYPE SCALE - GENERAL HOLDINGS

VARIABLE	ALL FARMS MEAN	ALL FARMS S/D	FULL TIME MEAN	FULL TIME S/D	PART TIME MEAN	PART TIME S/D
Age of Operator	53.06	7.96	53.23	I0.88	52.30	4.95
Total Labour Input	56I6.20	2I38.85	6456.37	3298.74	4025.26	978.92
Percentage of Operators Labour	5I.0%	I6.7%	52.I%	I9.8%	47.6%	I4.6%
Percentage of Unpaid Labour	I7.8%	I6.0%	I8.0%	I7.0%	2I.9%	I4.7%
Percentage of Family Labour	68.9%	2I.I%	70.2%	22.2%	69.5%	20.7%
Percentage of Hired Labour	3I.0%	2I.I%	29.7%	22.2%	30.4%	20.7%

LABOUR STRUCTURE I96I NORTH GRIMSBY TOWNSHIP TABLE I5.

ENTERPRISE TYPE SCALE - MIXED HOLDINGS

VARIABLE	ALL FARMS MEAN	ALL FARMS S/D	FULL TIME MEAN	FULL TIME S/D	PART TIME MEAN	PART TIME S/D
Age of Operator	45.77	I2.69	46.82	I0.49	43.I0	I4.90
Total Labour Input	4652.52	I093.87	629I.II	2707.I3	3483.99	II08.5I
Percentage of Operators Labour	62.6%	I9.8%	54.7%	20.8%	7I.5%	I8.9%
Percentage of Unpaid Labour	I9.9%	I5.4%	I9.3%	I7.0%	I4.6%	I3.9%
Percentage of Family Labour	82.6%	2I.0%	74.0%	24.I%	86.I%	I7.8%
Percentage of Hired Labour	I7.4%	2i.0%	25.9%	24.I%	I3.8%	I7.8%

(b) Total hours worked on the holding

General holdings have the largest mean total labour input requirement with 5616 hrs. per annum. Although these holdings are smaller in terms of mean acreage than Mixed farms, they are more intensive in terms of production. Specialised holdings have the lowest total labour input requirement, but are the most intensive in use of labour due to their small mean acreage.

In all cases, part-time holdings have a lower labour requirement than full-time farms. This may be explained not only by their smaller mean acreage, but also because there is evidence of machinery-labour substitution to reduce the total labour work load.

(c) Component labour structure

The farm operator provides the bulk of the total labour input on specialised and mixed farms, but only 51% on general holdings which are both large in acreage and relatively intensive in production.

The family as a group supply 82% of the total labour input on the less intensive Mixed holdings compared to 78% on specialised farms and 68% on general holdings.

Use of hired labour is greatest on the relatively intensive General farms and of least importance on the extensive Mixed holdings.

The percentage of hired labour employed on specialised holdings is relatively low when it is considered that the majority of these holdings specialised in tree-fruits which require much manual labour for pruning trees and harvesting.

The operator supplies a greater percentage of the total labour input on part-time farms compared to full-time holdings in the same

groups. As might be expected on this type of holding, the family plays a larger rôle in the operation of the holding, although the figure is only statistically significant in the case of the more marginal mixed holdings.

3. Leading Activity Scale.

Tree Fruits

The labour structure of farm holdings, whose dominant activity in terms of labour input is the growth of tree fruits, is shown in Table 16.

(a) Age of operator

The mean age of farm operators on mixed holdings is some seven years less than on similar specialised and general farms. The mixed farming group also show less variation about the mean value.

(b) Total hours worked

The total labour input is greatest on mixed holdings as a result of the diversity of activities and the more extensive nature of the enterprise. There would appear to be less variation about the mean value of total labour inputs for specialised holdings, resulting from the lower level of enterprise diversification within this group.

(c) Component labour structure

The farm operator supplies a larger percentage of the total labour input on specialised holdings than in the other more extensive groups, although there is a marginally greater variation about the mean value within this group. Specialised holdings also show a much higher level of family participation in the operation, resulting in

LABOUR STRUCTURE I96I NORTH GRIMSBY TOWNSHIP TABLE I6.

LEADING ACTIVITY SCALE - TREE FRUIT HOLDINGS

	SPECIALISED		GENERAL		MIXED	
VARIABLE	MEAN	S/D	MEAN	S/D	MEAN	S/D
Age of Operator	53·25	I2:83	54·79	II·06	47·88	I0.28
Total Hours Worked	4220.5I	I6I9.94	5697.I6	3257.64	58I0.25	3I92.52
Percentage of Operators Labour	6I.3I	I7.25	5I.5%	I8.07	53.94	2I.80
Percentage of Hired Labour	I9.8%	I6.I9	30.46	22.27	3I.I%	26.86
Percentage of Unpaid Labour	I8.7%	I6.44	I8.0%	I5.26	I4.9%	I3.45
Percentage of Family Labour	80.I%	I6.I9	69.5%	22.27	68.9%	26.86

the lower mean acreage and total labour requirement of this type of farm.

Component labour structure of General and Mixed holdings is very similar, despite disparities in economic structure.

Cattle

The component labour structure for farm groups with cattle as the major activity is shown in Table 17.

No enterprises within the township could be regarded as specialising in cattle.

(a) Age of operator

Mixed holdings again possessed the lowest mean age of operator, although there was substantially greater variation within this group when compared to the older general farmers.

(b) Total hours worked

Both types of enterprise have similar total labour inputs, although the mean value is marginally greater for General holdings.

(c) Component labour structure

The component labour structure is similar for both farm groups, although there is slightly more variation within the mixed farm group. The percentage of the total labour input supplied by the operator in General holdings is ten percent above the level on the average mixed cattle farm. There are indications that the slightly greater total labour input required on these holdings necessitates substitution of unpaid labour to take care of the extra labour required.

The smaller mixed holdings appear to be predominately family-run enterprises with little reliance on hired labour. Because of

LABOUR STRUCTURE I96I NORTH GRIMSBY TOWNSHIP TABLE I7.

LEADING ACTIVITY SCALE - CATTLE HOLDINGS

	SPECIALISED	GENERAL		MIXED	
VARIABLE		MEAN	S/D	MEAN	S/D
Age of Operator	No Observations	5I.79	4.64	39.36	I2.83
TOtal Hours Worked		4750.I2	I5I7.39	4375.8I	I582.II
Percentage of Operators Labour		56.24	I5.69	66.27	22.80
Percentage of Hired Labour		I6.I%	I0.II	I5.8%	I4.88
Percentage of Unpaid Labour		27.6%	2I.89	I7.9%	I9.62
Percentage of Family Labour		83.8%	I0.II	84.I%	I4.88

LABOUR STRUCTURE I96I NORTH GRIMSBY TOWNSHIP TABLE I8.

LEADING ACTIVITY SCALE - GRAPES

	SPECIALISED	GENERAL		MIXED	
VARIABLE		MEAN	S/D	MEAN	S/D
Age of Operator	No Observations	50.84	6.87	47.I0	I7.35
Total Hours Worked		6I94.I5	3662.58	3484.06	I046.39
Percentage of OPerators Labour		45.5%	23.40	76.8%	9.I6
Percentage of Hired Labour		3I.0%	2I.54	5.5I	4.89
Percentage of Unpaid Labour		23.3%	I4.52	I7.58	I3.30
Percentage of Family Labour		68.9%	2I.54	94.4%	4.89

their smaller size, the operator is able to play a much larger rôle in the operation of the mixed farm unit than on general holdings where hired labour accounts for nearly one-third of the total labour input requirement.

A greater range about the mean values of labour components occurs in the general holdings, possibly because their monthly labour input pattern would show greater variations, depending on the enterprise combination employed, than the more diverse mixed farms.

Grapes

The labour input structure of farm-groups with grapes as the leading activity is shown in Table 18. No farm groups in the township could be regarded as specialising in the production of grapes.

(a) Age of operator

In accordance with the trend in the township, the mean age of farm operators on mixed farms is lower and shows more variation than the mean age of general farm operators.

(b) Total hours worked

General holdings, with their greater mean acreage of this labour intensive crop possess a substantially larger mean total labour input than mixed farms.

(c) Component labour structure

Mixed farm groups appear to consist predominantly of family-farm units, as evidenced by the high percentage of family labour. General holdings, with their higher labour input requirement make extensive use of hired labour.

5.6 Summary

This chapter has outlined the labour structure of farm enterprise types in North Grimsby township. The distinction is made between the various component labour types, operator's labour, hired labour and unpaid labour, and their characteristics are discussed.

General trends and local variations in the spatial distribution of these component labour types are examined by means of trend surface analysis. The third order trend surface indicated increased operator participation in areas dominated by mixed holdings and tree-fruit farms. Positive residuals are found in specialised tree-fruit and mixed cattle areas. Percentage of paid labour is greatest on the General holdings in the township and positive residuals are found in the area of General holdings on the lighter soils in the township, indicating an even higher Paid labour requirement.

Unpaid labour is highest in the mixed and general tree-fruit zones, and positive residuals of the fitted surface indicate an even greater proportion of unpaid labour on the poorer clay soils and around the town of Grimsby as a result of part-time farming in zones of urban encroachment.

Labour structure is examined in some detail by farm type at the township, enterprise-type and leading crop/activity scale.

Mixed holdings are shown to have the lowest mean age of operator and highest level of family participation.

Specialised holdings have a relatively low total labour input requirement when compared to other types of enterprise, but are intensive in their use of labour since the labour input requirement is

high in comparison with the mean acreage. The family supplies 78% of total labour compared with 82% on mixed holdings.

General holdings are more intensive in their use of the labour input than mixed holdings and consequently a higher proportion of hired labour is used on these farms.

CHAPTER VI

DETERMINATION OF THE RELATIVE EFFICIENCY OF THE AGRICULTURAL LABOUR INPUT IN NORTH GRIMSBY TOWNSHIP 1961

The purpose of this chapter is to outline the method used to determine the relative efficiency of the agricultural labour inputs of farm-firms in North Grimsby Township. The method of labour input efficiency determination is discussed; together with the derivation of the Standard Labour Input factors used in the analysis.

6.1 Methods of Determining the Relative Efficiency of Agricultural Labour Inputs

Several methods are in current use by farm management consultants for the assessment of the relative efficiency of labour inputs. These have been reviewed briefly in a previous section. The method chosen for use in this study is the technique described by Nix[1] and utilised by Guither[2] in his study of part-time and full-time farmers in Illinois. The method, known as the Labour Efficiency Index, compares present labour input allocation to the standard labour inputs that should be used on a holding of that size and type. Although many criticisms have been made of this method, it remains perhaps the most useful for an initial investigation of labour input efficiency,[3]

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[1]Nix, J., "Labour Organization on the Farm", Agriculture, 75 (1968), p. 59.

[2]Guither, H.D., "Factors Influencing Farm Operator's Decisions to Leave Farming", Journal of Farm Economics, 45, (1963), p. 567.

[3]Nix, J., Op. cit., p. 60.

provided that the results are properly interpreted. It must be remembered that this type analysis is based on the use of average factors and consequently the results can only be viewed in general terms.

The method is used extensively in farm management planning in many parts of the world, although it is being replaced by such techniques as the Gang Work Index in the United Kingdom.[4] The latter is of more practical value to the farm operator since it deals in terms of specific numbers of men employed on specific tasks for specific periods at different times of the year, rather than dividing the labour input into man-hours.

6.2 Derivation of Individual Activity Factors

The usefulness of a study of this nature depends upon the validity of the conversion factors used to determine the optimum labour input, under local conditions, for that type of holding. It is proposed, therefore, to describe in some detail the calculation of factor levels used in this study and comment upon their relative accuracy.

Component activities for which factors were required are shown in Table 2 together with the relevant groupings from the Census of Agriculture.

6.3 Derivation of Activity Factor Levels

Initially, use was made of averaged Standard Labour Factors for each activity group, obtained by grouping the activities from

[4] Nix, J., Op. cit., p. 60.

the Census of Agriculture questionnaire. However, this practice substantially reduced the man-hours factors for some activity groups. An average factor for cattle was 54 Standard Man-Hours per head per year whereas the figure for dairy cattle should approximate 94 Standard Man-Hours per head per year.[5] The resulting Labour Efficiency Index reflected the fact that Standard Man-Hours factors produced in this manner were unrealistic.

It was decided, therefore, for the purposes of the present study, to utilise the maximum man-hours factor for each enterprise-group. In most cases, where one factor was required, or where the activity grouping coincided with the factor grouping, the choice of a factor level did not influence the result. An element of error has been introduced where there is a considerable difference in the Standard Man-Hour factors of the component activities. An example may be drawn from the case of the factor group cattle. The Standard Man-Hour factor for dairy cattle is 94 Standard Man-Hours per head, per year, whereas the factors for beef cattle range from 8 Standard Man-Hours per head, per year, to over 30 Standard Man-Hours per head, per year. Thus in the case of a dairy farm, the factor used is relatively accurate, but beef enterprise labour inputs have been over-assessed.

Results computed with the higher level factors proved to be more realistic than those computed using average input factor levels, and this fact, coupled with the small number of groups affected by

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[5]Ontario Department of Agriculture, Farm Business Management Handbook for Extension Workers, (Toronto: Ontario Department of Agriculture, 1966)

over-weighting, justified the use of the higher factors in the present study.

1. Crop and Livestock Factors

The purpose of this section is to describe and explain the derivation of individual crop and livestock labour input factors utilised in the study.

(a) Grain Crops

The factor for grain crops was obtained by utilising the factor for grain corn, of 8.5 Standard Man-Hours per acre. The grain corn factor was obtained from studies in Ontario[6] during the period 1958 to 1960. The figure taken was the average figure, and not the high, since the latter would represent only a small sample of provincial farms.

(b) Hay Crops

The standard factor for hay crops, which the Census of Agriculture defines to include silage corn, tame hay, alfalfa, and oats was obtained by taking the figure for silage corn, 9.6 Standard Man-Hours per acre given by the Ontario Department of Agriculture Handbook.[7] The factor was derived from a study in Western Ontario during the period 1957 to 1959.

(c) Potatoes and Roots

The factor for potatoes and root crops utilised was that for potatoes of 51.2 Standard Man-Hours per acre. The factor was derived

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[6]Ontario Department of Agriculture, op. cit., p. 110-821.

[7]Ontario Department of Agriculture, op. cit., p. 120-821.

from studies carried out in New Brunswick in 1959,[8] and adjusted to suit Ontario conditions.

(d) Strawberries

The factor for strawberries, 759.0 Standard Man-Hours per acre is derived from studies carried out by the Farm Economics, Co-operatives and Statistics Branch of the Ontario Department of Agriculture,[9] during 1951 and 1953.

(e) Raspberries

The standard labour factor for raspberries used was 476.0 Standard Man-Hours per acre. The factor was obtained from an Ontario study conducted during the period 1951 to 1953.[10]

(f) Grapes

The factor for grapes was obtained from a survey in the Niagara Peninsula during 1965 and 1966.[11] The factor used was 91.0 Standard Man-Hours per acre.

(g) Tree Fruits

One factor was chosen for tree fruits. The largest labour factor is that for cherries of 270 Standard Man-Hours per acre,[12] whereas the lowest is pears with 158 Standard Man-Hours per acre. It was decided in this case alone to use an average factor of 206 Standard Man-Hours per acre.

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[8] Ontario Department of Agriculture, op. cit., p. 161-821.

[9] Ontario Department of Agriculture, op. cit., p. 230-821.

[10] Ontario Department of Agriculture, op. cit., p. 230-821.

[11] Ontario Department of Agriculture, op. cit., p. 200-821.

[12] Ontario Department of Agriculture, op. cit., p. 200-822.

(h) Cattle

In the choice of factors for cattle, several problems had to be faced, most of them arising from the variety of enterprise types involving livestock, each with a separate Standard Labour Input factor. The main difficulty faced was the variation in labour requirement between a beef and a dairy enterprise. If the average of two Standard Labour factors was taken it would be too high for beef, but too low for dairy cattle. Since the majority of cattle in the township are associated with dairy enterprises, it was decided to utilise the dairy standard factor of 92 hours per head per year.

The source for this factor was the Farm Budget Reference Manual of the United States Department of Agriculture, adapted to suit Ontario conditions by the Ontario Department of Agriculture.[13]

(i) Vegetables

The factor for Vegetable crops was derived from studies undertaken by the Ontario Department of Agriculture in various areas of the Province.

6.5 The Labour Efficiency Index

Once standard labour requirements had been calculated for the farm groups in the township, the Labour Efficiency Index was computed by dividing the 1961 Labour input allocation by the group's Standard Labour Requirement expressed in Standard Man-Hours:

$$\text{Labour Efficiency Index} = \frac{\text{Total hours worked on the holding in 1961}}{\text{Sum of Standard Labour Input factors for the holding}}$$

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[13] Ontario Department of Agriculture, op. cit., p. 823.

Optimum labour allocation produced an index of 1.00. Holdings characterised by under-employment have indices greater than 1.00, and holdings overemployed less than 1.00

Assumptions

The calculation of the Labour Efficiency Index in the manner described above involved the use of several limiting assumptions.

(1) All labour inputs, regardless of type of supplier, are assumed to be homogeneous.

(2) Standard Labour Input factors are assumed to be realistic in terms of the conditions existing in the area.

(3) Production methods are assumed to be similar on all farm groups in the study area.

(4) Output per acre will be uniform under standard conditions on all farms in the study area.

6.6 Spatial Analysis of Labour Efficiency

The spatial distribution of Labour Efficiency Indices for farm groups in North Grimsby Township is shown in Figure 16.

An attempt was made to determine regional and local trends in the Labour Efficiency Index by means of trend surface analysis of degrees one through three, but no surface significant at the 5% level could be fitted. The indications are that at this scale of analysis, spatial variations in Labour Efficiency Indices are complex.

Despite the inability to fit a surface to the data, spatial analysis of general trends was possible. This was accomplished by sorting farm groups into holdings that:

NORTH GRIMSBY TOWNSHIP

LABOUR EFFICIENCY INDEX

SCALE : ONE INCH TO ONE MILE

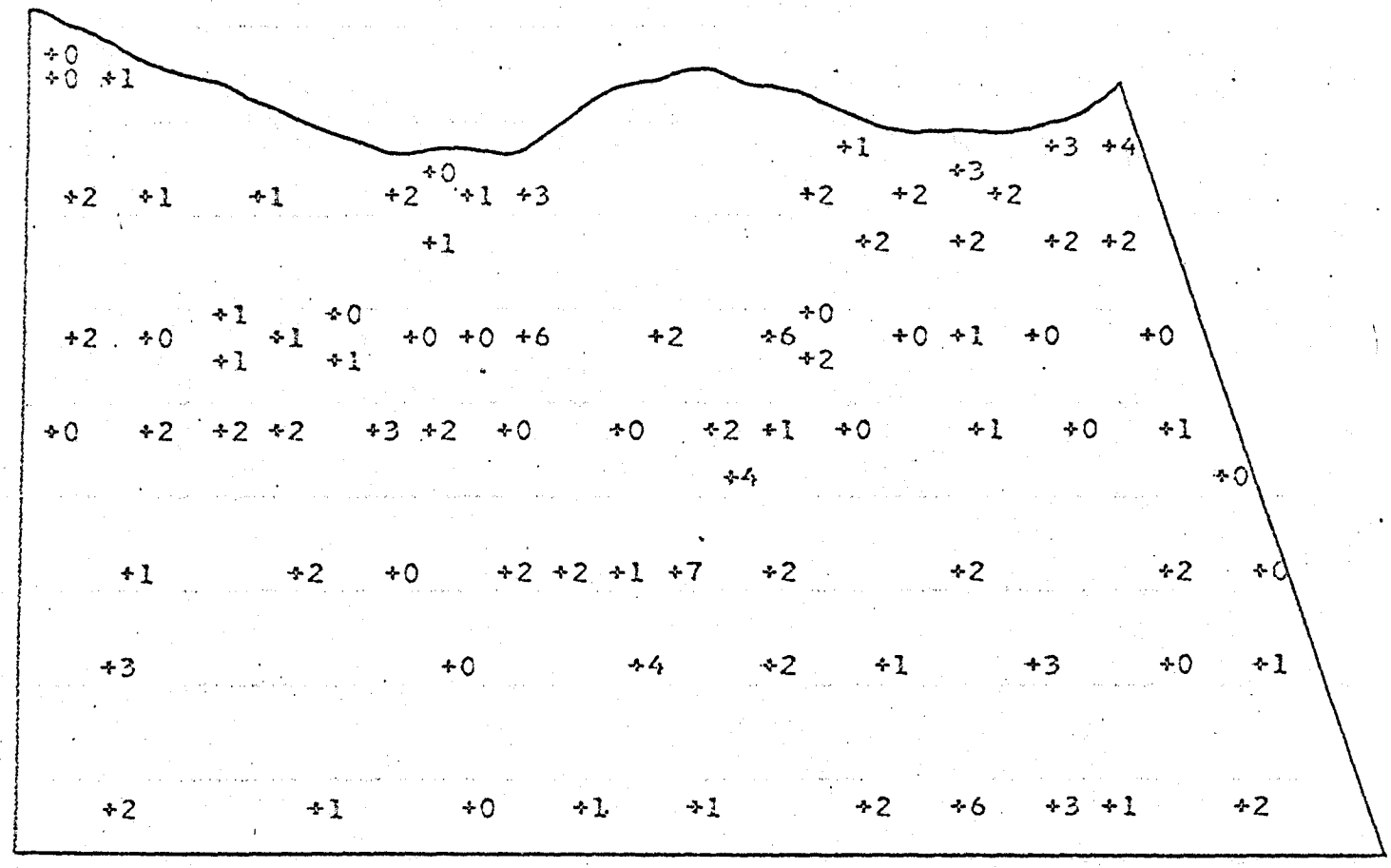

Fig. 16

(a) appear to be relatively efficient in their use of the labour input.

(b) show signs of under-employment of the labour input.

(c) show signs of over-employment of the labour input.

The definition of under-employment utilised in this study is that adopted by Guither[14] in his study of farm operations in Illinois.

Guither regarded as underemployed, farms whose labour input showed a level of employment less than 30%. Converting this level for use with the Labour Efficiency Index, underemployment may be defined as holdings whose Labour Efficiency Index exceeds 1.20.

No examination is made by Guither of the problem of over-employment. It was therefore decided to adopt a similar margin as that defined for underemployment. Hence farm groups with Labour Efficiency Indices less than 0.8 are regarded as overemployed? It could be argued that farms with Labour Efficiency Indices lower than this limit are merely more efficient in their use of the labour input. The limit as defined above will most likely include some of these superefficient holdings, but will also include holdings where an attempt is being made to operate an enterprise with a labour input that is too low in comparison to normal requirements, with a resultant loss of production.

The distribution of overemployed and underemployed holdings in the township is shown in Figure 17.

Underemployment seems to be the general trend in the township, especially to the south of the Niagara escarpment in the area

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[14] Guither, R.D., op. cit., p. 567.

FARM GROUPS OVEREMPLOYED

FARM GROUPS UNDEREMPLOYED

FARM GROUPS WITH AN L.E.I. OF 0.80 TO 1.20

NORTH GRIMSBY TOWNSHIP

UNDEREMPLOYMENT AND OVEREMPLOYMENT 1961

SCALE : ONE INCH TO ONE MILE

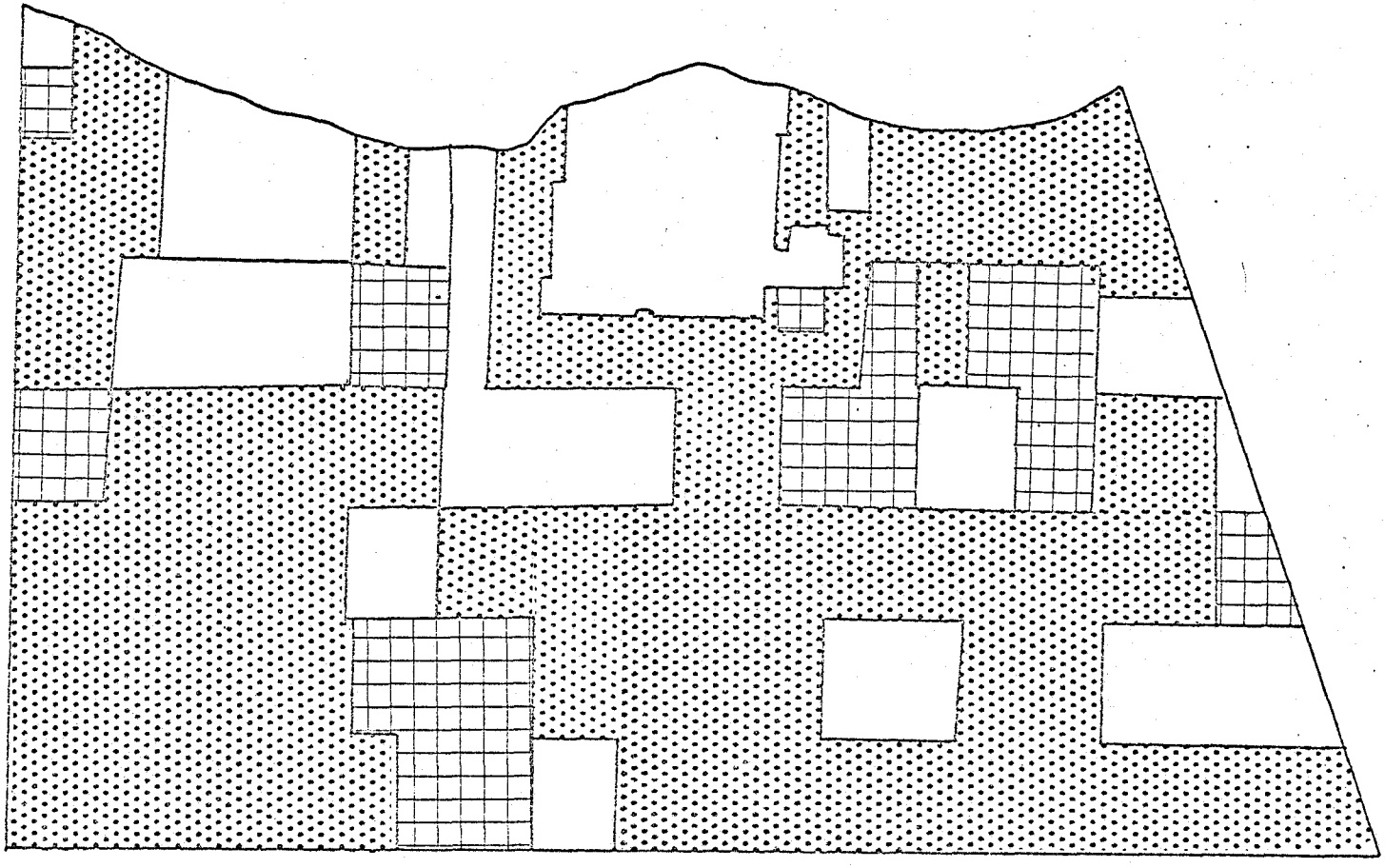

Fig. 17

of General and Mixed farming. Fifty-five percent of the 94 groups in the township are underemployed. This compares with forty-five percent of the sample of holdings examined by Guither in Illinois. The majority of Guither's underemployed holdings were grain farms where overemployment could be attributed to lack of agricultural activity in the winter months. The seasonal employment pattern is even more marked in North Grimsby Township with the high proportion of tree-fruit farms, coupled with the low mean acreage of holdings.

Holdings showing characteristics of overemployment are widely scattered in the township, but generally coincide with areas of General holdings. Overemployment is present on 12 farm groups representing twelve percent of the holdings in the township.

Farm groups with an optimum labour input are concentrated in areas where General holdings predominate, especially in the General Tree Fruit holdings situated on the heavier soils of the Lake Ontario plain, west of the town of Grimsby.

6.7 Analysis of Labour Efficiency by Farm Type

1. Township and Enterprise - Type Scale

Labour Efficiency Indices for farm groups at the township and enterprise-type scales are shown in Table 19.

The mean Labour Efficiency Index for all farms examined in the township was 1.81. This would indicate that a majority of farm holdings in the township are underemployed in terms of their total labour input, although the standard deviation of 1.40 indicates considerable variation exists.

TABLE I9.

NORTH GRIMSBY TOWNSHIP AGRICULTURAL LABOUR EFFICIENCY INDEX AT THE TOWNSHIP AND ENTERPRISE TYPE SCALES.

		Mean	S/D
TOWNSHIP	All Farms	I.8I	I.40
	Full time	I.88	I.55
	Part time	I.68	I.07
SPECIALISED	All Farms	I.72	I.I7
HOLDINGS	Full time	I.69	0.86
	Part time	I.76	I.54
GENERAL	All Farms	I.59	I.02
HOLDINGS	Full time	I.59	I.04
	Part time	I.55	I.00
MIXED	All Farms	2.30	2.07
HOLDINGS	Full time	2.83	3.00
	Part time	2.03	I.I8

It would appear from Table 19 that part-time holdings are more efficient in their use of the labour input than full-time holdings. Part-time farms also show less variation about the mean. This would seem to suggest that the part-time operator is more conscious of the need for efficient labour organisation although it must be remembered that the Census of Agriculture uses a minimum age limit when recording details of labour inputs on a farm, and the apparent efficiency of part-time holdings could be due in part to an under-estimation of the labour input by the Census.

At the enterprise-type scale, General holdings tended to have a lower Labour Efficiency Index and less overall variation than the more labour intensive specialised holdings. The mixed holding group, which were the most extensive in terms of acreage of farm groups in the township have the highest Labour Efficiency Index and variation about the mean value of any farm group in the township.

Part-time holdings, with their relatively lower labour input requirement and higher level of investment in machinery, possess lower mean Labour Efficiency Indices than full-time holdings in the General and Mixed farm group, and show less variation about the mean value. The exception to this trend are full-time specialised holdings, where part-time farms appear relatively less efficient and show considerable variation within the group in comparison with full-time farms.

2. Leading Activity Scale

Labour Efficiency Indices for farm groups at the Leading Activity scale are shown in Table 20.

TABLE 20.

NORTH GRIMSBY TOWNSHIP AGRICULTURAL LABOUR EFFICIENCY INDEX AT THE LEADING ACTIVITY SCALE.

		Mean	S/D
TREE FRUITS	Specialised	I.75	I.I8
(All Farms)	General	I.37	0.48
	Mixed	I.08	0.48
CATTLE	General	2.08	I.7I
(All Farms)	Mixed	2.45	I.82
GRAPES	General	2.2I	I.03
(All Farms)	Mixed	3.90	2.83

The lowest values of the Labour Efficiency Index at this scale are found in farm groups with tree fruits as the Leading Activity. In this group it is the more diversified enterprise types which show the lowest mean value of the Labour Efficiency Index and the smallest amount of variation within the group.

In the case of enterprises dominated by cattle and grapes, it is the less diversified holding groups which possess the lowest mean value for the Labour Efficiency Index and show less variation about the mean value.

CHAPTER VII

FACTORS INFLUENCING LABOUR EFFICIENCY

Previous sections have described the agricultural labour input structure in North Grimsby in 1961, at the township, enterprise-type, and leading activity scales. An attempt has been made to determine the relative efficiency of the labour input by the construction of an Index of Labour Efficiency. The purpose of this chapter is to generate and test hypothesised relationships between certain selected elements of farm structure, the physical basis of agricultural activities, and the labour efficiency index.

7.1 Definition of variables and statement of hypotheses.

The variables examined in this analysis are those elements of the physical environment, of the farm and labour input structure which are thought to be related to the Labour Efficiency Index. It is thought that these factors will influence the Labour Efficiency Index in one of two ways:

(1) by influencing the quality of the labour input

(2) by influencing the effectiveness of the labour input in the farm firm.

(1) Factors which may influence the quality of the labour input.

Age of operator (x_1)

As a farm operator becomes older, his capacity to perform a given unit of work decreases. It is expected that this will result

in an increasing length of time being taken over a particular task. The operator's functioning as an entrepreneur may also be adversely affected with a resultant influence on the utilisation of other input factors. It has been demonstrated that the operator supplies a large percentage of the total labour input on many of the holdings in the township, and consequently it is hypothesized that as the age of operator increases the Labour Efficiency Index will increase, i.e., the relative efficiency of labour input utilisation will decline.

Percentage of Total Labour Input Supplied by the Farm Operator (x_2)

This variable is a measure of the participation of the operator in the operation of the farm holding and thus indirectly could be construed as a measure of farm size. A high level of operator participation could indicate overworking of this labour input component. It is proposed that an increased operator participation will result in an increase in the Labour Efficiency Index.

Percentage of Total Labour Input Supplied by Unpaid Labour (x_3)

Unpaid labour is by definition part of the operator's family. As such, wide ranges in capacity and motivation towards work can result. In addition, much of this labour could be engaged in activities other than farm work for a greater part of the day, and undertake farm work as a part-time activity. A result of this can be the fragmentation of individual operations with a consequent waste of the labour input.

It is therefore proposed that as the unpaid labour input increases, so the Labour Efficiency Index will increase.

Percentage of Family Labour Employed on the Holding (x_4)

Family labour is defined as the combination of variables x_2 and x_3. It is included to investigate the overall influence of the family farm on the Labour Efficiency Index. As has been indicated for x_2 and x_3 above, an increasing level of family participation will result in an increasing Labour Efficiency Index.

Percentage of Hired Labour Employed on the Holding (x_5)

This input may be expected to be more efficient in the performance of a given task than unpaid labour, by reason of its direct economic motivation and less variation in capacity to perform a work. Hired labour is usually able to perform a given series of tasks without the fragmentation problems experienced by the unpaid labour input. It is therefore proposed that as the percentage of hired labour employed on the holding increases, so the Labour Efficiency Index will decrease.

(2) Factors influencing the effectiveness of a given labour input.

The second group of variables influence the effectiveness with which a given unit of labour may be employed on the farm. The group may be divided into (1) elements of farm structure including aspects of farm size, the level of mechanisation and the diversity of the farm firm and (2) elements of the physical environment in which the farm firm is situated and over which the entrepreneur has little or no direct control.

(1) Elements of farm structure

Direct Measures of Farm Size

The size of a holding is important in any consideration of

labour efficiency.[1] Many enterprises were originally set up under economic and technical conditions which no longer apply today. The result is that these holdings are often too small to utilise modern day techniques to maximum efficiency, with the result that efficiency of input use may be reduced. Two direct measures of farm size are considered.

Mean Acreage (x_6)

The first is the acreage (x_6) which is a physical measure of the extent of the land input. It is proposed that as the land input increases so the use of more efficient machinery becomes possible, with a resultant decrease in the Labour Efficiency Index.

Value of Capitalization (x_7)

The other measure of farm size is the value of capitalization in the form of land, buildings, and machinery, and the best measure of the scale of the enterprise. It is hypothesized that as the value of capitalization increases, the operator is better able to take advantage of the economies of scale, with a consequent decrease in the Labour Efficiency Index.

Mechanization

The level of mechanization is a direct influence on the relative efficiency of the labour input. Two measures of the level of mechanization are used.

Machinery/Labour Ratio (x_8)

The first variable is the value of machinery - value of annual

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[1] Heady, E.O. and Jensen, H., Farm Management Economics (New York: Prentice-Hall, 1954), p. 400.

labour input ratio, and is a measure of the substitution of machinery for the labour input on the holding. According to Heady and Jensen,[2] one method of increasing the efficiency of labour use on the farm is to substitute machinery for labour. It is therefore proposed that as the machinery/labour ratio increases, the Labour Efficiency Index will decrease.

Machinery/Capital Ratio (x_9)

The second measure of the level of mechanization is the ratio of the value of machinery to the total value of land, buildings, and machinery. This can be regarded as a measure of the level of mechanization in comparison to the scale of the enterprise.

It is hypothesised that the greater the level of investment in machinery compared to total investment, the lower will be the value of the Labour Efficiency Index.

Diversity Index (x_{10})

The final economic factor examined is the diversity of production undertaken on the holding. The more diverse forms of operation utilise the labour input more efficiently on an annual basis than does a holding with a concentrated peak labour demand. It is therefore proposed that the Labour Efficiency Index will decline as the value of the Diversity Index increases. The Index of Diversity is a series of discrete numerals of 1,.....14 calculated in the manner used by Weaver[3] in his analysis of crop combinations in the U.S. mid-west. The derivation of the index has been described in a previous section.

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[2]Heady, E.O., and Jensen, H., Op. cit., pp. 450-451.

[3]Weaver, J.C.,"Crop Combinations in the Middle West", Geographic Review, XLIV, 2 (1954), p. 175-200.

(2) Physical Environment: Soils and Climate

> "I drown in the drumming ploughland, I drag up
> Heel after heel from the swallowing of earth's mouth,
> from clay that clutches my each step to the ankle
> with the habit of dogged grave."
>
> Ted Hughes "The Hawk in the Rain".[4]

Climatic factors and weather conditions affect the date and speed of farm operations. They are the factors which determine the dates or days upon which it is possible to sow or harvest, to hoe or spray. Climatic factors and weather also affect the state of the crop, the ability of a machine to work on a crop and the workability (trafficability and cultivability) of the soil. It may therefore be expected that climate, meteorology and soils have considerable influence on the effectiveness of a given labour input.

Lack of sufficient detailed information prevented the inclusion of any climatic or meteorological variables in the analysis. It must be assumed for the purposes of this study that homogeneous climatic and meteorological conditions exist in all parts of the township. This assumption is not strictly valid, since variations do occur in climate and weather conditions between the Lake Ontario Plain and the area to the south of the escarpment. However, this limitation has been partially overcome by using soil drainage characteristics as a variable.

Soils

The importance of soil workability (trafficability and cultivability) as a factor in the relative efficiency of farm opera-

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[4]Hughes, T., The Hawk in the Rain, (London: Faber, 1957)

tions has been emphasised by Morris.[5] Duckham[6] has indicated that soil workability is closely associated with the moisture status of the soil. Since homogeneous climatic conditions have been assumed in the study area, it is to be expected that an association will exist between soil drainage characteristics and the effectiveness of the labour input expressed in terms of the Labour Efficiency Index.

(1) Soil Drainage

Soil types in the township were divided into the four drainage classes proposed by Wicklund and Matthews.[7] The drainage classes and their component soil types are reproduced in Table 21. The drainage class shown for each soil type is made for the soils under present drainage conditions. The installation of drains would, in the case of many of the clay soils, considerably improve their drainage and hence crop yields. The following relationships between variables and the Labour Efficiency Index are proposed.

Percentage of soils with Good (x_{11}) and Moderate to Good (x_{12}) Drainage.

Well drained soils dry out faster after the spring thaw or periods of heavy precipitation and tend to be easier to cultivate and possess a higher level of trafficability than less well-drained soils. It is therefore hypothesized that a negative relationship will exist between the Labour Efficiency Index and the percentage of soils in the Good (x_{11}) and Moderate to Good (x_{12}) category.

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[5] Morris, S.T., "Tractor operating costs on a sample of farms in South-West England". Rep. 121, Dept. Agric. Econ. University of Bristol, 1961.

[6] Duckham, A.N., "The Farming Year", (London: Chatto and Windus, 1963), p. 186.

[7] Wicklund, R.E., and Matthews, B.C., 1963. "The Soil Survey of Lincoln County", Report No. 34 of the Ontario Soil Survey. (Ottawa: Canada Department of Agriculture).

TABLE 2I.

SOIL DRAINAGE CLASSES

(1) GOOD

Grimsby Sandy Loam

Grimsby Fine Sandy Loam

(2) MODERATE TO GOOD

Oneida Loam

Smithville Loam

Smithville Silt Loam

Smithville Silty Clay Loam

(3) IMPERFECT

Chinguacousy Clay Loam

Haldimand Clay Loam

Haldimand Silty Clay Loam

Haldimand Silt Loam

Trafalgar Silty Clay Loam

Vineland Sandy Loam

Vineland Fine Sandy Loam

Winona Sandy Loam

Winona Fine Sandy Loam

Farmington Clay Loam

(4) POOR

Jeddo Clay Loam

Jeddo Stony Loam

Lincoln Clay

Morley Silty Clay Loam

Percentage of soils with Imperfect (x_{13}) and Poor (x_{14}) Drainage Characteristics.

Poor soil drainage delays farming operations by making the soil more difficult to cultivate. It is therefore proposed that a positive relationship will exist between the percentage of poorly drained soils and the Labour Efficiency Index.

(2) Soil texture

In addition to the testing of the hypothesized relationships between soil drainage characteristics and the Labour Efficiency Index, it was decided to supplement the soil drainage tests with an analysis of the influence of soil texture on the L.E.I. Soil types were divided into eight textural classes based on the official classification of soil texture of the United States Department of Agriculture. The textural groups and their component soil types are shown in Table 22. Analysis of the textural classes was performed in a slightly different manner than that adopted for farm structure and soil drainage. The complexity of the textural groupings and the wide variations in farm enterprise types in the township prevented the formulation of specific hypothesized relationships. The variables were tested for significant association with the Labour Efficiency Index with no prior assumption of the form or existence of any type of relationship and the results used to supplement the analysis of the influence of soil drainage conditions.

7.2 Method of Analysis.

The Pearson Product-moment Correlation Coefficient (r) was used to test the hypotheses at each scale of analysis. The statistic

TABLE 22.

SOIL TEXTURE CLASSES

STONY LOAMS (9)

Jeddo Stony Loam

SANDY LOAMS (10)

Grimsby Sandy Loam

Vineland Sandy Loam

Winona Sandy Loam

FINE SANDY LOAMS (11)

Grimsby Fine Sandy Loam

Vineland Fine Sandy Loam

Winona Fine Sandy Loam

LOAMS (13)

Oneida Loam

Smithville Loam

SILT LOAM (14)

Haldimand Silt Loam

Smithville Silt Loam

SILTY CLAY LOAMS (17)

Haldimand Silty Clay Loam

Smithville Silty Clay Loam

Trafalgar Silty Clay Loam

Morley Silty Clay Loam

TABLE 22. Contd.

CLAY LOAM (I8)

Chinguacousy Clay Loam

Jeddo Clay Loam

Haldimand Clay Loam

Farmington Clay Loam

CLAY (2I)

Lincoln Clay

is the most widely used measure of the strength of a linear relationship between two variables.[8]

It can be argued that non-linear relationships are as probable as linear ones, for some of the variables defined, but, as Found[9] stated in his analysis of the relationship of certain elements of farm structure to output per unit area, the proposal of more rigorous mathematical relationships is impossible because of insufficient theoretical knowledge.

Freund[10] has pointed out that:

> "Linear relationships are important not only because there exist many relationships that are actually of this form but also because they often provide close approximations (at least within a given range of interest) to relationships which would otherwise be difficult to describe in mathematical terms."

The measure is purely statistical in that no assumptions are made that variable x controls variable y. According to Krumbein and Greybill:[11]

> "Any such interpretation is purely substantive and must be evaluated in terms of the problem at hand".

The Product Moment Correlation Coefficient

The formula used in calculating the Product-moment correlation coefficient is given below:

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[8] Freund, J.E., Modern Elementary Statistics

[9] Found, W.C., "A Multivariate Analysis of Farm Output in Selected Land-Reform Areas of Jamaica", Canadian Geographer, XII 1, (1968), p. 45.

[10] Freund, J.E., Op. cit., p. 332.

[11] Krumbein, W.C., and Greybill, F.A., Statistical Models in Geology, (New York: McGraw-Hill, 1965), p. 238.

$$r = \frac{n(xy) - (x).(y)}{\sqrt{n(x^2)-(x^2)^2}\ \sqrt{n(y^2)-(y)^2}}$$

x and y are the two variables

n is the number of observations

The statistic r indicates the goodness of fit of a line fitted by the method of least squares. In turn, this indicates the existence of a linear relationship between x and y. If r is close to 0.0, the fit is poor, whereas a value of $\pm$ 1.0 is indicative of a strong positive (+) or negative (-) linear relationship.

Significance of the Correlation Coefficient

The significance of the correlation coefficient is evaluated by means of the t distribution, using the formula:

$$t = \frac{r.\sqrt{n-2}}{1-r^2}$$

Where n = number of pairs of data studied, and where the degrees of freedom are (n-2). The test assumes that the population from which the sample is taken is normally distributed.

Assumptions

The use of the product-moment correlation coefficient involves the making certain assumptions[12] about the population from which the observations are drawn.

Firstly, it is assumed that the relationship between two variables is linear. This point has been examined in a previous section. Using a linear approximation to a function that is not

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[12]Sterling, T.D., and Pollack, S.V., Introduction to Statistical Data Processing, (Englewood Cliffs, N.J.: Prentice-Hall Inc., 1968)p, 414.

linear will result in errors of estimate that will be increasingly larger in relation to the degree with which the true function departs from a straight line. One result of this is that the correlation coefficient is usually an underestimate of the true correlation that holds between two variables, rather than an overestimate.

The second assumption made is that the distribution of each variable is normal and that their joint distribution is normal. In the case of the distribution of the variables used in this analysis, many of the distributions were found to approximate the normal. Variables whose distribution was not approximately normal were transformed. The transformation used for each variable is indicated in the table of results.

7.3 Results of the Analysis.

The hypotheses outlined in the previous section were tested at the township, enterprise type and leading activity scales. Testing of the hypotheses on full-time and part-time holdings at the latter scale was not possible because of lack of sufficient observations.

The correlation coefficients and names of variables found significantly associated with the Labour Efficiency Index at each level of analysis are listed in Tables 23 to 26.

It is evident from the results that neither one nor all the hypotheses are upheld at all levels of analysis. Each particular level of analysis appears unique with respect to the relationships between the Labour Efficiency Index and the various independent variables. It would appear therefore that the existence of the

TABLE 23.

FACTORS ASSOCIATED WITH THE LABOUR EFFICIENCY INDEX - TOWNSHIP SCALE

ALL FARMS

Number of Observations 94 Significance at the 0.05 Level : $\pm$ 0.205

FACTOR	r	r^2
Percentage of Family Labour (sqrt)	0.396	I5.7%
Percentage of Unpaid Labour (log)	0.368	I3.5%
Total Capital Value (log)	- 0.422	I7.8%
Percentage of Hired Labour (log)	- 0.396	I5.7%
Machinery / Labour Ratio	- 0.264	7.0%

FULL TIME FARMS

Number of Observations 39 Significance at the 0.05 Level $\pm$ 0.325

FACTOR	r	r^2
Percentage of Family Labour (sqrt)	0.430	I8.5%
Percentage of Unpaid Labour (log)	0.427	I8.2%
Total Capital Value (log)	-0.475	22.6%
Machinery / Labour Ratio	-0.454	20.6%
Percentage of Hired Labour (log)	-0.430	I8.5%

PART TIME FARMS

Number of Observations 55 Significance at the 0.05 Level $\pm$ 0.273

FACTOR	r	r^2
Percentage of Family Labour (sqrt)	0.390	I5.4%
Percentage of Unpaid Labour (log)	0.344	II.8%
Total Capital Value (log)	-0.440	I9.2%
Percentage of Hired Labour (log)	-0.390	I5.4%

TABLE 24.

FACTORS ASSOCIATED WITH THE LABOUR EFFICIENCY INDEX -ENTERPRISE TYPE SCALE SPECIALISED HOLDINGS

ALL FARMS

Number of Obsrevations : 34 Significance at the 0.05 level : $\pm$ 0.370

FACTOR	r	r^2
Size of Farmiin Acres	— 0.542	29.4%
Total Capital Value	— 0.477	22.8%

FULL TIME FARMS

Number of Observations : 20 Significance at the 0.05 level: $\pm$ 0.444

FACTOR		
Percentage of Operators Labour	0.571	32.6%
Size of Farm in Acres	— 0.653	42.6%

PART TIME FARMS

Number of Observations :I4 Significance at the 0.05 level $\pm$ 0.532

Percentage of Unpaid Labour	0.727	52.9%
Total Capital Value	— 0.535	28.6%

TABLE 25.

FACTORS ASSOCIATED WITH THE LABOUR EFFICIENCY INDEX - ENTERPRISE TYPE SCALE GENERAL HOLDINGS

ALL FARMS

Number of Observations :37 Significance at the 0.05 level : $\pm$0.330

FACTOR	r	r^2
Percentage of Unpaid Labour	0.577	33.3%
Percentage of Family Labour	0.405	I6.4%
Percentage of Hired Labour	— 0.405	I6.4%

FULL TIME FARMS

Number of Observations : 23 Significance at the 0.05 level: 0.4I3

FACTOR		
Percentage of Unpaid Labour	0.630	39.7%
Machinery/Caipal Ratio	— 0.480	23.0%

PART TIME FARMS

Number of Observations :I4 Significance at the 0.05 level: $\pm$0.532

No Factors significant

TABLE 26.

FACTORS ASSOCIATED WITH THE LABOUR EFFICIENCY INDEX - ENTERPRISE TYPE SCALE MIXED HOLDINGS

ALL FARMS

Number of Observations :32	Significance at the 0.05 level ±0.430	
FACTOR	r	r^2
Total Capital Value	−.0.486	23.6%
Size of Farm in Acres	−0.445	I9.8%

FULLTIME FARMS

Number of Observations: 20	Significance at the 0.05 level 0.632	
FACTOR		
Size of Farm in Acres	−0.649	42.I%

PART TIME FARMS

Number of Observations: I3	Significance at the 0.05 level ±0.553	
FACTOR		
Percentage of Family Labour	0.597	35.6%
Percentage of Hired Labour	−0.597	35.6%
Machinery Labour Ratio	−0.584	34.I%
Machinery Capital Ratio	−0.55I	30.4%

hypothesized relationships is dependent on various complex local interrelationships. A degree of intercorrelation occurs between the various independent variables defined, but it occurs in various ways at each level.

(a) Labour Input and Farm-firm Structure

The hypothesized relationships most consistently related to the Labour Efficiency Index are the positive linear relationship proposed with the percentage of unpaid labour (x_3) and the value of land, buildings and machinery (x_7). The former hypothesis is upheld mainly in part-time and labour intensive operations, whereas the latter is upheld in General and associated farm groups where relatively extensive operations are undertaken using large amounts of capital.

The hypothesized positive relationship between the percentage of family labour (x_4) and the Labour Efficiency Index was upheld in five farm groups. Farms relying on the family for the bulk of their labour will be small operations, unable in many cases to take advantage of modern economies of scale.

The expected negative relationship between the percentage of hired labour employed and the Labour Efficiency Index was upheld on five farm-types. It is interesting to note that the hypothesis was not confirmed on small, intensive farm types with a concentrated peak labour demand. The proposed negative relationship between the size of holding in acres (x_6) and the Labour Efficiency Index was upheld on only four farm types. It should be noted that this hypothesis was upheld largely on full-time and specialised holdings, an

TABLE 27.

FACTORS ASSOCIATED WITH THE LABOUR EFFICIENCY INDEX - LEADING ACTIVITY SCALE TREE FRUITS

SPECIALISED

Number of Observations: 33 Significance at the 0.05 level : ± 0.349

FACTOR	r	r^2
Size of Farm in Acres	− 0.588	34.6%
Total Capital Value	− 0.562	31.6%

GENERAL

Number of Observations: 20 Significance at the 0.05 level : ± 0.444

FACTOR		
Machinery Labour Ratio	− 0.445	19.8%

MIXED

Number of Observations: 9 Significance at the 0.05 level ± 0.666

FACTOR		
Percentage of Unpaid Labour	0.627	39.3%
Machinery Capital Ratio	-0.796	63.4%

TABLE 28.

FACTORS ASSOCIATED WITH THE LABOUR EFFICIENCY INDEX - LEADING ACTIVITY SCALE CATTLE

GENERAL

Number of Observations :7 Significance at the 0.05 level $\pm$ 0.754

FACTOR	r	r^2
Percentage of Family Labour	0.816	66.6%
Percentage of Unpaid Labour	0.810	65.6%
Percentage of Hired Labour	-0.816	66.6%

MIXED

Number of Observations : 8 Significance at the 0.05 level $\pm$0.708

Total Capital Value	-0.780	60.8%

TABLE 29.

FACTORS ASSOCIATED WITH THE LABOUR EFFICIENCY INDEX AT THE LEADING ACTIVITY SCALE - GRAPES

GENERAL

Number of Observations : 6 Significance at the 0.05 level $\pm$ 0.811

FACTOR	r	r^2
Percentage of Unpaid Labour	0.840	70.6%

MIXED

Number of Observations : 6 Significance at the 0.05 level $\pm$ 0.811

FACTOR		
Percentage of Unpaid Labour	0.802	64.3%

indication that many of these holdings are too small to fully utilise their current resource inputs.

The negative relationship between the machinery labour ratio (x_8) and the Labour Efficiency Index is upheld on three farm types. The relationship was confined to the larger mixed and general holdings with no extensive use of manual labour during the picking season. The hypothesized negative relationship between the Efficiency Index and the machinery capital ratio was significant on the same farm types. The positive linear relationship between the Labour Efficiency Index and the percentage of operator's labour was upheld only on one farm type, the small full-time specialised holdings.

The proposed negative relationship between the Diversity Index and the Labour Efficiency Index was rejected at all levels of analysis. This is significant, since farm management workers often advise a higher level of diversification in order to utilise resources more fully on an annual basis.

(b) Physical Variables: Soils

Physical variables showing significant association with the Labour Efficiency Index (L.E.I.) are shown in Tables 30 to 32.

Soil Drainage

Few of the normative hypothesized relationships proposed concerning the association between the soil drainage characteristics and the Labour Efficiency Index were upheld by the analysis.

At the township scale on full-time farms, the positive relationship between the poorly drained soils (x_{14}) and the L.E.I. was upheld,

TABLE 30.

PHYSICAL FACTORS ASSOCIATED WITH THE LABOUR EFFICIENCY INDEX

TOWNSHIP SCALE

ALL FARMS

Number of Observations 94 Significance at the 0.05% level ± 0.2I

Variable	r	r^2
Percentage of Clay Soils	0.3I	9.6I%

FULL TIME FARMS

Number of Observations 46 Significance at the 0.05% level ±0.32

Variable	r	r^2
Percentage of Clay Soils	0.44	I9.2%
Percentage of Fine Sandy Loam Soils	0.33	I0.8%
Percentage of Poorly Drained Soils	-0.38	I4.4%

TABLE 31.

PHYSICAL FACTORS ASSOCIATED WITH THE LABOUR EFFICIENCY INDEX

ENTERPRISE TYPE SCALE

SPECIALISED FARMS - ALL FARMS

Number of Observations 31 Significance at the 0.05% level ±0.35

Variable	r	r^2
Percentage of Soils with Good Drainage	0.45	20.6%

GENERAL FARMS - FULL TIME

Number of Observations 23 Significance at the 0.05 level ± 0.44

Percentage of Soils with Moderate to Good Drainage	0.48	23.0%

MIXED FARMS - ALL FARMS

Number of Observations 22 Significance at the 0.05 level ± 0.46

Variable	r	r^2
Percentage of Soils with Imperfect Drainage	0.49	24.0%

TABLE 32.

PHYSICAL FACTORS ASSOCIATED WITH THE LABOUR EFFICIENCY INDEX.

LEADING ACTIVITY SCALE

TREE FRUITS - SPECIALISED

Number of Observations 30 Significance at the 0.05 level ±0.38

Variable	r	r^2
Percentage of Soils with Good Drainage	0.46	21.1%

Note

No other factors were found significant at the 0.05 level.

but the relationship of the percentage of imperfectly-drained soils (x_{13}) to the Labour Efficiency Index was shown to be negative rather than positive.

The results of the analysis at the Enterprise and Leading Activity Scales all showed variables significantly associated with the Labour Efficiency Index in a manner contrary to that hypothesized. Soils in the well-drained category were positively associated with the Index on specialised, General full-time and farms with Tree Fruits as the leading activity. On mixed farms imperfect drainage was negatively associated with the Labour Efficiency Index.

Soil Texture

Significant associations between soil texture and the L.E.I. were obtained only at the township level. The percentage of clay soils was positively associated with the L.E.I. on "all farms" in the township and on "full-time" farms, a result which confirms the hypothesized positive relationship obtained between poorly-drained soils and the L.E.I. The percentage of fine sandy loam soils is also shown to be positively associated with the L.E.I. at this level of analysis. The result in the case of the latter variable would appear anomalous since a majority of these soil types fall within the imperfectly-drained soil category shown to be negatively associated with the Labour Efficiency Index.

The results of the analysis tend to confirm the overall importance of the type of labour input and size of enterprise in the determination of the relative efficiency of the labour input structure at all levels in the township. Soil workability would seem to be

important only at the township scale where poorly-drained clay soils are a definite hindrance to the efficient operation of the farm holding.

CHAPTER VIII

SUMMARY AND CONCLUSIONS

8.1 Summary.

The main objectives of the study were:

(a) to determine and describe spatial trends in the structure of the agricultural labour force.

(b) to determine the relative efficiency of the agricultural labour input by the construction of a Labour Efficiency Index for farm enterprise types in the study area.

(c) to test certain normative hypothesized rlationships between the Labour Efficiency Index and selected elements of the farm structure and physical environment.

Information on farm structure in North Grimsby was obtained from the Canada Census of Agriculture taken in 1961. In order to maintain the anonymity of individual census returns, it was necessary to group farms on the basis of size of holding, defined in terms of acreage and proximity of location.

To identify the main types of farm enterprise in the township, crop acreages and livestock numbers were reduced to the common denominator of Standard Labour Inputs expressed in Man-Hours. Conversion factors were obtained from the Ontario Department of Agriculture, and are those in current use by extension workers.

The main farm-types in the township were delineated on the basis of the percentage of the total labour input allocated to each

component activity undertaken on the farm. Three main enterprise-types were delineated:

(1) Specialised holdings, with over 75% of total labour input in one activity.

(2) General holdings, with between 50% and 75% of total labour input allocated to one activity.

(3) Mixed holdings, with not more than 50% of the total labour input in any single activity.

Enterprise types as defined above, were further subdivided according to the leading agricultural activity. Limitations imposed by the data prevented detailed analysis beyond the three main agricultural activities of Tree fruits, Grapes and Cattle.

Analysis of farm structure was conducted at three scales:

(1) Township

(2) Enterprise-type

(3) Leading Activity

In addition, distinction was made within each of the first two scales between full-time and part-time holdings. Part-time holdings were defined as farm groups where the operator was employed at farm or non-farm work off the holding for more than one hundred days per year.

The economic structure of the farm groups was examined under three main headings (a) farm size, measured in terms of acreage and total capital investment; (b) mechanization (c) productivity.

Farms in the township tended to be smaller than similar holdings in adjacent counties. In particular, the holdings specialising in tree fruits were found to possess significantly smaller

mean acreages. The total value of land, buildings and machinery on farm holdings in the township was larger than on similar holdings in other areas of Lincoln County. This was thought to be the result of a combination of first rate physical conditions for the growth of tree fruits and land-use competition from non-agricultural land uses. Specialised holdings were found to have the smallest mean acreage of any farm group in township, although they possessed the highest total values of land, buildings and machinery. Specialised holdings also had the highest machinery-labour ratio of all farms examined, despite the reliance of this type of enterprise on the extensive use of manual labour for harvesting. The more extensive Mixed holdings possessed the highest amount of machinery in comparison with their total capitalisation, although the latter figure was much below other enterprise types in the township.

Evidence of increased machinery-labour substitution was encountered on part-time holdings although this could possibly be attributed to an underestimation of the unpaid labour input.

Productivity per acre was highest on the intensive specialised holdings and lowest on the more extensive mixed farms. In terms of the productivity of capital, both general and mixed show returns over 20% whilst the low returns on specialised holdings could be the result of the high initial investment involved in the operation of these holdings.

The structure of the agricultural labour input in the township during 1961 was examined at the township, enterprise-type and leading activity scales. Labour input statistics were derived from the Census

of Agriculture and converted to Standard Man-Hours using conversion factors supplied by the Canada Deoartment of Labour.

Examination was made, not only of the total labour input for each farm group, but also of the component structure of the labour input including the percentage of operators labour, the percentage of hired labour and the percentage of unpaid labour. In addition, an analysis was made of the average age of the farm operator, since this has been shown to influence attitudes and work capability.

General trends and local components of the spatial distribution of the component labour types were examined at the township level by means of trend surface analysis. Fitted surfaces indicated a general trend for operator participation to be greatest in areas of Mixed holdings and in areas dominated by Specialised and General tree fruit farms. Positive residuals indicated a local trend towards increased operator participation in Specialised tree fruits and in areas where Mixed cattles enterprises were dominant. The percentage of paid labour was greatest in areas dominated by General holdings and positive residuals were found where this enterprise type coincided with the lighter and more easily tillable soils. The Unpaid Labour surface indicated a maximum coinciding with mixed and General tree fruit dominated areas. Positive residuals indicated an even greater reliance on unpaid labour on the heavier clay soils and in the area around the Town of Grimsby.

Further detailed analysis of labour force structure was undertaken at the enterprise-type and leading activity levels. Mixed holdings had the lowest mean age of operator and the highest level of family participation. Specialised holdings were the most intensive farm group in

terms of labour inputs per acre. Family participation was found to be lower on specialised holdings than on the larger, but less intensive, mixed farms. General holdings were both extensive in acreage and intensive in their use of labour.

Part-time holdings were found to have a lower total labour input than full-time farms. This could result, not only from their smaller acreage, but also because of the possibility of machinery-labour substitution in order to maximise production from a reduced labour input. An alternative explanation of the high level of the machinery-labour ratio on these farms is the possibility of an underestimate by the Census of the unpaid labour input.

The relative efficiency of agricultural labour use was determined by comparing the total farm labour input in Man-Hours to the Standard Labour Requirement of the holding, calculated from Standard Labour input factors supplied by the Ontario Department of Agriculture. The result was expressed in the form of a Labour Efficiency Index for each farm-group. An attempt was made to analyse the spatial distribution of Labour Efficiency in the Township, by means of trend surface analysis. No surface significant at the 0.05 level could be fitted.

Distinction was made, however, between farm groups that were underemployed, i.e. utilised more labour than the Standard Labour Requirement, and overemployed holdings where the standard labour requirement exceeded the labour input on the holding. Underemployment appeared to be a general trend in the Township, especially in the General and Mixed farming area to the south of the Niagara

Escarpment. Evidence of overemployment was found on twelve farm groups mostly in areas dominated by general holdings, although this could be taken as evidence of above average efficiency.

Farm groups with optimum labour inputs were concentrated in areas where general farms predominate, especially on the heavier soils of the Lake Ontario plain, west of the town of Grimsby.

Part-time holdings had, in general, lower labour efficiency indices than their full-time counterparts, although this could be the result of an underestimation on the part of the census of the unpaid labour input.

Finally, it was proposed, mainly on the basis of previous works, that particular linear relationships existed between the Labour Efficiency Index and elements of farm structure and the physical environment. The variables examined relate to the component structure of the farm labour input, the degree of mechanisation, the size of the farm operation, the diversity of the enterprise and the workability of the soil expressed in terms of drainage characteristics and soil texture. Climatic variables were not examined because of a lack of suitable data.

The hypotheses were tested by means of the Pearson Product-Moment Correlation Coefficient, and hypotheses rejected if results fell below the 0.05 significance level, or if the relationship indicated by the correlation coefficient was contrary to that hypothesized.

The results of the analysis indicated that none of the original hypotheses were universally applicable to farm types in the township.

The analysis tended to confirm the overall importance of the type of labour input and size of enterprise in the determination of the relative efficiency of the labour input at all levels of analysis. Soil workability appeared to be important only at the township scale, where poorly drained soils proved to be a definite hindrance to the efficient operation of the farm holding.

8.2 Conclusions.

> "It is too often forgotten that geographical studies are not descriptions of the real world, but rather perceptions passed through the double filter of the author's mind and his available tools of argument and representation".[1]

The study has demonstrated that predicted normative hypothesized relationships exist at most levels of analysis between the Labour Efficiency Index, the component structure of the labour input, the size of the farm firm measured in terms of capitalisation or acreage, and level of mechanisation. Of the variables described above, the component structure of the labour input, in the form of the percentages of Unpaid and family labour and measures of farm size were significant at almost all levels of analysis, the level of substitution of machinery for labour appeared to be of secondary importance. The hypothesized relationships between the Labour Efficiency Index and the percentages of clay and poorly drained soils were the only predicted physical hypotheses upheld.

Rejection of hypothesized relationships in this analysis could be the result of three possible causes.

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[1] Curry, L., "Climatic change as a Random Series". Annals of the Association of American Geographers, 52. (1962), p. 21.

(1) the hypothesized relationship is not valid in the study area.

(2) the size of the sample population on which the analysis is based is too small to allow meaningful testing of the hypotheses.

(3) the use of grouped Census Statistics as the main data source has obliterated the trend being examined.

Two of the economic variables were rejected at all levels of analysis. No significant association was obtained between the Labour Efficiency Index, the age of farm operator and the diversity of the farm enterprise. In the case of the age of the operator, it is likely that the grouping of farms necessitated by the use of Census of Agriculture Data has sufficiently diluted the variable to prevent analysis of its true significance. Diversification of the farm enterprise has long been regarded as a method of increasing labour input efficiency. It is therefore surprising to find that this variable was not significant at any level of the analysis. Two possibilities exist, either grouping of farms has obliterated the effects of this variable, or it is not valid in the study area. The problem can only be resolved by an analysis of individual farm firms using non-grouped data.

In addition to the outright rejection of hypotheses, a number of physical variables were shown to be significantly associated with the Labour Efficiency Index in a manner contrary to that predicted. The percentages of well drained soil groups were shown to be positively associated with the Labour Efficiency Index at the Enterprise-type level, instead of the predicted negative association. In the case of these variables it is possible that the normative hypothesis, as proposed, is not correct, for the results suggest that more care is taken in the cultivation of the better soils in the area.

The general failure of the physical variables to show significant associations at the lower levels of analysis could result from the limited number of observations on which the hypotheses were tested. It must be noted, however, that enterprise-types at these levels are each located on similar soil types, with the result that inter enterprise-type variations are more likely than intra-group differences.

The validation of many of the normative hypotheses at various levels of the analysis leads to the conclusion that the Labour Efficiency Index adopted for the study is adequate for the examination of factors influencing the relative efficiency of the farm labour input in a multi-enterprise environment. There are indications, however, that the use of grouped census data is not entirely satisfactory as a basis for a study of this nature. Variables showing considerable variability within the farm groups, eg. age of operator and diversity of enterprise, were not found significantly associated with the Labour Efficiency Index at any level of analysis, whereas hypotheses involving factors with a lesser degree of intra-group variability were upheld. It is likely that the use of grouped census data with a high degree of intra-group variability, dilutes the data sufficiently to prevent the true significance of the variable from being discerned. Some form of grouping is unavoidable when using Canadian census of agriculture data, and therefore it is recommended that data from individual farm firms be used in any detailed analysis of labour input at the micro scale.

APPENDIX 1

DEFINITION OF CENSUS TERMS USED IN THE STUDY

DEFINITION OF A FARM.

In the 1961 Census, a farm is defined as an agricultural holding of one acre or more with sales of agricultural products during the past twelve months of $50 or more.

The holding may consist of a single tract of land or of a number of separate tracts held under the same or different tenures, and operated as a single unit. Where the farm was made up of several parts located in different municipalities, the 1961 census reported the complete farm as one unit in the municipality where the headquarters was located.

FARM OPERATOR.

This term is used to designate the person who is directly responsible for the agricultural operations of the farm, whether as owner, tennant or hired manager. As only one operator was listed for each farm, the number of farm operators is the same as the number of farms. If the farm is operated as a partnership only one partner is considered as the farm operator.

FARM VALUES.

This is the value of the farm capital; land and buildings, machinery and equipment (including automobiles), and livestock and poultry. The value reported was to be an estimate of market value, not the original, replacement or assessed value.

The value of land and buildings was to be the value of the property when used for agricultural purposes.

The value to be reported for farm machinery was the present market value -- that is, the amount for which machinery and equipment would sell if there were a willing buyer and a willing seller and not a forced sale. The original or replacement value was not to be reported unless it conformed to the market value.

The total value of farm machinery and equipment includes the value of items not reported separately as well as the value of the machines which are reported separately.

FARM MACHINERY AND EQUIPMENT

The number and value was to be reported for farm machines on the farm at the census date, regardless of whether the machines were owned by the operator or not. Old machines not longer in use were not to be reported. Equipment owned in partnership was to be reported on the farm where it was located as of the census date.

AGRICULTURAL LABOUR

Number of weeks of agricultural labour for persons 15 yrs. of age and older was collected for male and female workers and for paid workers and unpaid family workers.

Any person doing farm work on the farm for wages, salary, commission, or piece rate or labour contract basis was reported as paid labour. This included paid managers and members of the operator's family receiving regular or specified cash wages.

Members of the operator's family who did agricultural work or chores full time or part-time on the farm, but did not receive specified cash wages were reported as unpaid family labour.

FARM EXPENDITURES

Specified farm expenditures, whether paid by cash or obtained on credit were reported for each farm for the twelve month period June 1st 1960 to May 31st 1961. If the operator preferred to report expenditures for the calendar year 1960 this was permitted. In the case of tenant-operated farms, expenditures for feed and seed were to include those paid for by the landlord as well as those purchased by the tenant-operator.

If the farmer had a livestock or poultry contract with some other person or firm, the enumerator was to include the value of any feed supplied by the other party.

FARM REVENUES

Farm revenues represent the value of sales of all agricultural products sold from the farm, including products traded or exchanged, whether received by the operator, or some other person. For tenant-operated farms, the landlord's share of products sold was to be included. Sales were reported over the twelve month period June 1, 1960 to May 31, 1961, or the calendar year 1960 if the operator preferred.

Government deficiency payments were to be reported for the particular products for which payments were being made.

SOURCE

Dominion Bureau of Statistics. Census of Canada. Agriculture Ontario. Bulletin 5.2 (Ottawa: Queen's Printers 1963), pp. vii-xii.

APPENDIX 2

AGRICULTURAL CENSUS ENNUMERATION FORM 1961

FORM 6

CENSUS OF CANADA, 1961

AGRICULTURE QUESTIONNAIRE

DOMINION BUREAU OF STATISTICS

IDENTIFICATION
(To be completed by enumerator)

AGRICULTURE QUESTIONNAIRE NUMBER _____
(This is not necessarily the same as the household number)

HOUSEHOLDS LIVING ON THIS HOLDING

HOUSEHOLD NUMBER (5) (From "Visitation Record") _____

No household living on this holding ☐

IMPORTANT

Complete this form for the person in charge of agricultural operations on holdings of one acre or more if the sales of agricultural products during the past twelve months were valued at $50 or more.

Section I – OPERATOR, JUNE 1, 1961

1. Name and address of the operator
(Person in charge of this holding – owner, tenant, or hired manager)

Print in Block Letters

(Surname or family name)

(Given name and initials)

R.R. No.

(Post office address)

2. How many months did the operator live on this holding during past 12 months? (Check one) [1]

9-12 months ☐ 5-8 months ☐ 1-4 months ☐ Did not live on this holding ☐

3. Age of the operator at last birthday: (Check one) [2]

Under 25 years ☐ 25-34 years ☐ 35-44 years ☐ 45-54 years ☐ 55-59 years ☐ 60-64 years ☐ 65-69 years ☐ 70 years and over ☐

Section II – LOCATION, AREA, TENURE AND VALUE, JUNE 1, 1961

4. LOCATION – List each lot, section or part separately.
(Include all land operated in this enumeration area or elsewhere, whether owned, rented or leased from others, or managed).

LAND DESCRIPTION				Owned, rented or leased, managed (state which)	Area in acres
Quarter and Section (a)	Township (b)	Range (c)	Meridian (d)	(e)	(f)
HQ					

Lot No. [3] Range or concession [4]

5. What is the total area of all land you operate? [5]
(In this enumeration area or elsewhere. This must agree with area given in question 4).

6. TENURE SUMMARY (Question 4, columns (e) and (f))

(a) Area owned (Exclude land you rent to others) [6]

(b) Area rented or leased from others (Include land worked by you on shares) [7]

(c) Area operated for others as a hired manager [8]
(The total of questions 6(a), (b) and (c) must equal the total acreage in question 5).

7. What is your estimate of the present market value of the land and buildings on this holding? [9] $ _____ /00
(Include value of land and buildings rented from others) (dollars only)

Section III – FIELD CROPS

Area sown or to be sown for harvest in 1961 — Acres

GRAINS (to be threshed or combined)

8. Spring wheat (exclude durum) [9]
9. Durum wheat [10]
10. Winter wheat (sown last fall) [11]
11. Oats for grain [12]
12. Barley [13]
13. Mixed grains (two or more grains sown together) [14]
14. Fall rye for grain (sown last fall) [15]
15. Spring rye for grain [16]
16. Buckwheat [17]
17. Dry field peas (exclude canning peas) [18]
18. Dry field beans [19]
19. Corn for grain (exclude sweet and canning corn and corn for ensilage or fodder) [20]

HAY AND FODDER CROPS

20. Corn for ensilage or fodder [21]
21. Alfalfa and alfalfa mixtures cut or to be cut for hay, ensilage or seed [22]
22. All other tame hay cut or to be cut for hay, ensilage or seed (exclude alfalfa and alfalfa mixtures) [23]
23. Oats to be cut for green feed, hay or ensilage [24]
24. Other fodder crops – To be cut for grain hay, green feed, or ensilage [25]

OILSEED CROPS

25. Flaxseed [26]
26. Soybeans for beans [27]
27. Sunflowers for seed [28]
28. Rapeseed [29]
29. Mustard seed [30]
30. Safflower [31]

POTATOES, ROOTS AND TOBACCO (Report to nearest tenth acre)

31. Potatoes for home use or for sale [32] .10
32. Turnips, swedes and mangels grown for:
(a) Livestock feed [33] .10
(b) Table use (exclude those grown in home gardens) [34] .10
33. Tobacco [35] .10

OTHER CROPS

34. Sugar beets for sugar [36]
35. Other field crops (Flax for fibre, hops, etc.) _____ (name)

Section IV – FRUITS, GREENHOUSES AND NURSERIES

CULTIVATED SMALL FRUITS (Mainly for sale)

36. Do you grow mainly for sale any grapes, berries or other small cultivated fruits? ☐ No – *If "No" skip to question 41* ☐ Yes – *Answer questions 37 to 40*

What is the area in 1961 of the following: — Acres

37. Strawberries [37] .10
38. Raspberries [38] .10
39. Grapes [39] .10
40. Other (cranberries, cultivated blueberries, etc.) _____ (name) [40] .10

TREE FRUITS

41. Have you 25 or more fruit trees on this holding? No ☐ – *If "No" skip to question 51* Yes ☐ – *Answer questions 42 to 50* — (41) acres

42. Area of tree fruits if 25 or more trees (bearing and non-bearing) ..... (10) acres

If 25 or more fruit trees, state number of trees:

	Number of trees	
	(43) Under 10 years	(44) 10 years and over
43. Apple		
	(45) Under 10 years	(46) 10 years and over
44. Pear		
	(47) Under 5 years	(48) 5 years and over
45. Plum and prune		
	(49) Under 5 years	(50) 5 years and over
46. Cherry (sweet)		
	(51) Under 5 years	(52) 5 years and over
47. Cherry (sour)		
	(53) Under 5 years	(54) 5 years and over
48. Peach		
	(55) Under 5 years	(56) 5 years and over
49. Apricot		

50. How many of the apple trees (question 43) were planted during the past five years? ..... (57) (number)

GREENHOUSE AND NURSERY PRODUCTS, MUSHROOMS (Mainly for sale)

51. Do you grow greenhouse or nursery products, cut flowers, dry bulbs or mushrooms, mainly for sale? No ☐ – *If "No" skip to question 56* Yes ☐ – *Answer questions 52 to 55*

What is the area in 1961 of the following grown mainly for sale:

52. Greenhouse products grown under glass (include sashes and cold frames.) ..... (58) square feet
53. Mushroom cellars ..... (59) square feet
54. Cut flowers and dry bulbs grown out of doors ..... (60) acres . (10)
55. Nursery products (include area of shrubs, trees, vines, ornamentals, etc.) ..... (61) acres . (10)

Section V – VEGETABLES GROWN FOR SALE

56. Will any vegetables (excluding potatoes and turnips) be grown this year mainly for sale (for fresh market, canning, freezing or other processing)? No ☐ – *If "No" skip to question 73* Yes ☐ – *Answer questions 57 to 72*

Area of the following vegetables planted (or to be planted) in 1961 mainly for sale:
(Report to the nearest tenth acre.)

	Acres		Acres
57. Asparagus	(62) . (10)	67. Lettuce	(72) . (10)
58. Beans (wax, green or snap)	(63) . (10)	68. Onions	(73) . (10)
59. Beets	(64) . (10)	69. Spinach	(74) . (10)
60. Broccoli	(65) . (10)	70. Sweet corn	(75) . (10)
61. Cabbage	(66) . (10)	71. Tomatoes	(76) . (10)
62. Carrots	(67) . (10)	72. Other (see list below)	(77) . (10)
63. Cauliflower	(68) . (10)	(name)	
64. Celery	(69) . (10)	(name)	
65. Cucumbers	(70) . (10)		
66. Green peas	(71) . (10)		

brussels sprouts, cantaloupes, melons, parsnips, peppers, pumpkins, radishes, rhubarb, squash, vegetable marrow

Section VI – USE OF LAND IN 1961

		Acres
73. Cropland sown or to be sown for harvest in 1961 (*Total of questions 8 to 35, 37 to 40, 42, 52 to 55 and 57 to 72 less double cropping.*)	None ☐	(78)
74. Improved land for pasture or grazing (Exclude area to be cut this year for hay, ensilage or seed.)	None ☐	(79)
75. Summer fallow	None ☐	(80)
76. Other improved land (Barnyards, lanes, home gardens, improved idle land, etc.)	None ☐	(81)
77. Woodland (Woodlots, sugar bush, treed wind breaks, cut-over land, etc.)	None ☐	(82)
78. Other unimproved land (Unimproved hay land, native pasture, sloughs, marshes, etc.)	None ☐	(83)
79. Total of questions 73 to 78 (*This total must equal the total area of the holding, question 5*)		(84)

Section VII – UNIMPROVED PASTURE, NEW BREAKING AND GRASS SILAGE

80. Unimproved pasture — Area of unimproved land (question 78) used for pasture ..... None ☐ — (85) acres
81. New breaking – Area of virgin land first ploughed in 1960 ..... None ☐ — (86) acres
82. Grass silage – Tons of grass, alfalfa and clover to be cut for ensilage in 1961 ..... None ☐ (Exclude grain mixtures and prairie or marsh hay) — (87) tons

Section VIII – GRAIN ON HAND

(Prairie Provinces and British Columbia only)

83. Was any wheat, oats, flaxseed or barley (regardless of ownership) on hand on this holding on June 1, 1961? No ☐ – *If "No" skip to question 88* Yes ☐ – *Answer questions 84 to 87*
(Include whole grain, chopped, rolled or crushed grain)

How many bushels of the following grains were on this holding on June 1, 1961?

	Bushels
84. Wheat (all, including durum)	(88)
85. Oats	(89)
86. Barley	(90)
87. Flaxseed	(91)

Section IX – FORAGE SEED HARVESTED IN 1960

88. Did you harvest any grass, clover or alfalfa seed in 1960? No ☐ – *If "No" skip to question 100* Yes ☐ – *Answer questions 89 to 99*

State the quantity (in pounds) of cleaned seed harvested in 1960 for the following:

	Pounds		Pounds
89. Alfalfa	(92)	95. Meadow fescue	(98)
90. Alsike	(93)	96. Red clover	(99)
91. Brome grass	(94)	97. Sweet clover	(100)
92. Creeping red fescue	(95)	98. Timothy	(101)
93. Crested wheat grass	(96)	99. Other (name)	(102)
94. Kentucky blue grass	(97)		

Section X – MACHINERY AND ELECTRIC POWER

MACHINERY

State the number and the present market value of the following machines on this holding, June 1, 1961:

	Number (103)	Value (dollars only)
100. Automobiles	(104)	$ /00
101. Motor trucks	(105)	$ /00
102. Tractors (exclude garden tractors)	(106)	$ /00
103. Grain combines: (a) Self-propelled	(107)	$ /00
(b) Other	(108)	$ /00
104. Grain binders	(109)	$ /00
105. Swathers (Prairie Provinces and British Columbia only)	(110)	$ /00
106. Threshing machines	(111)	$ /00
107. Pick-up hay balers	(112)	$ /00
108. Forage crop harvesters	(113)	$ /00
109. Electric motors (1/3 horse-power and over)	(114)	$ /00
110. Milking machines	(115)	$ /00
111. Electric milk coolers (*Report bulk milk coolers in question 112*)	(116)	(117) $ /00
112. Value of all other machinery and equipment (Tillage machinery, seeders, tractor attachments, manure spreaders, mowers, rakes, sprayers, irrigation equipment, stationary gasoline engines, wagons, small tools, etc.)		(118) $ /00
113. Total value of all machinery and equipment (*Total of values reported in questions 100 to 112*)		$ /00

ELECTRIC POWER (119)

114. Source of electric power on this holding: Power line ☐ Other sources ☐ None ☐

Section XI – LIVESTOCK ON THIS HOLDING, JUNE 1, 1961

(Include livestock being pastured or fed for others; also include animals being kept on community pastures)

Number

CATTLE

1. Total cattle and calves ..... None ☐ 120
If "none" skip to question 120 121

(a) Calves, under 1 year 122

(b) Steers, 1 year and over 123

(c) Bulls, 1 year and over 124

(d) Heifers, 1 year and under 2 125

(e) Cows and heifers, 2 years and over .....
(The total of questions (a) to (e) must equal the number given for question 115.)

OF THE COWS AND HEIFERS REPORTED ABOVE, HOW MANY ARE:

116. Heifers, 1 year and under 2, being raised mainly for milk production? ..... 126 number

117. Cows and heifers, 2 years and over, milking or to be milked? ..... 127 number

MILK PRODUCED YESTERDAY:

118. How many cows and heifers were milked yesterday? ..... 128 number

119. How many pounds of milk were produced yesterday? ..... 129 pounds

Number

PIGS

120. Total pigs (all ages) ..... None ☐ 130
If "none" skip to question 122 131

(a) Pigs, under 6 months 132
(Born since December 1.)

(b) Pigs, 6 months and over (include sows, boars and market pigs) .....
(The total of questions (a) and (b) must equal the number given for question 120)

121. Of the pigs 6 months and over (question 120(b)), how many are sows kept for breeding purposes? ..... 133 number
(Include bred gilts)

Number

SHEEP

122. Total sheep and lambs ..... None ☐ 134
If "none" skip to question 123 135

(a) All lambs, under 1 year 136

(b) Ewes, rams and wethers, 1 year and over .....
(The total of questions (a) and (b) must equal the number given for question 122)

Number

OTHER LIVESTOCK

123. Total horses and ponies (all ages) ..... None ☐ 137

124. Total goats (all ages) ..... None ☐ 138

Section XII – POULTRY, JUNE 1, 1961

Number

HENS AND CHICKENS

125. Total hens and chickens (all ages) ..... None ☐ 139
If "none" skip to question 127 140

(a) Chicks, under 2 months 141

(b) Pullets, 2 to 6 months, intended for laying 142

(c) Hens and pullets, 6 months and over, kept for laying 143

(d) All other chickens over 2 months old not intended for laying .....
(Include roosters)
(The total of questions (a) to (d) must equal the number given for question 125)

126. Of the chicks under 2 months (question 125(a)), how many are pullet chicks intended for laying? ..... 144 number

Number

OTHER POULTRY

127. Turkeys (all ages) ..... None ☐ 145

128. Geese (all ages) ..... None ☐ 146

129. Ducks (all ages) ..... None ☐ 147

BROILER PRODUCTION

130. Do you raise chicken or turkey broilers? (Include those raised for others under contract.) No ☐ – *If "No" skip to question 133* Yes ☐ – *Answer questions 131 and 132*

Number

During the past 12 months how many broilers were placed on feed?

131. Chicken broilers 148

132. Turkey broilers 149

Section XIII – LIVESTOCK, POULTRY AND EGG CONTRACTS

133. Did you produce under contract with a feed dealer, processor, hatchery, retailer, or co-operative any livestock, poultry or eggs during the past 12 months? (Do not include milk contracts and contracts with other farmers) No ☐ – *If "No" skip to question 136* Yes ☐ – *Answer questions 134 and 135*

134. Which of the following were produced under contract during the past 12 months? 150

cattle ☐ pigs ☐ chicken broilers ☐ turkeys ☐ eggs ☐ other ☐ _____ (name)

135. Is this contract with a co-operative? 151 No ☐ Yes ☐

Section XIV – FUR-BEARING ANIMALS, JUNE 1, 1961

(Including chinchilla)

136. Do you keep fur-bearing animals on this holding? 152 No ☐ Yes ☐

Section XV – MAPLE SYRUP AND SUGAR, 1961

137. Were any maple products produced on this holding this spring? No ☐ – *If "No" skip to question 141* Yes ☐ – *Answer questions 138 to 140*

138. Number of buckets hung this spring ..... 153 number

139. Maple syrup made this spring ..... 154 gallons

140. Maple sugar, cream or taffy made this spring ..... 155 pounds

Section XVI – PART-TIME WORK DURING THE PAST 12 MONTHS 1

141. Was the income that the operator and his family received from non-agricultural work and agricultural work off this holding greater than the amount received from the sale of agricultural products during the post 12 months? (Exclude income from investments.) No ☐ Yes ☐

142. Days operator worked at non-agricultural work and at agricultural work off this holding during the past 12 months (Do not include exchange work) None ☐ 2 (days)

143. Kind of part-time work: 3

☐ Agricultural work off this holding (Including custom work)
☐ Truck or bus driver
☐ Working in the woods
☐ Factory production work
☐ Fisherman or trapper
☐ Clerical work
☐ Construction work
☐ Other _____ (name)

Section XVII – AGRICULTURAL LABOUR

(15 years of age and over – exclude operator)

	Male	Female
144. Weeks worked during the past 12 months on this holding (excluding housework):	4 weeks	5 weeks
(a) by paid workers ..... None ☐	6 weeks	7 weeks
(b) by unpaid family workers ..... None ☐ (Exclude operator.)		

145. How many paid agricultural workers do you employ on a year round basis? ..... None ☐ 8 . _____ (number)
(Exclude housework)

Section XVIII – PRODUCTION OF WHOLE MILK, MAY 1961

MILK EQUIVALENT TABLE

1 gal. milk	=	approximately	10 lb. milk	EXAMPLE:
1 lb. cream	=	"	10 lb. "	325 gallons of milk are equivalent to approximately 3,250 pounds of milk (325 x 10).
1 gal. cream	=	"	100 lb. "	
1 lb. butterfat	=	"	30 lb. "	
1 lb. butter	=	"	25 lb. "	

		Equivalent pounds of milk
SALE OF MILK AND CREAM, MAY 1961	gallons of milk	9
146. Whole milk sold, May 1961 ..... (Include milk sold to dairy, factory or direct to consumers)		10
147. Cream sold, May 1961 ..... *(Report in most familiar unit and convert to milk equivalent by using above table)*	(1) gallons of cream	
	(2) pounds of cream	
	(3) pounds of butterfat	
HOME USE OF MILK AND CREAM, MAY 1961 (Do not include milk bought.)	pounds of butter	11
148. Butter made on this holding, May 1961	gallons of milk	12
149. Milk and cream used in households, May 1961 (Convert cream to milk equivalent.)	gallons of milk	13
150. Whole milk fed to livestock, May 1961 ..... (Do not include skim milk.)		14
151. Total whole milk produced, May 1961 ..... *(Must equal the amount reported in questions 146 to 150)*		

Section XIX – EXPENDITURES DURING THE PAST 12 MONTHS

What were the expenses for the following during the past 12 months?

		Amount (dollars only)
152. Taxes ..... None ☐ (Amount levied on all agricultural property now owned and operated by you whether paid or not)	15	$ /00
153. Rent (For all agricultural property now operated by you): (a) Cash basis ..... None ☐	16	$ /00
(b) Share or kind basis ..... None ☐	17	$ /00
154. Cash wages paid to hired agricultural labour ..... None ☐ (Exclude amount paid for housework, custom work and construction labour)	18	$ /00
155. Feed and seed purchases ..... None ☐ (Include expenditures made for this holding by the landlord)	19	$ /00

Section XX – VALUE OF AGRICULTURAL PRODUCTS SOLD DURING THE PAST 12 MONTHS

(Report deficiency payments as sales' revenue for the particular product(s) involved. Include landlord's share of products sold)

		Value (dollars only)
FIELD CROPS	20	
156. Wheat (spring, durum and winter) (Include Canadian Wheat Board payments and patronage dividends.)	21	$ /00
157. Other cash grains (oats, barley, mixed grains, rye, buckwheat, dry field peas and beans, corn for grain) (Include Canadian Wheat Board payments and patronage dividends)	22	$ /00
158. Oilseeds (flax, soybeans, sunflowers, rape, mustard, safflower)	23	$ /00
159. Hay and fodder crops, including forage crop seed	24	$ /00
160. Potatoes, roots, tobacco, sugar beets and other field crops	25	$ /00
161. Other receipts such as PFAA payments, crop insurance, etc. received during the past 12 months (name)	26	$ /00
OTHER CROPS		
162. Vegetables and vegetable seeds (Exclude potatoes and turnips)	27	$ /00
163. Tree fruits	28	$ /00
164. Grapes, berries and other small cultivated fruits	29	$ /00
165. Greenhouse and nursery products, cut flowers, dry bulbs, and mushrooms	30	$ /00

LIVESTOCK AND POULTRY SOLD ALIVE OR SLAUGHTERED FOR SALE	Number		
166. Cattle (a) Calves under one year		31	$ /00
(b) Other cattle one year and over		32	$ /00
167. Pigs (a) Weanling pigs		33	$ /00
(b) All other pigs		34	$ /00
168. Sheep and lambs		35	$ /00
169. Horses (all ages)		36	$ /00
170. Hens and chickens (Include hatchery chicks sold. Report full sales value for broilers produced under contract)		37	$ /00
171. Turkeys (all ages)		38	$ /00
172. Ducks, geese and other poultry (name)			

OTHER PRODUCTS SOLD		
173. Dairy products – whole milk, cream, butter, cheese, etc.	39	$ /00
174. Eggs (Include hatching eggs)	40	$ /00
175. Wool	41	$ /00
176. Honey and beeswax	42	$ /00
177. Fur-bearing animals and pelts	43	$ /00
178. Maple products	44	$ /00
179. Forest products	45	$ /00
180. Other agricultural products sold (Goats, goat's milk, etc.) (name)	46	$ /00

FOR OFFICE USE ONLY

155 Specified ☐ 157 47 Institutional ☐ 158 48

Section XXI – MORTGAGES OR AGREEMENTS FOR SALE

181. Is there a mortgage or agreement for sale debt on any part of the agricultural property that you own? No ☐ – *If "No" skip to question 183* Yes ☐ – *Answer question 182*

182. Is this mortgage or agreement for sale held by: 49

Government (Dominion, Provincial, Municipal) ☐ Bank, Insurance, Loan, Trust or Mortgage Co. ☐ Private individual ☐ Other (Credit Union, Railway Co., etc.) ☐

Section XXII – IRRIGATION

183. Have you a crop irrigation system of any kind on this holding? 50 (Include purchase of custom irrigation in 1960; exclude systems used only for home gardens.) No ☐ Yes ☐ – *If "Yes" complete IRRIGATION QUESTIONNAIRE, Form 8, in British Columbia, Alberta, Saskatchewan and Ontario.*

184. Area irrigated in 1960 ..... None ☐ 51 (acres)

Section XXIII – FOREST PRODUCTS AND FOREST FIRES

FOREST PRODUCTS

185. Were any wood products from this holding cut or sold or used during the past 12 months? (See list below) No ☐ Yes ☐

Fuelwood, Wood for charcoal, Pulpwood, Fence posts, Fence rails, Hewn ties, Logs, Bolts, Piling, Poles, Round mining timber, Christmas trees 52

Complete the WOODLAND QUESTIONNAIRE, Form 9, if "yes" to either question 185 or 186

FOREST FIRES

186. Have there been any fires on the woodland of this holding during the past five years? No ☐ Yes ☐

COMMENTS

ENUMERATOR'S RECORD

187. Did the operator receive an advance copy of the "Agriculture Questionnaire", Form 6? No ☐ Yes ☐

188. If "Yes", did the operator complete any part of the "Agriculture Questionnaire", Form 6? No ☐ Yes ☐

189. Who furnished the information in this report? (Check one)

Operator ☐ Wife or other member of the operator's family ☐ Hired labourer ☐ Neighbour ☐ Other ☐

159

190. Date enumerated, day _____ month _____

191. District _____ Enumeration area _____

192. Enumerated by _____

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