MUNICIPAL WATER SUPPLIES AS A CONSTRAINT ON ECONOMIC DEVELOPMENT IN AGRO-MANITOBA

by

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A thesis
presented to the University of Manitoba
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ABSTRACT

The problem which this thesis addresses is regional development within a region that has limited non-agricultural potential. The focus is on:

1. the regional impacts of implementing water-intensive agriculturally based secondary processing industries and
2. the conditions that are necessary to accommodate such industrialization.

The study begins by establishing a theoretical background for regional development with an accompanying outline of location theory. This theoretical base defines the regional development scenario, which in turn shows the rural region's susceptibility to economic change through agricultural centre development.

Industrial development is assessed as the catalyst for agricultural centre development. However, there are other contributing variables, such as infrastructural stability. Since water is a limiting factor of production in the regions under study, the objective is to ensure that this component of the infrastructure is capable of accommodating increased industrialization.

Following the establishment of theories and necessary industrial development conditions, the thesis analyses different types of potential water-intensive agriculturally based secondary processing industries.

Data on primary production and industrial water usage, along with municipal water system renovations are evaluated to identify the appropriate types of secondary processing industries. Once these industry types are designated, the next step is the analysis of these different types of economic deviations (community/industry projects).

Partial cost-benefit analysis is the methodology used. This method is chosen in consideration of the characteristics of the projects, for example, high initial capital outlay with benefits and/or additional costs accruing in the future.

With the cost-benefit components chosen, the partial cost-benefit analysis is implemented to evaluate the viability of increased industrialization. This is done by assessing each industry's capability of generating positive net impacts to their appropriate regions.

In essence, the analysis is a preliminary industrial screening process. It evaluates the economic impact accrued to the region by water-intensive agriculturally based secondary processing project implementation.

The results of the analyses demonstrate that none of the chosen industry/community projects are viable since they do not fulfill the specified cost-benefit criteria. This reflects the effects of a high initial capital outly of each industrial implementation. In addition, the results demonstrate a substantial effect from water system renovation costs, i.e., the negative impacts were significantly higher for the communities which required system changes. This suggests that a necessary preliminary condition for industrial implementation is a strong infrastructure which can accommodate the added stress of increased industrialization.

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Chapter I

INTRODUCTION

The presence of large quantities of usable water does not necessarily guarantee economic growth and industrial development. Many factors relevant to the water supply, the type of industry and the location must be considered. This thesis examines the possibility of regional development through industrial growth, via the modification of a municipal water supply system.

Economic growth and development are often signified by increased industrialization. As a result, this study investigates the potential of various Manitoba communities for water-intensive agriculturally based secondary processing industries. An evaluation of each community's water system is also pursued. This evaluation will show whether the system can accomodate increased industrialization. In the case of water system shortcomings, an assessment of complementary water system additions is also done.

1.1 THESIS ORGANIZATION

The thesis will begin with a description of regional development within a region (Agro-Manitoba) that has a limited number of industrial alternatives. This will be followed by a review of growth and location theories. These theories, combined with a summary of various communities' infrastructures, will set the scenario for regional development.

More specifically, these conditions combined will make the region prone to economic change, which in turn will be 'triggered' by economic deviations. The next step is to identify types of industrial activity (economic deviation) which can be expanded with increased water supply, that is, the focus is on industries where water is currently the only major constraint to industrial growth. A further categorization of these industrial activities will give a better perspective when evaluating potential industrial development sites.

The categorizing of industries involves appraisal of the water quantity requirements of various industrial processes. Another aspect used in categorizing the industry is the availability of region specific crops, e.g., a potato plant in a potato growing region. For agriculturally based industries, locating the firm in a region or close to a region where the primary agricultural product is grown will be advantageous to both the producers and consumers of the raw product. The specifics of categorizing will be dealt with in a later section.

Once the industries have been designated, the municipal water situation of each of the potential sites will be evaluated and shown. The water system shortcomings of each of these sites will also be discussed. Derivation of the water supply limits and constraints will facilitate the elimination of some of the prospective industrial communities. This type of preliminary screening will be accomplished by assessing the current water supply system and the amount of upgrading that will be required to meet the potential increase in industrial water usage. The study will continue by moving to a discussion of how enhanced water availability plays an important role in augmenting the potential for manufacturing activities, which in turn will promote regional development.

A brief discussion will be presented of the water treatment capabilities of the various remaining communities and whether the quantity and quality is sufficient for existing manufacturers and/or for increased industrial activity. This will include seasonal variations and a description of the municipal water supply shortcomings where they exist. The quality aspect will be reflected by the treatment facility, and the quality that is expected by the major water users in the area. Of course, minimum levels of purity of the water used will ultimately depend on the nature of the industrial use. To conclude this portion of the study, a ranking of each community system will be performed on the basis of the most easily upgradable community water system with respect to time and costs.

The next component of this thesis evaluates each community's demand for water. A description of various types of consumption will be presented. To demonstrate the industrial demand for water, the 1981 water consumption data of various agriculturally based industries will be used.

To acquire a general knowlege of primary production, a study of crop acreages in the various regions is presented. This reveals the types of agriculturally based secondary processing that are most appropriate in particular regions. This study continues by describing various secondary processing firms' procedures and their annual demand for water plus seasonal peak usages. If the bulk of industrial water volume use is of a seasonal nature, i.e., high usage in summer months, a method other than increasing water treatment capacity of existing plants will be appropriate. The methods of augmenting the water supply systems in the communities will depend on which condition is prevalent.

Once the demand and supply situations have been clarified, there will be a comparison of the two and from this analysis conclusions will be drawn regarding the extent to which a water supply system can limit increased industrial activity. A comparison of the various communities (i.e. the costs of renovating their water supply systems and the respective benefits and costs of industry implementation), will be pursued by a partial cost-benefit analysis.

This form of cost-benefit analysis will consist of assessing a projects impact on a region. Critical values are derived from the analysis. These critical values are the cost-benefit analysis results. More specifically these results consist of; Net Present Value, The Cost-Benefit Ratio and the Internal Rate of Return. If these values exceed the specified significant critical values, the project is considered viable. However, these criteria will be discussed in detail in the "Method of Analysis" chapter.

This study will rank the viable projects by using one of the derived criterions, the project's positive net present value (benefit) to the region. The ranking will establish the project that will be most beneficial to the community, and will show the project[1] that will be the best 'catalyst' for regional development and economic growth.

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[1] The 'optimal' projects will be derived from a set of limited alternatives that this study has designated.

Chapter II

REGIONAL ECONOMIC DEVELOPMENT, GROWTH AND LOCATION THEORIES

2.1 REGIONAL DEVELOPMENT IN AGRO-MANITOBA

One of the more critical components of regional development policy is the rural development mandate. Synonymous with rural development, in agricultural regions, is the growth of the agricultural service centre.[2] There must be sufficient agricultural service facilities to accomodate expanded production by the primary agricultural sector.

This aspect of agricultural sector growth encompasses increased agricultural investment and increased agricultural production to meet the ever increasing aggregate demand for agricultural goods. This demand is both foreign with respect to the region and domestically oriented. Agricultural sector expansion will result when trying to supply this increasing demand for 'foodstuffs'. An agricultural sector expansion will be associated with; capital investment, and expanded demand for labor, as well as a growth in vertically-linked industries. An example of a vertically-linked industry is the secondary processing industry. It is fundamental that agriculture becomes the driving force behind rural development in such areas where other nonagricultural potential is limited. Since the producing region generally is not able to consume all of

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[2] This comparison is evident in rural Manitoba because of the limited nonagricultural potential of this region.

its production, it can be emphasized that the development of regional exports is a primary regional economic growth and development determinant.

These previously stated characteristics can be explained by export base theories. In short, export base theories postulate that two mutually exclusive sectors exist within any regional economy, namely the export base sector and the residentiary sector. The export base sector encompasses activities for which the resulting demand is external to the region itself (regional export activities), while the residentiary sector encompasses activities for which the effective demand comes from within the region.

A characteristic of export oriented regions is sensitivity of the local economy to the level of exports. Associated with the exports of the region is an induced level of economic activity that takes place within the region. In such a case the producing region is very sensitive to deviations in economic activity in areas absorbing its exports. The ratio of the induced activity to the export levels is the multiplier effect. "The multiplier is thus, a measure of the 'deviation-amplifying' potential of the economic system."[3] A further definition of a multiplier is "the ratio of the change in income to the permanent change in expenditure that caused it.[4]

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[3] Peter E. Lloyd and Peter Dicken, Location In Space: A Theoretical Approach To Economic Geography (Harper and Row, Published New York 1972), p. 170

[4] Ibid. p.185.

When dealing with agriculturally based secondary processing, it can be hypothesized that the region with a high concentration of these types of industries will have a strong export orientation. This is especially evident with agricultural produce since it often cannot be fully consumed by its own region. Such an example is the potato processing industry or the canned vegetable industry.

This study will assume markets exist for increased levels of processed agricultural goods. Therefore, increased primary agricultural production becomes the major determinant behind the economic growth of these communities and regions.

The extent of rural growth and development are dependent on services provided by the rural community. More specifically, the rural community's significance in the context of this study lies in its ability to provide the necessary infrastructure to support agricultural sector expansion. The infrastructure provides the foundation on which the vertically-linked secondary processing industry can develop. At the same time, it must also accommodate the possible increased population (migration of workers) and economic growth that may result from agricultural sector expansion.

Agricultural service centre development (size and nature) varies from region to region. These differences in regional economic growth and development are the result of a number of attributes and circumstances. One such reason stems from crop specialization, which will support immediate secondary processing. An example of this would be that segment of the potato crop which is grown for the processing market, such as dehydrated potato processing (processed into flakes or powdered potatoes), or turning the processing potato into french fries or potato chips. This crop specialization aspect could be the result of suitable climate and soil conditions exclusive to a particular region, resulting in regional economic growth.

When an economic stimulant is initiated within these regions, any crop specialization advantage becomes apparent. In economic terms, these regional disparities combined with market forces tend to widen the developmental and economic gaps between regions. Regional advantages could also be the result of lower transportation costs, e.g., ability to transport to a close agricultural service centre with accomodating facilities for the produce or possibly to take advantage of the secondary processing plants. These secondary processing plants will decrease the costs of transportation through their weight shedding process. Immediate processing of the primary products will also be advantageous in another way; it will reduce the perishability losses of crops.

Economic growth and industrial development of these various agricultural service centres also depend on other factors. These encompass labor availability, accessibility of transportation, resource availability, market availability and location. The extent to which these infrastructural factors constrain growth varies from centre to centre. A sound infrastructure also plays a major role in economic development. Greater elaboration of possible regional growth processes will be pursued further in the latter sections of this chapter.

Decision variables important to locating or expanding industries are also important to a growing community. This is evident if the economic growth of an agricultural service centre is identified with industrial development. In such a case, the components of a viable infrastructure would be criteria in determining firm location. In short, the infrastructure must be able to support the economic growth that industrial introduction or expansion might stimulate. Industrialization plays an even more important role if coupled with a multiplier mechanism. This is most distinctly demonstrated by A. Pred's diagram of circular and cumulative growth (Figure 1).[5]

Since water is a major component in many of the agriculturally based secondary processing activities, guaranteed water availability is necessary. As a result, it is imperative to assess whether it is enough of a constraint to limit agricultural service centre growth by confining agricultural secondary processing growth.

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[5] Ibid. p.167.

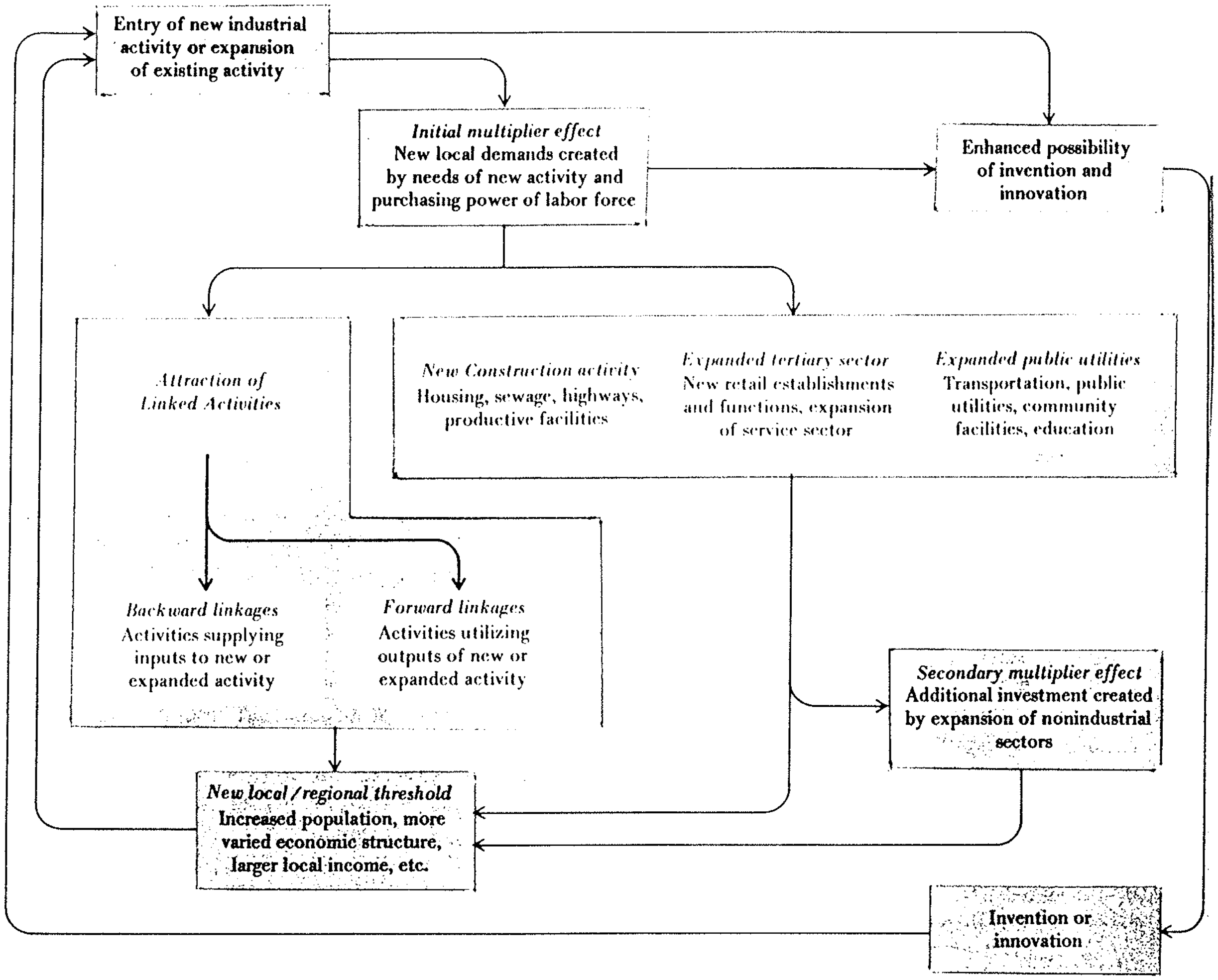

Figure 1: Diagram Of Circular And Cumulative Growth

Water resource development can be a poor tool for increasing economic growth if other critical factors such as the infrastructure components are at levels which are limiting or constraining. Evidence of such a finding is shown by Cox, Grover and Siskin:

> Water availability in regional economic growth has been assessed in at least one study [Howe,1968], which found that water did not constitute a bottleneck to economic growth in water deficit areas of the country and that its presence in large quantities in other regions did not guarantee rapid growth. The study suggested that water resource developments are likely to be poor tools for accelerating regional economic growth if markets resources, and other developmental factors

> are lacking. Howe's study emphasized water availability as measured by water transportation, streamflow and average runoff of rather large regions.[6]

To ascertain if water resource development projects had an effect on economic growth in small regions, Cox, Grover and Siskin designed their study to evaluate the economic impact during a water project implementation. In addition, their observation period was to include the next few years following water project implementation. While dealing strictly with the Northeastern United States, they assessed the limitations of the data collected and the problems of time lags and 'diffusion through space', all of which are relevant to other areas. The authors concluded that:

> 1) There was no relationship shown between project size and economic growth, and 2) the selection of project sites was biased toward urban areas, where there is a greater a priori likelihood of economic growth. We concluded that it is dubious whether water resource projects serve as a stimulus of economic growth for the strictly rural counties in the Northeastern United States.[7]

Within Manitoba there are cases in which implementation of large water development projects has not had a significant effect on regional economic growth. Such examples are the Northern Hydro Developments in Manitoba, which have had negligible impact on economic growth for those regions. If any impact was observed it was an indirect impact. More specifically, the hydro developments have helped other regions of the province, thereby generating enough government revenue to allow greater transfer payments to the North. As a result, one might hypothesize that

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[6] P. Thomas Cox, Grover and Siskin, Effect Of Water Resource Investment On Economic Growth (Water Resources Research Volume 7, 1971), p. 32.

[7] Ibid., p.37.

the North declined slowly as a result of hydro's indirect benefits rather than quickly.

The study by Cox, Grover and Sisken explicitly shows that the growth of a region is not solely dependent on water developments. However, water development plays an integral part in regional growth if the rest of the infrastructural components of the community is sufficiently developed to complement it. A criterion that can be used to link project size (water development) with economic growth is the relative level of the community's other infrastructural features. A weak infrastructure will not be able to support any economic growth let alone initiate economic growth and development. To clarify, this infrastructure criterion is:

> The underlying capital of a society embodied in roads and other transportation, and communications systems, as well as water supplies electric power and other public services. Sometimes called social overhead capital, the term is often widened to include the health, skills, education and other qualities of the population.[8]

In practice, economic development decisions do not necessarily follow the criterion of a strong infrastructure. Occasionally, regional planners use a different criterion. For example, in evaluating which communities will experience increased industrialization, regional planners often investigate the rate of past economic growth with hopes of continuing this trend. However, past economic growth should not be the only criterion since it does not necessarily determine whether the infrastructure is fit for additional economic growth and development. Instead, regional planners should be using the infrastructure's potential

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[8] Bannock, Baxter and Rees, Penguin Dictionary Of Economics (Hazell Watson and Viney Ltd, Great Britain 1979) p.238.

for handling increased growth and development as a guideline for their decisions, as well as a demand for agricultural products where the benefits exceed the costs.

By concentrating public and private investment on specific aspects of a community (infrastructure), industrial development has a possibility of contributing to an agricultural service centre's growth. A weak infrastructure can lead to a community's demise if stressed beyond its capacity:

> The built environment of an urban area provides a physical link to its past and to its future. Although the urban capital stock takes many forms ... in public and private hands ... the sinews of the permanent city lies in its road, bridge, and transit network, in its water and sewer lines, power facilities, parks and recreation areas and public buildings. This infra-structure has been inherited from the past, and its character, location and pricing will help shape urban development in the future ... At the same time, inadequate, inappropriate, or poorly maintained infrastructure can greatly restrict the development opportunities of older cities and contribute to the spiral of urban deterioration and disinvestment.[9]

Successful examples of rural and urban development[10] have a common characteristic; both are dependent on a strong infrastructure.

The rationale for locating a firm in a certain community within a specific region can encompass many different theories of growth and development. From the material (Cox, Grover and Sisken) quoted previous-

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[9] National Research Council <u>Critical Issues For National Urban Policy: A Reconnaissance And Agenda For Further Study</u> (National Academy Press Washington D.C. 1982) p.87.

[10] Their differences stem from urban development's infrastructure being at a much larger scale than rural development's infrastructure. Another contrast is a rural development will typically base its economy on agricultural or other primary products while an urban development will lean towards manufacturing, transportation, retail outlets, etc.

ly, it is not just water endowments or developments that will result in regional economic growth. Therefore, it is appropriate to focus attention on different aspects of regional development. More specifically, these aspects encompass theories that attempt to explain the differences in regional growth and development, i.e., regional disparities.

2.2 GROWTH THEORIES

Regional disparities are significant and can influence future economic growth and welfare. They are evident when comparing different sectors. As suggested in Clark Edwards's, The Political Economy of Rural Development: Theoretical Pespectives, growth in either rural or urban sectors have an impact on one another. Although this shows an interlinking characteristic between the two sectors, the growth processes are often unbalanced in favor of the urban sector. This is illustrated in Edwards's article by:

> The income gap between the rural and urban sectors continues to widen; rural income per capita is around three fourths of urban income. The incidence of rural poverty is twice as high as urban poverty. Rural people have relatively limited access to health facilities, they are more likely than urban dwellers to live in substandard housing, and they attain lower levels of education.[11]

In an attempt to understand regional disparities and growth, it is advantageous to be familiar with the various theoretical explanations of economic growth. Edwards has identified these 'five key theoretical factors' as:[12]

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[11] Clark Edwards The Political Economy Of Rural Development: Theoretical Perspectives American Journal of Agricultural Economics 58(1976) p.914.

[12] Ibid. pp. 914-921.

1. Increasing Resource Availabilities
2. Advancing Technology
3. Expanding Markets
4. Conquering Space
5. Building Institutions

These theories attempt to describe the factors that cause economic growth. Although not all of these theories will be used in this study, the range of these theories provides a good background for understanding various types of economic growth impacts. Consequently each will be considered in some detail below. The basic premise of these theories are illustrated by Edwards's article and are reproduced as follows;

2.2.1 i) Increasing Resource Availabilities (more input impels more output)

Neoclassical and classical theories suggest that regional disparities stem from variances in the regional availability of three resources: 1) Land, 2) Labor, 3) Capital. Edwards suggests the most popular theory for growth is the accumulation of capital.

The question that is debatable is whether either public or private capital is the cause of economic development. Hirschman leans away from crediting public capital. In contrast, other theorists have felt that economic growth would find its origin in public capital (i.e., schools, roads, sewer and water, etc.).

The supply of land, in Ricardo's eyes, was perfectly inelastic. Therefore, there would be a limit to resource availability. That is, once all the prime land has been employed the land would have to be more intensively used. In the same era, Malthus suggested that the population growth would be limited by food production capacity.

With respect to regional population, the impact of growth in migration was focused upon much more by theorists than the impact of natural population growth. However, different aspects of migration were considered to be significant. Labor increase, by way of large influxes of people to the community, could either be "economically positive" through an increase in productive capabilities, or "economically negative". This means if the immigrants failed to acquire jobs and be productive, they would become a burden on society through their lack of taxable income. In addition, the need for increased expenditures for welfare support, which is locally funded, would be required to support the nonproductive immigrant.

In summary, neoclassical growth theorists believed the best way to induce growth in rural areas would be through the provision of more resources. These are basically supply oriented theories.

In a Manitoba context, an example of such a community is Winkler. Increasing resource availability (increased primary production, water, fuel, migration of workers, increased capital investments) coupled with an increase in industrial park size, as well as tax incentives have initiated economic growth for this region. Therefore, the catalyst to economic growth in the region was increased agriculturally-related industries.

2.2.2 ii) Advancing Technology

Technological advancement seems to be another popular explanation for economic growth as argued by contemporary economists. These theories imply that increasing resource productivity is associated with technological advances, i.e., technical improvements resulting in increased productivity. Increased productivity, in turn, promotes economic growth. Regional growth will also be dependent on how well the labor force is trained with respect to implementing the technical improvements to increase production and benefit society.

In terms of rural communities, examples of such changes have been improved seed varieties, i.e., advancing technology in seed production and germination. There have also been technological developments in land management and cultivational practices, e.g., fertilizers and chemicals. A facility in South central Manitoba which undertakes such research is the Agriculture Canada Research Station, which is situated on 627 acres of farmland in Morden. Here, new strains are sought for early maturing field crops, fruits and ornamentals. Adoption of these new varieties by farmers will stimulate increased agricultural production which in turn will stimulate economic growth in the surrounding region.

Another example of technology's role is illustrated by rapeseed advancements. Thirty years ago rapeseed did not have varieties with appropriate characteristics to capture the markets. Through technological advances it is now the second most valuable export crop. Without these technological developments, the notion of expanding markets for this crop would never have been realized.

2.2.3 iii) Expanding Markets

Expanding markets, as a factor in economic development, have been evident through interregional, interprovincial and international trade flows. The growth of a community is often dependent on its ability to sell its processed goods to outside markets. Exporting processed goods constitute a means for market expansion for the community (region), since outside income is received by the community.

Demand oriented theories that support this view are export base theory and economic base theory. Both argue that increases in exports promote economic growth through directly and indirectly increasing employment, income and output. Regions mutually gaining through exports or imports is a concept that was developed by Ricardo[13] and also by Mill.[14] In support of this, Edwards states:

> Comparative advantage, which is based not only on markets but also on internal resource availability, technology, and economic structure, implies that two trading regions can produce a greater total produce than if there was no trade.[15]

Evidence of the need for expanded markets with respect to Agro-Manitoba was stated in the beginning of this chapter. More specifically, canned and other forms of secondary processed goods are not entirely consumed domestically. As a result, a large portion of total production

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[13] David Ricardo The Principles Of Political Economy And Taxation (1st edition 1817) Reprint 3rd edition New York E.P. Dutton and Company. (1912).

[14] John Stuart Mill Principles Of Political Economy Books IV and V Edition Donald Winch (1st edition 1848) Baltimore: Penguin Books, 1970.

[15] Clark Edwards The Political Economy Of Rural Developments: Theoretical Perspectives American Journal of Agricultural Economics 58 (1976) p.916.

of the processed goods is exported. Consequently, expanding the export market will result in domestic growth.

2.2.4 iv) Conquering Space

Some theorists have felt the aspect of spatial relationships are the basis of economic growth. In essence, this means that the prospects for development of a specific area will depend on where it is located, i.e., in an isolated region which is rural or in the hinterland of an urban region. Evidently, locating in an isolated region is less preferable since high transportation costs and labor shortages will occur. This will be due to the inability of the community to reach the various markets (product and labor).

The conquering of space is directly related to the alleviation of transportation and communication problems over time and space. This suggests the transportation of goods and labor to the points of production (processing firms) and consumption (markets) with minimal use of the resources required in moving them. As a result, resources salvaged through efficient usage could then contribute to the production of more goods and services. In turn, this would promote economic growth.

An example of this in Manitoba is improved accessibility via highways and railways allowing the rural community to import and export produce. Increased accessibility will also promote regional growth since it will be easier and more economical for the producer to transport commodities from the farm to the processing firms or the markets.

2.2.5 v) Building Institutions

Edwards stresses that public institution installation does not always succeed economic development. Instead, 'purposive institution building may be required to produce desired economic development'.[16] That is, institutions may precede economic development in hopes of inspiring or promoting regional economic development.

Examples of such institutions which have contributed to regional development are: the Department of Regional Economic Expansion (DREE), Prairie Farm Rehabilitation Administration (PFRA), and with respect to Manitoba, the various Regional Development Corporations (West-Man, East-Man, Pembina Valley, etc.).

The above 'five key factors' are evident in many different examples of regional growth. Usually it is a combination of these factors that spark and support economic growth. Although all factors play a role with respect to locating water intensive agriculturally based secondary processing industries, this study will focus on the increased resource availability aspect (treated water and agricultural primary product). The rationale for focussing on resource availability is the limited potential in rural Manitoba for other factors of processing.

In order to distinguish between an economically optimal vs. sub-optimal locational site, various aspects of location theory must be discussed. As a result, this thesis will now discuss the portions of loca-

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[16] Ibid. p.920.

tion theory that will be relevant to the study. It will help in eliminating factors irrelevant to the nature and characteristics of the firms under consideration, which are agriculturally based secondary processing firms and their finished products.

2.3 LOCATION THEORY

It is important to be familiar with certain aspects of the theory of location and the type of objective systems analysis a large firm will use in selecting a particular plant site. Some of these principles and concepts of location theory have been developed from Weber's (1909)[17] initial suppositions and theories of industrial location. Weber's theories in turn stemmed from Von Thunen's model (1826)[18] which explained the relationship between land utilization and spatial location.

In essence, Weber's analysis began with various basic assumptions regarding location of basic resources, climate and topography. The objective of the analysis was to determine the best location for an industry if raw materials were available at one site, resources needed in processing at a second site and the major market at a third site. The highlight of his study was the consideration of transportation and the influencing conditions (agglomeration economics) resulting from various factors on location decisions which aided in determining the optimum location. In short, location theory describes the economic analysis in-

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[17] Alfred Weber Alfred Weber's Theory Of The Location Of Industries (1st edition 1909) translated by Carl J. Friedrich, Chicago: University of Chicago Press, 1957.

[18] Johann Heinrich Von Thunen Der Isolierte Staat (1st edition Hamberg: Perthes, 1826).

volved in comparing alternative spatial locations for a specific type of activity. This study will focus on one aspect of location theory models in an attempt to justify the location of particular types of industries in various communities.

Assuming that industrialists have an economist's preconceptions of a firm's motives, industrialists will try to maximize their profit in the selection of firm sites. This suggests that the selected sites will facilitate the industry's physical requirements and at the same time meet the requirements of high productivity, low costs and a readily available market.

The industrial firm must move through three stages of production to attain its objective of meeting the supply requirement of the market. The firm must:

a) acquire raw materials for processing (resource base - agricultural primary products, water),

b) process the raw material into a marketable output,

c) distribute the finished output to its various consumers.

In essence, stages b) and c) are infrastructure requirements. Within these three stages of production there are two major types of costs; transfer costs and processing costs. More specifically, stages a) and c) primarily involve transportation costs. Stage b) involves processing (production) costs. These latter expenses are the costs which arise as labor, water and other input factors are used in transforming raw materials into semi-finished and/or manufactured goods. Transportation expenses deal with the costs involved in moving; materials to the processing firms (distance from primary production land), and the processed good to the markets. If procurement costs are high and variable, the firm is one of a material oriented industrial nature. It should locate its plant near the source of raw materials to keep the procurement costs low.

A raw material orientation arises if there is a great weight or bulk reduction of raw material in the processing stage. A raw material oriented firm produces output that is more compact and lighter, thereby reducing costs in shipping to the market. Another type of material oriented industry involves those firms where the raw materials are much more fragile or perishable than the processed output. These considerations are relevant in Agro-Manitoba since some of the secondary processing involved is done to reduce bulk (e.g., potato processing, oilseed crushing) and preserve produce (e.g., canning plants).

Material oriented industry can be categorized into four groups:

1) Industries such as fishing, lumbering, mining, and outdoor recreation and agriculture are material oriented industries. Since they are limited to the location of the basic natural resource which they are dependent upon.

2) Industries which have activities that would involve elimination of waste materials and unnecessary weight, eg. are minerals which have a large quantity of rock and slag following extraction. Various agricultural processing activities are also in the class eg. sugar beets or sugar cane prefer processing facilities nearer as does cheese, dried and condensed milk, cane and maple syrup, resin, turpentine and vegetable oil processing plants try to be near to their source of supply.

3) A third class of material oriented industry are ones which involve activities that require large quantities of power, fuel, or water. More generally activities that require great quantities of resources which will not appear in the fi-

nal output. Such examples are aluminum plants which locate near hydro electric power sites.

4) The fourth group involves processing activities that will make the output less perishable and create greater ease in handling. Such examples would be canning operations which lower transportation and storage costs while at the same time reducing perishability of various agricultural products such as fruits and vegetables. A more explicit example would be processing metals into sheets to increase ease in handling and storage.[19]

The savings in transfer costs have to exceed the cost advantages of another location before the industry can be classified as material oriented.

The opposite of a material oriented industry is a market oriented industry. This type of industry is characterized by:

1. output being perishable or fragile,
2. frequent contact with consumers,
3. bulk or weight gain in production or processing, i.e., output more expensive to transport than raw material,
4. transportation rate charge is higher for finished output than raw materials,
5. products are more complex and must be transported separately.

Examples are: milk bottling, bottled beverage plants, building construction industries, breweries.

A third type of industry is the 'foot-loose' or other attraction oriented industry. These industries are neither primarily material oriented nor market oriented. Therefore, they are bound only by specific lo-

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[19] Raleigh Barlowe, Land Resource Economics Second Edition (Prentice-Hall Inc., N.J. 1972), pp.292-293.

cation incentives, e.g.,taxbreaks, financial inducements (money gifts, rent free or low rent sites, etc...). They can locate between principal sources of raw materials and their major market or at either point. Such an example, could be an industry that requires a high volume of labor. It will locate in an area that has sufficient available labor and low wages. This could be near its source of raw materials, markets or somewhere in between. Firms could also import the labor into the area if the mobility of labor is high. In general, intermediate locations are less desirable because of higher handling costs, i.e., primary (raw product) to secondary processing, to market and then to the consumer.

Various components of both growth and location theories are apparant when dealing with regional development. Location theory is illustrated by both infrastructure requirements of a community and resource availability (primary production and water). These factors are illustrated by growth theories as well, i.e., growth through increased availability of resources.

The next chapter will deal with the infrastructure of the 19 'potential sites'. The components of a water supply system are illustrated as is the water supply situation of each community. The infrastructure demonstration will show each community's capabilities for supporting industrial and economic growth.

The growth theories and location theory combined with a summary of the various communities and their infrastructures will set the scenario for regional development. However, there must be some economic deviation (catalyst) implemented to trigger this regional development.

As suggested previously, the rural areas of Southern Manitoba are agriculturally based. This characteristic, combined with the region's limited non-agricultural industrial potential, suggests the 'catalyst' will be agriculturally based secondary processing industries. Due to the limited potential in rural Manitoba for the development of other raw materials and the requirement of significant quantities of water for most types of agricultural product processing, the water availability aspect will be concentrated on. That is, water is the most limiting factor of production in these regions. As a result, the focus will now be water-intensive agriculturally based secondary processing industries. The various centres will be examined to determine location advantages for these types of industries.

The two location criteria that will be focused on are: water, a major infrastructure requirement in food processing, and agricultural primary product availability, which affects the first stage of production as illustrated in the location theory section. Agricultural primary product availability will help this study choose appropriate water-intensive secondary processing industries for various sites. Since some of the processing is bulk reducing and material oriented, it should be located near the primary resource. If the site and industry combination meet these criteria, a cost-benefit analysis will be applied to evaluate the impact of implementation for various sites and industries.

Chapter III

LOCAL INFRASTRUCTURE AND THE SUPPLY OF MUNICIPAL WATER

3.1 INFRASTRUCTURES

Infrastructure plays a critical role in the success or failure of an agricultural centre's growth and development. If the infrastructure is strong, it will be able to support the added demands associated with the agricultural centre's growth and may proceed a step further to actually promote more growth and development. In this situation a strong infrastructure with excess capacity attracts more capital investment which will result in economic growth.

To illustrate the infrastructures of the various communities clearly, the most recent relevant facts and figures are presented in tabular form in Tables 1-7. Tables 1-7 have been derived from a combination of the Manitoba Community Reports (1981) and the Water Resources Branch's Water Demand Study - Municipal And Industrial - Current And Historical Water Uses (November 1982).

There are several factors to consider, one being population growth represented by population figures for four successive census years for each community. Other factors are utilities: municipal water supply, sewage treatment, electrical, gas, and heating oil. These have been described to show the capacities and availability.

TABLE 1

Communities And Their Infrastructures

	Altona	Beausejour
A) Population		
i) 1966 Census	2,129	2,214
ii) 1971 Census	2,125	2,235
iii) 1976 Census	2,480	2,422
iv) 1979 Census	2,961	2,692
B) Water (Imperial gallons)		
i) Source	Neche, North Dakota	Wells (2)
ii) Plant Capacity	240,000/day	775,000/day
iii) Storage Cap.	500,000	62,000
iv) Avg. Consump.	110,000/day	180,000/day
v) Peak Consump.	135,000/day	320,000/day
vi) Peak Months	June-August	March, June-July
C) Sewage		
i) Treatment	Aerated Lagoon-3cells	Lagoon-5cells
ii) Capacity	45 acres	77.6 acres
iii) Operating %	30% of Capacity	90% of capacity
D) Other Utilities		
i) Electrical	Manitoba Hydro	Manitoba Hydro
ii) Gas	Plains Western Gas	Greater Winnipeg Gas
iii) Heating Oil 35,000 B.T.U./L	$.255/L tank wagon	$.255/L tank wagon
E) Transportation		
i) Rail	-------------	Freight-C.P.R as traff. warrants
ii) Truck	Altona Freightways Limited for C.N.&C.P.	Naayken's Transport
iii) Bus	Grey Goose (Wpg.)	Grey Goose
iv) Air strip	1 mile S.E. of town (lighted)	-------------

TABLE 2

Communities And Their Infrastructures

	Boissevain	Brandon	Carman
A)			
i)	1,473	29,981	1,922
ii)	1,510	31,150	2,030
iii)	1,584	34,901	2,272
iv)	1,763	37,879	2,563
B)			
i)	P.F.R.A. Reservoir	Assiniboine River	Boyne River and (Stephenfield Res.)
ii)	288,000/day	12,000,000/day	560,000/day
iii)	125,000	4,625,000	304,000
iv)	82,000/day	3,500,000/day	200,000/day
v)	130,000/day	5,850,000/day	350,000/day
vi)	July-August	July-August	May-July
C)			
i)	Aerat. Lagoon-2cells	Lagoons-5cells and 1Sewage treat. plant	Lagoon-3cells plus 1 standby
ii)	11 acres	6 million gal./day	34 acres
iii)	70% of capacity	60% of capacity	70% of capacity
D)			
i)	Manitoba Hydro	Manitoba Hydro	Manitoba Hydro
ii)	Propane-3 suppliers	Plains Western Gas	Plains Western Gas
iii)	$.259/L tank wagon	$.257/L tank wagon	$.255/L tank wagon
E)			
i)	Freight - C.P.R. as traffic warrants	Freight - C.P.R.&C.N. Passenger - Via	Freight-C.P.R., C. N.-traff. warrants
ii)	Hammond Transport	20 truck lines	Carman Transfer C.N. Express
iii)	Grey Goose	Grey Goose&Grey Hound Man. Motor Transit	Grey Goose - daily
iv)	1 mile N. of town (lighted)	4 miles N. of city (lighted) Perimeter Airlines	S.W. edge of town (lighted)

TABLE 3

Communities And Their Infrastructures

	Dauphin	Deloraine	Melita
A)			
i)	8,655	910	1,101
ii)	8,890	960	1,135
iii)	9,109	1,019	1,169
iv)	9,916	1,174	1,323
B)			
i)	Edwards Lake, Ver- (gravity flow)	Turtle Head Creek P.F.R.A. reservoir	5 wells
ii)	1,800,000/day	93,600/day	230,400/day
iii)	1,500,000	80,000	62,500
iv)	960,000/day	35,000/day	73,000/day
v)	1,400,000/day	45,000/day	110,000/day
vi)	March,May,August	May-June	-------------
C)			
i)	Aerated Lagoon-5cells	Lagoon-3cells	Lagoon-3cells
ii)	96 acres	15.5 acres	13.5 acres
iii)	75% of capacity	60% of capacity	-------------
D)			
i)	Manitoba hydro	Manitoba Hydro	Manitoba Hydro
ii)	Inter-City Gas	-------------	-------------
iii)	$.259/L tank wagon	$.259/L tank wagon	$.259/L tank wagon
E)			
i)	Freight - C.N.(daily) Passenger - Via	Freight - C.P.R. as traffic warrants	Freight - C.P.R. as traff. warrants
ii)	Gardewine Freighters	Hammond Transport Border Transport	Hammond Transport Critchlow Trucking
iii)	Grey Goose and Grey Hound	Grey Goose and Grey Hound	Grey Goose and Grey Hound
iv)	3 miles S. of town (lighted) Perimeter Airlines	3 miles S. of town (lighted)	S.W. edge of town (lighted)

TABLE 4

Communities And Their Infrastructures

	Minnedosa	Morden	Morris
A)			
i)	2,305	3,097	1,339
ii)	2,620	3,270	1,400
iii)	2,718	3,886	1,572
iv)	3,093	4,585	1,872
B)			
i)	3 municipal wells Minnedosa Lake	P.F.R.A. reservoir Lake Minnewasta	Red River
ii)	950,000/day	720,000/day	200,000/day
iii)	220,000	730,000	150,000
iv)	380,000/day	365,000/day	130,000/day
v)	900,000/day	1,100,000/day	250,000/day
vi)	-------------	July-August	May-August
C)			
i)	Aerated Lagoon	Lagoon Domes.-4cells Industry-3cells	Lagoon-4cells
ii)	-------------	Domestic-18 acres Industry-71 acres	40 acres
iii)	-------------	-------------	80% of capacity
D)			
i)	Manitoba Hydro	Manitoba Hydro	Manitoba Hydro
ii)	Inter-City Gas	Plains Western Gas	Plains Western Gas
iii)	$.257/L tank wagon	$.257/L tank wagon	$.255/L tank wagon
E)			
i)	Freight-C.P.R. daily	Freight-C.P.R. Tri-weekly	Freight-C.N. daily C.P.R. tri-weekly
ii)	C.P. Trucking, Hare's Cartage, Neepawa Trk. Serv., Delmage Trans.	Southwest Transfer	Morris Transfer
iii)	Grey Goose, Webb Grey Hound	Grey Goose	Grey Goose & Grey Hound
iv)	4 miles S.E. of town	2 miles N.E. of town (lighted)	3 miles N. of town

TABLE 5

Communities And Their Infrastructures

	Neepawa	Portage La Prairie	Russell
A)			
i)	3,229	13,012	1,511
ii)	3,215	12,950	1,525
iii)	3,508	12,555	1,524
iv)	3,979	13,928	1,911
B)			
i)	Whitemud River, Lake Irwin	Assiniboine River, Wells	Conjuring Creek
ii)	300,000/day	5,000,000/day	100,000/day
iii)	650,000	1,500,000	80,000
iv)	250,000/day	2,000,000/day	55,000/day
v)	441,300/day	2,000,000/day	65,000/day
vi)	July-August	March, August	May-July
C)			
i)	Lagoon-3cells	Pollution Control Centre	Lagoon-2cells
ii)	56 acres	25 acres	10 acres
iii)	80% of capacity	-------------	50% of capacity
D)			
i)	Manitoba Hydro	Manitoba Hydro	Manitoba Hydro
ii)	Inter-City Gas	Inter-City Gas	Inter-City Gas
iii)	$.257/L tank wagon	$.255/L tank wagon	$.257/L tank wagon
E)			
i)	Freight-C.P.R. daily C.N. as traffic warrants	Freight-C.P.R. & C.N. daily Passenger - Via	Freight-C.P.R., C. N.-traff. warrants
ii)	Neepawa Truck Serv. Hare's Cartage	Atomic Transfer, C.P. Transport, Transx, C.N. Express, Hale's Transport	Russell Transfer C.P. Transport
iii)	Grey Goose, Webb, Grey Hound	Grey Goose, Webb, Grey Hound	Grey Goose, Webb, Grey Hound
iv)	1.7 miles W. of town	4 miles from city (lighted)	-------------

TABLE 6

Communities And Their Infrastructures

	Steinbach	Souris	Selkirk
A)			
i)	4,648	1,829	9,157
ii)	5,200	1,675	9,331
iii)	5,979	1,712	9,862
iv)	7,397	1,870	10,546
B)			
i)	2 wells	Souris River, Wells	Red River
ii)	1,800,000/day	360,000/day	1,900,000/day
iii)	750,000	175,460	120,000
iv)	500,000/day	115,000/day	830,000/day
v)	650,000/day	192,000/day	1,665,000/day
vi)	March, August	June-August	May
C)			
i)	Lagoon-5cells	Septic tank-2units	Contact Stabilization plant
ii)	45 acres	-------------	-------------
iii)	85% of capacity	-------------	40% of capacity
D)			
i)	Manitoba Hydro	Manitoba Hydro	Manitoba Hydro
ii)	Inter-City Gas	-------------	Greater Winnipeg Gas
iii)	$.255/L tank wagon	$.259/L tank wagon	$.252/L tank wagon
E)			
i)	-------------	Freight-C.N. as traffic warrants	Freight-C.P.R., C.N.-traff. warrants
ii)	Southeast Transfer	C.P. Transport, Al's Transfer	Veitch Truck Lines Goodbrandson's Transfer
iii)	Grey Goose - daily	Grey Hound, Webb	Beaver Bus Lines
iv)	In city (lighted)	2.5 miles E. of town (lighted)	1 mile N. of town

TABLE 7

Communities And Their Infrastructures

	Virden	Winkler
A)		
i)	2,933	2,570
ii)	2,820	2,980
iii)	2,936	3,749
iv)	3,099	5,902
B)		
i)	Well	Wells - Manitoba Water Supply Board
ii)	400,000/day	720,000/day
iii)	230,000	330,000
iv)	250,000/day	138,000/day
v)	350,000/day	175,000/day
vi)	June-August	July-August
C)		
i)	Deep Shaft	Lagoon-5cells
ii)	for population of 5,000	56 acres
iii)	60% of capacity	75% of capacity
D)		
i)	Manitoba Hydro	Manitoba Hydro
ii)	Inter-City Gas	Plains Western Gas
iii)	$.257/L tank wagon	$.257/L tank wagon
E)		
i)	Freight - C.P.R. daily Passenger - Via	Freight - C.P.R. tri-weekly
ii)	C.P. Transport, Transx	W. Freightways, Winkler CO-OP Trucking
iii)	Grey Hound	Grey Goose
iv)	1 mile N. of town	1/2 mile S.E. of town

The final factor in the infrastructure table is the availability of transportation (rail, truck, bus, air). This is employed to illustrate the alternative means available for product distribution. More importantly, it exemplifies the fact that the community is or is not an isolated district without accessibility. As a result, the communities are accessible and economic growth is supported by a healthy infrastructure.

Since this study focuses on water (a major infrastructure requirement in food processing), the next section will illustrate the existing municipal water supply systems.

3.2 MUNICIPAL WATER SUPPLY SYSTEMS

Clarification of the nature of the components of various current water supply systems is needed. They consist of;

1) Raw water supply: This encompasses wells, rivers, reservoirs etc.. An adequate raw water supply is very important since inadequacies in this major component would result in a need for discoveries or diversions of other supplies of water. Diversions can present a number of problems. First the high cost associated with implementing new supplies of water and secondly, the associated costs from renovating the treatment and storage capacities of the current system to adapt them to the increased supply of municipal water.

The source of water in this analysis is viewed from a short run perspective. This eliminates the problem associated with developing a greater water supply from a limited source. When a water supply source is limited, e.g., reservoirs, wells, etc., the only alternative a community has is to acquire a new source. If such a source is not readily available, costs can be astronomical. It is important to note that long run water availability can be a major problem when dealing with limited water sources or diversions. Communities with a perpetually flowing river as a source of water will not come across such problems.

2) Water treatment facility: The study will consider this factor in terms of its capacity rather than measure it in terms of water treatment quality. This recognizes that the majority of communities provide sufficient water quality for any industrial activity discussed.

3) Water storage facility: This component is one of the most important, since it would be the amount of buffer capacity available in instances of treatment facility servicing or peak period usage.

4) Sewage treatment: The main objective of this component is to remove wastes (i.e., contaminated water, etc.). In general, it was found that the capacities of the sewage treatment facilities in the communities studied were adequate.[20] In the same short run context as observed in the raw water supply section, the sewage removal facility is relatively cheap and readily available if the facility is a river. However, in communities which use lagoons, the availability of sewage disposal is to some extent limited. Once these lagoons are at capacity, the only recourse available is the implementation of a new lagoon.

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[20] This was demonstrated by Provincial Community Reports and also by Manitoba Department of Natural Resources Water Resources Branch, Prairie Provinces Water Board Water Demand Study Municipal And Industrial Current And Historical Water Uses (November 1982). Recently the adequacy of these sewage treatment facilities have come into question. However since sewage facilities are not the focus of this study, it should not have an effect on this study.

As a result, both sewage treatment and water sources have been viewed using a relatively short time frame to avoid such problems.

The four factors of the municipal water supply system discussed above are reviewed on a community by community basis in Appendix A to specifically show the existing municipal water systems and associated constraints. The following communities are grouped (Figure 2) using the five economic regions of Manitoba; South-West, North-West, Interlake, Central and Eastern. The communities are inversely ranked with respect to the magnitude of the water supply system renovations required.[21] That is, a complete renovation corresponds to the lowest ranking. The groupings also correspond to the magnitude of the water supply system renovation. The ranking of the 19 communities is illustrated by Table 8.

As demonstrated in the ranking, there are some community water systems available which do not presently require renovation or upgrading to accomodate increased industrialization. These are; Carman, Boissevain, Beausejour, Brandon, Souris, Neepawa, Morris, and Morden. The present water systems of these communities seem capable. However, it depends on the type of industrialization to be implemented. Water intensive industries may require an increase in the buffer capacity (water storage) to meet peak requirements.

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[21] The information regarding the changes to each municipal water supply systems were acquired from the people at each of the Communities' water treatment facility or other town officials.

Figure 2: Map Of Five Economic Regions - (Southwest #1,2,3 Northwest #4,5,6 Central #7,8 Eastern #9,10 Interlake #11,12)

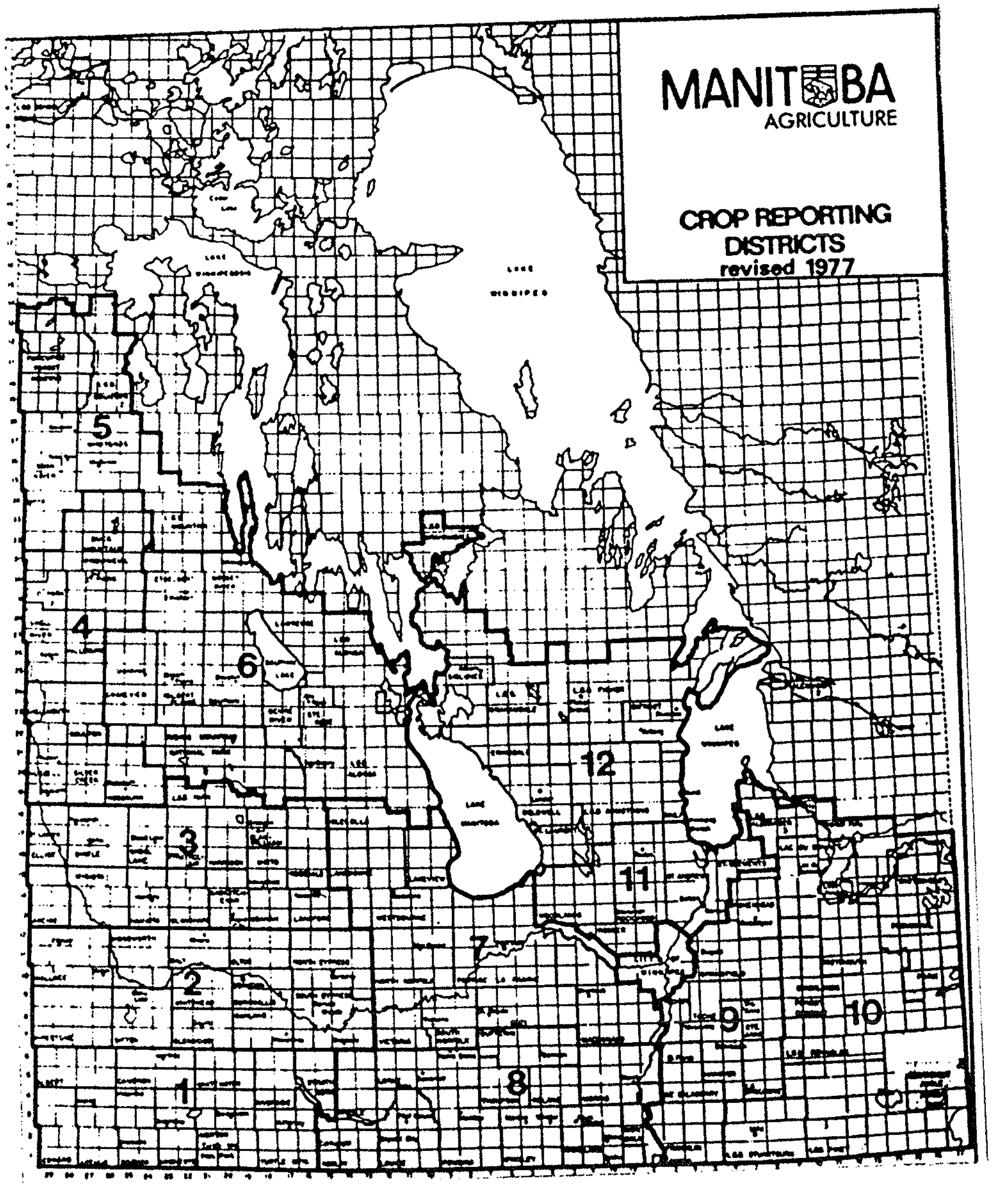

TABLE 8

Communities And Their Municipal Water System Problems

Carman: no immediate problems seem evident.

Boissevain: no immediate problems seem evident.

Beausejour: no immediate problems seem evident.

Souris: no immediate problems seem evident.

Neepawa: no immediate problems seem evident.

Brandon: no immediate problems seem evident.

Morris: quality of the water is often suspect.

Morden: supply is adequate but quality could be improved, i.e., improved filtration.

Melita: needs supplemental water storage facility.

Selkirk: needs supplemental water storage facility.

Portage La Prairie: needs supplemental water storage facility.

Russell: needs supplemental water storage facility.

Winkler: needs additional storage facility and additional source of raw water.

Virden: needs additional storage facility and additional source of raw water.

Steinbach: needs additional storage facility and additional source of raw water.

Minnedosa: treatment facilities must increase volume treated.

Deloraine: treatment facilities must increase volume treated, i.e., more volume pumped through plant eg. 100 imperial gallons/minute.

Dauphin: needs a water treatment facility.

Altona: needs its own municipal water supply system, i.e., needs a treatment plant and a large reservoir that could be filled by both its own plant and the Neche plant.

The most effective means to upgrade a water supply system is the storage facility. Many of the communities which appear to have problems with respect to water supply systems are the communities which have very limited or restrictive storage capabilities. The next chapter deals with local demand for water, production acreages and the implications for secondary processing, which in turn may create a need for increased water storage capabilities.

Chapter IV

LOCAL DEMAND FOR WATER

4.1 TREATED WATER USAGE

For any good, whether consumed by individuals or industries, there is both a supply and a demand. If the supply greatly exceeds demand inefficiency exists in the form of a misallocation of resources. The same can be said of the reverse situation where the supply cannot keep up with demand. With a municipally supplied public good such as water, either extreme can be detrimental to the economy. If not enough water is supplied, water intensive industries will eventually close or be forced to find their own source of water. As a result, an economy which depends on such industries will deteriorate.

The other extreme also has negative effects with respect to the region, i.e., a water supply system that exceeds its demands must be constructed and maintained even if it is not used to capacity. As a result, the community would have to bear unnecessary overhead expenses.

Now that the supply situations have been presented in Appendix A, there must be a discussion on the demands for this municipally supplied good. Clear distinctions must be made between various user groups to be able to specify and isolate water users that are relevant to this study. Current uses consist of:

a) industrial: water which is used in secondary processing and manufacturing.

b) residential: trailer courts, houses, apartment blocks, condominiums.

c) commercial: hotels, motels, restaurants, stores, service stations, car washes, dry cleaners, laundromats, banks, offices, theaters, beauty salons, etc.

d) public: libraries, swimming pools, ice rinks, golfcourses, government agencies, museums.

e) institutional: schools, hospitals, churches, penitentiaries, senior citizen homes, etc.

Although consumption can be divided into these various classifications, it was discovered that municipalities most often divide their consumption under three headings. These were; i)commercial, ii)domestic, and iii)industrial. Quite often the industrial heading was not in existence, in which case only commercial and domestic uses were included in aggregate water consumption totals. In such an event, domestic included residential while commercial covered all other remaining consumption categories.

4.2 AGRICULTURAL PRIMARY PRODUCTION

Before the study can focus on water intensive processing industries, it must be decided what industries are appropriate.

To determine the best location for the various types of water intensive secondary processing firms, the data required include:

i) districts immediately serviced by the agricultural service centre.

ii) acreages of various types of primary production for each district (Appendix B).

The primary production data, obtained from the 1981 Census of Agriculture in Manitoba, will aid in eliminating some of the secondary processing activities and locations so that the study can focus on industries that will contribute to the benefit of the region and the adjacent regions. That is, there would be little point in locating a potato processing plant in a district that does not produce potatoes. It would be much more suitable to situate this plant close to a potato growing district. Thus food producers and processors will be able to take advantage of reduced transportation costs, both in moving produce to the plant and the finished good from the plant, due to the weight shedding procedure of production.

Since water is one of the criteria, the emphasis will be on the highly water extensive processing industries. An example of such an industry is potato processing, where activities range from cleaning and packing the potatoes for table use to changing their form to potato chips, potato flakes or to frozen states.

As stated previously, most of the agriculturally based secondary processing in Agro-Manitoba would be considered material oriented industries. Therefore, the processing involves reducing the bulk of the primary agricultural product. Of course, locating the plant in a district should not suggest the plant is for the exclusive use of that district only. Any nearby district will also use the facility if it were to be more economical than going to a different district or constructing additional plants nearby.

The districts that have been focused on are those which immediately surround the nineteen communities and the adjacent districts which will be benefitted by increased industrialization. The districts must have enough primary production to warrant locating a secondary processing firm there. The districts which each agricultural centre is assumed to service are shown in Figure 3 and described in Table 9.

The aggregate crop and livestock production of the primary and adjacent census divisions are dealt with more thoroughly in Appendix B. This assists in deciding which industries should be concentrated on in specific regions. Certain crops tend to be climate and soil specific. Therefore, the vertically linked secondary processing industries will tend to be region specific.

By analysing Appendix B, more specifically the Aggregate Divisional Crop Acreages, it can be seen that almost all of the divisions are highly grain oriented. However, as discussed previously, there are certain regions that produce a crop which thrives on particular soil and climatic conditions specific to that region. The distinctive agricultural

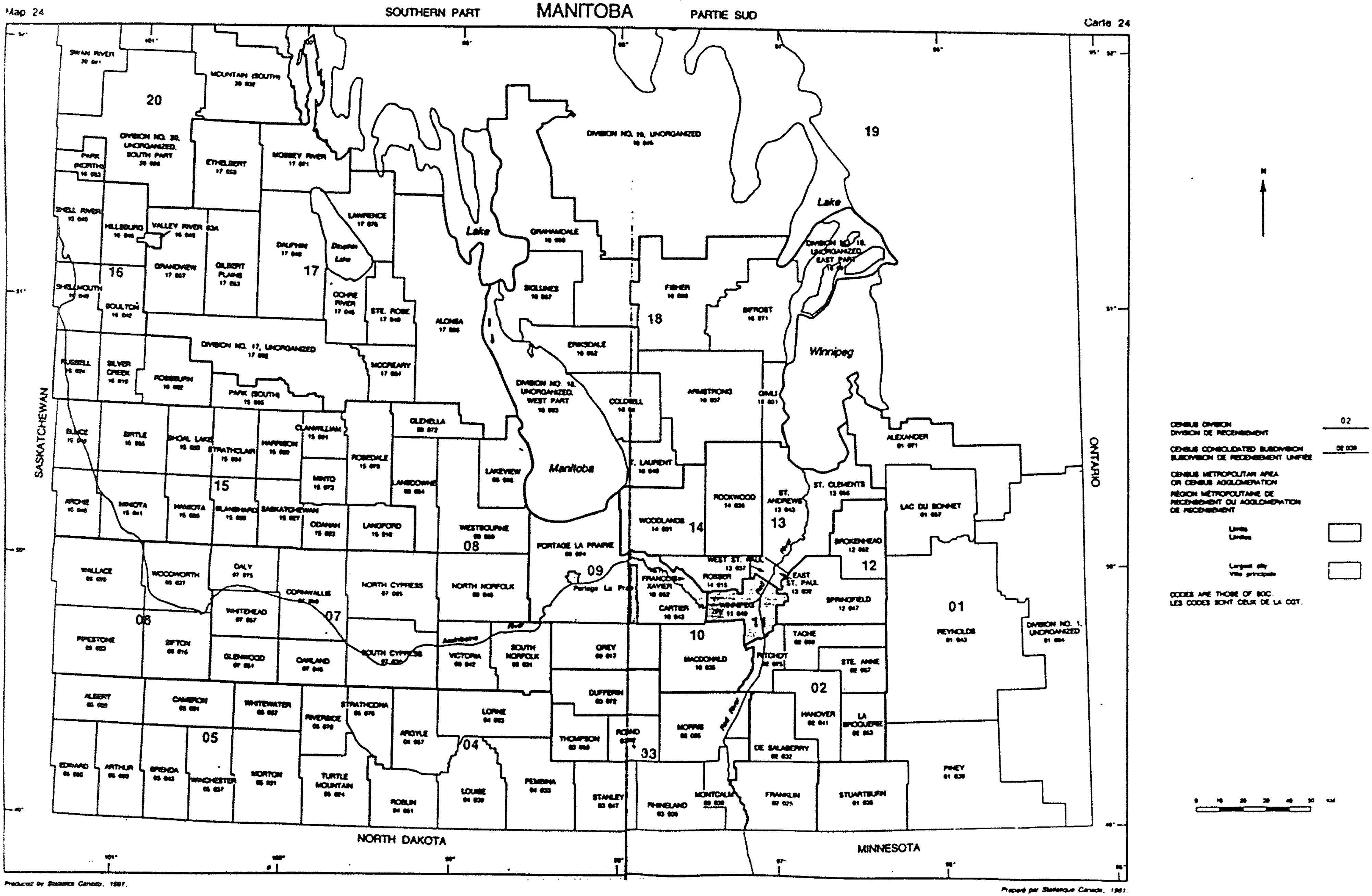

Figure 3: Agricultural Census Division Map

TABLE 9

Communities And The Adjacent Divisions Serviced

i) Melita, Deloraine and Boissevain service divisions #4,5,6,and 7.
ii) Virden services divisions #5,6,7,and 15.
iii) Souris and Brandon service divisions #5,6,7,8,and 15.
iv) Minnedosa and Neepawa service divisions #4,6,7,8,9,15,16,and 17.
v) Russell services divisions #15,16,17,and 20.
vi) Dauphin services divisions #8,15,16,17,and 20.
vii) Portage La Prairie services divisions #3,4,8,9,10,and 14.
viii) Carman, Morris, Mordan, Winkler and Altona service divisions #2,3,4,8,9,10,11,and 14.
ix) Steinbach services divisions #1,2,3,10,11,12,and 13.
x) Beausejour services divisions #1,2,10,11,12,13,and 14.
xi) Selkirk services divisions #11,12,13, and 14.

primary products other than grain, and their corresponding communities, are grouped by census divisions and are described in Table 10.

TABLE 10

Communities And The Various Types Of Primary Production In The Adjacent Census Divisions

i) Melita, Deloraine and Boissevain -	flaxseed, sunflowers, alfalfa,rapeseed, mustard seed, cattle, ducks, hens and chickens.
ii) Virden ------------------------	alfalfa, cattle, hens and chickens.
iii) Souris and Brandon -------------	corn, rapeseed, sunflowers, mustard seed, alfalfa, potatoes, dry field peas, flaxseed, turkeys, hens and chickens.
iv) Minnedosa and Neepawa -----------	alfalfa, rapeseed, mustard seed, flaxseed, cattle, geese, hens and chickens.
v) Russell -------------------------	rapeseed, mustard seed, alfalfa and ducks.
vi) Dauphin ------------------------	alfalfa, rapeseed, cattle, turkeys, hens and chickens.
vii) Portage La Prairie -------------	corn, flaxseed, sunflowers, alfalfa, rapeseed, potatoes, sugar beets, dry field peas, dry field beans, vegetables, ducks, turkeys, hens and chickens.
viii) Carman, Morris, Morden, Winkler, Altona -	corn, flaxseed, sunflowers, rapeseed, mustard seed, potatoes, sugar beets, dry field peas, dry field beans, vegetables, pigs, ducks, hens and chickens.
ix) Steinbach ----------------------	corn, sunflowers, alfalfa, sugar beets, dry field peas, dry field beans, pigs, vegetables, turkeys, hens and chickens.
x) Beausejour ----------------------	vegetables, dry field peas, dry field beans, hens and chickens.
xi) Selkirk -------------------------	dry field peas, dry field beans, vegetables, hens and chickens.

Now that the crop situation has been presented, the next step is to discuss the various types of agriculturally based secondary processing that will be appropriate for the different regions. Appendix C shows the existing agriculturally based processing activities in each of the nineteen communities and the relevant annual water usages of each of these industries for the year 1981.

4.3 AGRICULTURALLY BASED WATER-INTENSIVE SECONDARY PROCESSING

For this study, the most crucial part of the agriculturally based secondary industries' information is the volume of water used in processing operations. Water is a crucial component in locational decisions (i.e., water is the constraint). Many of the industries from Appendix C have not been taken under study since they do not use a significant amount of water and as a result are not constrained by limited treated water availability.

Some of the major water users such as meat processors have also been excluded. This is due to the special nature of these firms, i.e., agglomeration economies. This component of location decision-making is best substantiated through Berry, Conkling and Ray's The Geography of Economic Systems, where Weber's views are expressed:

> Having combined the effects of transport and labor costs, Weber then turned to the problem of determining how that location may be deflected within the region by the tendency of firms to agglomerate. In Weber's view, there are two main ways in which a company can gain the benefits of agglomeration. First, it may increase the concentration of production by enlarging its factory, thus obtaining savings through a

> larger scale of operation. Second, it may benefit by selecting a location in close-association with other plants. This "social" agglomeration yields benefits from showing specialized labor, and large-scale purchasing and marketing.[22]

In short, agglomeration economics has had a prevalent effect on locating new meat processing firms near existing firms, due to the economic advantages of sharing certain facilities and services which are industry specific, e.g., common stock yards for meat processors. This study wishes to focus on water constraints rather than other locational factors such as agglomeration economics.

The sugar beet industry is another exclusion. Given the nature of the sugar market and the costs of processing, it was discovered that sugar beet processing is a high cost process relative to cane sugar processing. Due to this high processing cost and the current state of the sugar market, it is questionable whether implementation of this type of industrial process will contribute to the goal of regional development. As a result of the insignificant potential of this type of industry, it is pointless to consider expansion of the capacity of this sugar beet processing sector.[23]

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[22] Berry, Conkling and Ray _The Geography Of Economic Systems_ (Prentice-Hall, Inc., Englewood Cliffs, New Jersey 1976) p.160

[23] The actual secondary process of sugar beets consists of three procedures which require a high volume of water; washing the beets, fluming them and additions. Approximately thirty to fifty million imperial gallons of water are used per year in the processing plant. However, in effect, the plant is only in operation for 90 days in a year. Although, the plant is functioning an intense 24 hours per day (in each of the ninety days), it does not operate past the 90th processing day.

Another exclusion, due to the questionable economic impact with respect to regional development, is the vegetable canning industry. In Agro-Manitoba this high unit cost sector is marginally profitable given the short length of the growing season. As a result of the low level of unit profit, industrial implementation of expansion of this type of industry is not feasible.

The processing of alfalfa is a dehydration process and is also omitted in this study since it uses negligible amounts of water.

Due to the nature of the rural area and the objectives of this study, the main criteria for choosing agriculturally based secondary processing industries for this study is their water-intensiveness. In essence, the more water-intensive, the more constraining a limited water supply system would be. After screening the various agriculturally based industries, the remaining secondary processes to be considered are shown by Table 11.

The next aspect to be considered is a description of these industries and their relative water-intensiveness. The description includes the annual water usage of each industry and the amount of primary product processed per year.

The following industry descriptions use derived estimates of annual treated water usage for each industry (Appendix C). The estimates are from various communities' municipal industrial water usage data (1981).[24]

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[24] Some descriptions and water usage figures were acquired from the Manitoba Department of Economics pers. comm. Mike Wallace 1984.

TABLE 11

Potential Secondary Processing Industries

i) potato processing,

ii) corn processing,

iii) french fry plant

iv) oilseed processing,

v) ethanol,

vi) vegetable processing,

vii) ingredient powders,

viii) soup producer,

ix) poultry processor.

A potato processing plant, as demonstrated by municipal water data (1981), will annually use approximately three million imperial gallons per year. Most of the water used in processing table potatoes will be in the cleaning and fluming processes. The annual amount of potatoes processed in such a facility is approximately 250,000 hundred weight.

In the processing of corn, the resulting output is assumed to be cornstarch (70%), corngerm (2.5%) and feed by-products (25%), allowing for shrinkage. If this type of secondary processing were to move a step further, i.e., cornstarch to sweetener, more water would be used. As it is now, processing at a rate of 20,000 bushels of corn/day will require approximately three million imperial gallons per day. Currently none of these corn processing plants exist in Manitoba.

In a french fry plant, processing the potatoes into a frozen state will require approximately ninety to one hundred forty-four million imperial gallons of water annually. Approximately 150 million pounds of potatoes are processed per year. Thirty percent of this is waste, i.e. peels.

Oilseed processing uses most of its water in washing and cleaning up. Approximately ten to twenty-five million imperial gallons of water are used in a six hundred ton/day operation.

In ethanol processing, employing a dry milling system, approximately twenty-five to forty million imperial gallons of water are consumed annually. Corn and barley are the primary products used in producing ethanol. Approximately 1.8 million bushels of corn would be processed in such a facility per year.

Ingredient powder processing requires approximately twenty-two million imperial gallons per year in processing approximately 2 million pounds of field peas per year. This type of processing involves saturating field peas, crushing them into paste and then drying them (by storing in elevators). This is done to break down peas into protein starch additives which become a by-product additive for foods such as hamburgers and Japanese baked goods.

The process of soup production employs approximately one hundred and twenty million imperial gallons of water annually. Since water remains in the final product, a soup producer will treat incoming water, i.e., they have their own water treatment facilities too. Locating near an abundant vegetable and potato producing area is appropriate in this case, since these are the major primary products used. Approximately 11 million pounds of fresh vegetables and 100,000 pounds of brine vegetables are processed per year.

The final type of processing considered is the poultry and/or waterfowl processor. Water usage ranges from four to twelve million imperial gallons per year. Approximately 70,000 head of water fowl, 600,000-700,000 chickens of various grades and 5,000 turkeys are processed per year in such a facility.

4.4 INDUSTRIES AND APPROPRIATE SITE LOCATIONS

From the previous information, the secondary processing industries

TABLE 12

Potential Sites And Relative Industry Types

Industry Type	Communities
Potato processing ----	Brandon, Souris, Portage La Prairie, Carman, Morris, Morden, Winkler, Altona.
Corn processing ------	Brandon, Souris, Portage La Prairie, Carman, Morris, Morden, Winkler, Altona.
French fry plant -----	Brandon, Souris, Portage La Prairie, Carman, Morris, Morden, Winkler, Altona.
Oilseed processing ---	Melita, Deloraine, Boissevain, Brandon, Souris, Minnedosa, Neepawa, Russell, Dauphin, Portage La Prairie, Carman, Morris, Morden, Winkler, Altona.
Ethanol --------------	Melita, Deloraine, Boissevain, Minnedosa, Neepawa, Carman, Morris, Morden, Winkler, Altona.
Ingredient powders ---	Melita, Deloraine, Boissevain, Souris, Brandon, Minnedosa, Neepawa, Russell.
Soup processing ------	Portage La Prairie, Carman, Morris, Morden, Winkler, Altona.
Poultry processing ---	Melita, Deloraine, Boissevain, Souris, Brandon, Minnedosa, Neepawa, Winkler, Portage La Prairie, Carman, Morris, Morden, Altona, Steinbach.

and potential communities are matched as shown in Table 12.

Conclusion

The agricultural crop acreage analysis (plus location theory, resource availability etc.) pursued lead to identification of prevalent types of water intensive agriculturally based secondary processing appropriate to each (limited nonagricultural potential) region.

This analysis suggests that the potential for increased industrialization of this nature will be limited by the municipal water system's volume constraints (i.e., the inability of the system to accomodate increased demands).

Chapter V

METHOD OF ANALYSIS

This chapter will begin by describing the sensitive nature of a prairie community's economic situation. The sensitivity stems from the nature of production, i.e., agricultural products (food stuffs). The more sensitive the community is, the more susceptible it is to minor deviations in its economic state.

The second section in this chapter describes cost-benefit analysis as a tool appropriate to assess the feasibility of project implementation. Included will be the mechanics of this type of measurement. This section will also discuss the various types of impacts which will play a role in cost-benefit analysis, as well as some of the problems related to this type of analysis.

5.1 THE ECONOMIC SENSITIVITY OF AN AGRICULTURAL REGION

Historically, the communities or vicinities under study, i.e., prairie communities, have serviced food stuff producing regions. The characteristics of the prairie regions are reflected in the communities' agriculturally related industries, and will be sensitive due to the communities' foundation of agriculturally based business and the perpetually cyclical demand for food products. Carle Zimmerman and Garry Moneo comment:

> The differences between the independent trading centres and the smaller villages are increasing. One represents commerce and the other represents living. Commerce is more fragile than living in the sense that it is affected by volatile economic cycles. The commerce-oriented village is gesellschaft, or contractual in more of its social relations, and the living type of village is more geninschaft or neighborly. In good years the large trading centers ride high on the crests of the waves. In bad years they have nowhere to go but down or bankrupt. The small places have more alternatives in bad times, as Mayor Wardill's above letter points out for Eatonia. They can cultivate their trees and gardens and grow inwardly, even in periods of outward adversity. These are not absolute but relative differences. This very important aspect of the total prairie community, if remembered and used, could serve the people well. The wheat and other industries of the prairies are, to a considerable extent, products with what are called in economics, inelastic demand curves.... Since the wheat can't be sold at or near the expected prices, the sales of other products, such as the electricity produced from the coal of the prairies, the phosphate for fertilizer, and even the oil and gas dwindle considerably because the towns and cities are filled with merchants, or persons working for them, who can't sell goods to wheat, the merchants can't sell their goods, and the bankers can't collect the interest and mortgage payments owed them for the debts on lands, machinery and goods sold previously.
>
> This volatility of extreme swings of economic conditions in the export wheat belts is, it is believed, considerably a permanent way of their life. It has existed in the prairie provinces since the beginning of commercial production and will probably continue to do so in the future.[25]

Due to the sensitive characteristic of the prairie communities under study, any economic deviation will have an extremely positive or negative impact. The extent of divergence would be dependent upon the vigor and direction with which the deviation is employed.

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[25] Carle C. Zimmerman and Garry W. Moneo <u>The Prairie Community System</u> (Agricultural Economics Research Council of Canada, Canada, 1971) pp. 31, 32, 34.

5.2 CHOICE OF METHODOLOGY

This study adopts the methodolgy of a partial cost-benefit analysis to evaluate the various deviations in the economy resulting from industry implementation. This would encompass the cost-benefit analysis of the various water-intensive agriculturally based secondary processing projects in the various compatible communities. Cost-benefit analysis is used to identify the stimulants of positive/negative economic impact on a region.

The criteria followed in determining actual benefits and costs as particular components of cost-benefit analysis will be discussed next. In short, this type of project appraisal is rooted in the measure of positive repercussions (benefits) versus negative repercussions (costs). If the benefits exceed the costs then the project becomes viable as exemplified in Richard Layard's Cost-Benefit Analysis where:

> The basic notion is very simple. If we have to decide whether to do A or not, the rule is: Do A if the benefits exceed those of the next best alternative course of action, and not otherwise. If we apply this rule to all possible choices, we shall generate the largest possible benefits, given the constraints within which we live. And no-one could complain at that.
>
> Going on a step, it seems quite natural to refer to the 'benefits of the next best alternative to A' as the 'costs of A'. For if A is done those alternative benefits are lost. So the rule becomes: do A if its benefits exceed its costs, and not otherwise.
>
> So far so good. The problems of course arise over the measurement of benefits and costs.[26]

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[26] Richard Layard Cost-Benefit Analysis (The Chaucer Press Ltd, Bungay, Suffolk 1980) p.9.

Other factors which contribute to a partial cost-benefit analysis will be discussed after the general principles of cost-benefit analysis have been presented.

As described previously, this study deals with renovation of municipal water supply systems, industrial implementations and the benefits accompanying them. Municipal water supply system renovations are financed through public expenditures. Therefore, one of the objectives will be to measure the effectiveness of this type of government project. In essence, the goal of cost-benefit analysis is to gauge the total production and consumption levels with and without the proposed public expenditures. A more detailed description of allocative costs and benefits is:

> Efficiency or allocative benefits are those favorable consequences of projects which represent opportunities to increase production or consumption; the allocative costs are the opportunities for production or consumption foregone because of projects undertaken. It is considered that a project is efficient and should be undertaken if its allocative benefits exceed its allocative costs.[27]

The general process of implementing cost-benefit analysis is best summarized in the <u>Benefit-Cost Analysis Guide</u> issued by the Treasury Board:

1. Identify the problem, clarify the issues and set the terms of reference.

2. Clearly define and set the objective(s) of the investment.

3. Generate alternatives that would meet the stated objective(s).

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[27] Treasury Board Benefit-Cost Analysis Guide (Canada 1976) p.9.

4. Identify the constraints that exist within the environment of the investment and eliminate those alternatives that do not fall within the constraints.

5. Examine each chosen alternative in detail. For each alternative:

-List the benefits and costs and the underlying assumption.

-Quantify the benefits and costs.

-Draw up a benefit-cost profile.

-Calculate the indicators (net present value, benefit cost ratio, internal rate of return) and test for sensitivity.

-Identify and, whenever possible, provide quantitative measures of distributional effects.

6. Finally, prepare the report comparing the results of the analysis for each alternative examined.[28]

Problems stem from the valuation of benefits and costs including non-monetary benefits and costs, as well as market prices, social values, discount rates etc. In this sense, this type of project analysis differs greatly from financial or technical analysis. The extent to which cost-benefit analysis differs from the other types of analysis is demonstrated by the Treasury Board's guide:

However, benefit-cost analysis differs from purely technical and financial analysis in several important aspects.

Firstly, while business investment decisions are made to enhance the interests of the shareholders and/or the managers of the firm, benefit-cost analysis takes a much wider perspective by assessing the impact on the country as a whole. Misallocation of resources will result if public investment projects are appraised in terms of only technical and financial feasibility, without regard for the benefits and costs to the whole country. The range of benefits and costs that must be considered in public investment project appraisal is therefore much wider....

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[28] Ibid. p.51.

> Secondly, the benefits and costs considered in financial analysis are both expressed in dollar terms. The valuation of the benefits and costs arising from public investment is usually more difficult. In many cases, the outputs of public investment projects are provided free of charge to the public. Benefit-cost analysis then requires that dollar values be imputed to these outputs, usually by estimating what consumers are willing to pay for them.
>
> Similarly, where the inputs of projects do not have market prices, the dollar values of the inputs must be estimated. Furthermore, market-determined prices of inputs and outputs sometimes may not reflect true social costs and benefits. Accordingly, the dollar benefits and costs may have to be adjusted to reflect this discrepancy.[29]

There is a particularly characteristic application of cost-benefit analysis that is relevant to this study, which is its use in evaluating projects with high initial capital outlay and belated benefits. Again, this is noted in the Treasury Board's guide:

> It should be clear by now that benefit-cost analysis is designed for a particular kind of problem, that of achieving efficient resource allocation when lumpy initial capital outlays are required and benefits accrue over extended periods of time.[30]

In the case of implementing a better water supply system or even renovating it, this situation exists. That is, high initial capital outlay with benefits accumulating and occuring in the future. However, cost-benefit requires that a comparison of estimated benefits and costs be made on a present value basis. This procedure is executed by means of an appropriate discount rate.

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[29] Ibid. p.4.

[30] Ibid. p.6.

5.2.1 The Social Discount Rate

The benefits and costs of a project do not necessarily occur at a single point in time. As a result, a problem arises when weighting these benefits and costs. That is, the evaluation of a project will be affected by the time differences of these analysis components.

Society's perspective of benefits is such that benefits occuring immediately have a greater value than future benefits. This difference is due to the anticipated benefit's inability to be currently consumed or reinvested. Therefore, to compare the future benefits and costs accordingly, the component value must be evaluated in terms of present values, so that all values are treated on equivalent terms.

Calculating these present values is recognized as discounting as demonstrated by the Treasury Board's guide:

> More precisely, costs and benefits occurring in future years are multiplied by a discount factor (________) where i is the social discount rate per year and j is the index of the year in which the cost or benefit will occur. As j becomes larger, that is, the more remote in the future benefits and costs are, the smaller is the discount factor and hence the present value of costs and benefits. Similarly, the larger the social discount rate, i, the smaller is the present value of costs and benefits occurring in any future year.[31]

The result of this process is a set of costs and benefits which are brought to a common point in time. The discount rate chosen determines the weight that future benefits and costs receive. The choice of a discount rate is a complex issue. For the purpose of this study the 10 percent social discount rate suggested by the Treasury Board will be

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[31] Ibid. p.25.

used.

By multiplying benefits and costs by the discount factor $(1/(1+i)^j)$, the present values of benefits and costs in any year are attained. The next course of action is to sum the discounted values of costs and benefits as follows (from the Treasury Board guide).[32]

bo, b1, b2,... bn = project benefits in years 0, 1, 2,... n,

co, c1, c2,... cn = project costs in years 0, 1, 2,... n,

i = social discount rate,

j = index of year concerned,

r = internal rate of return.

Present value of Benefits:

$$\sum_{j=0}^{n} \frac{b_j}{(1+i)^j} = \frac{b_o}{(1+i)^o} + \frac{b_1}{(1+i)^1} + \ldots + \frac{b_n}{(1+i)^n}$$

Present value of Costs:

$$\sum_{j=0}^{n} \frac{c_j}{(1+i)^j} = \frac{c_o}{(1+i)^o} + \frac{c_1}{(1+i)^1} + \ldots + \frac{c_n}{(1+i)^n}$$

The net present value of a project is thus:

$$\sum_{j=0}^{n} \frac{b_j}{(1+i)^j} - \sum_{j=0}^{n} \frac{c_j}{(1+i)^j} = \sum_{j=0}^{n} \frac{(b_j-c_j)}{(1+i)^j} = \frac{(b_o-c_o)}{(1+i)^o} + \ldots + \frac{(b_n-c_n)}{(1+i)^n}$$

Our first investment criterion states that projects will be undertaken only if their net present values are positive.

Correspondingly, the benefit-cost ratio for a project is:

$$\sum_{j=0}^{n} \frac{b_j}{(1+i)^j} \div \sum_{j=0}^{n} \frac{c_j}{(1+i)^j}$$

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[32] Ibid. pp.27-28.

Using the benefit cost ratio as an investment criterion, all projects will be undertaken which have benefit-cost ratios greater than unity.

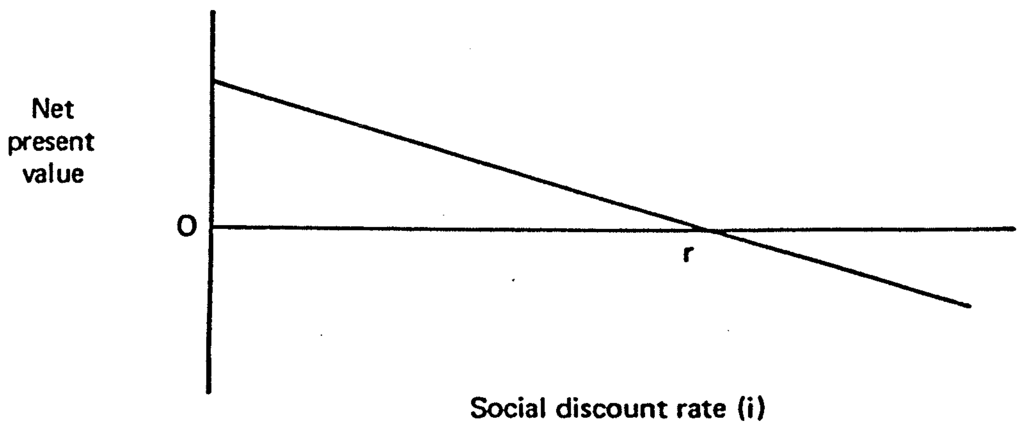
The internal rate of return (r) is that rate of interest which equals the present value of benefits and costs. In other words, r is the rate of interest for which:

$$\sum_{j=0}^{n} \frac{b_j}{(1+r)^j} - \sum_{j=0}^{n} \frac{c_j}{(1+r)^j} = 0$$

The relationship between the net present value of a project, the social discount rate (i) and the internal rate of return (r) is illustrated in Diagram 3.

Diagram 3

Net present values, social discount rates and internal rates of return



The diagram shows that for social discount rates below r, the present value of project benefits exceeds the present value of project costs (the net present value of the project is positive). At social discount rates greater than r, the net present value of the project is negative (the present value of costs exceeds the present value of benefits). Using the internal rate of return, our investment criterion is that only those projects will be undertaken where r > i.

As previously stated, cost-benefit analysis will be used in assessing the feasibility of project implementation. Reviewing the criteria for cost-benefit analysis, it is illustrated that various conditions must be met before the project is appropriate for public sector investment. The three conditions are as follows:

> i) Maximum present value - i.e., to maximize the present value of future revenues from the project. In essence this criterion simply maximizes the positive (i.e., benefits>costs) difference between the benefits and costs.
>
> ii) Benefit/cost ratio - this second criterion is fulfilled when Bo/Co > 1.0 or Bo/Co = 1.0 where Bo = present value of the stream of benefits and Co = present value of the stream of costs.
>
> iii) Internal rate of return - is the rate of discount that will make its present value = 0. When this discount rate (IRR) is equal or greater than the given social discount rate (10%) then the project should be included in the public sector investment strategy.

The same results will be yielded by both the B/C ratio and the maximum present value criterion if there is no constraint on funds for public sector investment. That is, the same projects will be included in public investment strategy using both these methods of analysis. Assuming there are no constraints on funds, the internal rate of return is used by implementing the projects with the internal rate of return which is equal or greater to the social discount rate (10%).

This study will rank the projects instead of only judging whether the project is appropriate for public investment as suggested by the first two methods. The reasoning behind this is to show the projects which meet the critical values of a benefit/cost ratio greater than one, have a sufficiently high internal rate of return and a positive net present value. Such a project would be a good candidate for triggering regional economic in that particular region. The ranking will also show which of the projects will be appropriate if there is a constraint on funds available for public sector investment.

5.2.2 The Identification Of Costs And Benefits

As previously discussed, problems do not primarily lie with the mechanics of cost-benefit analysis. The problems that develop stem from identification and measurement of costs and benefits that are relevant to the project.

Benefits and costs will vary from project to project. A broad list of benefits and costs (for demonstration purposes) might include;

Benefits

- value of output,
- scrap value of equipment,
- increase in productivity,
- decrease in unemployment,
- research and development spillovers,
- increase in standard of living and quality of life,
- environmental and health improvements,
- other positive externalities.

Costs

- capital expenditures,
- operating costs,
- maintenance costs,

- labour costs,
- costs of inputs (raw materials and intermediate manufactured goods),
- research and development costs,
- opportunity costs associated with using land and/or facilities already in the public domain
- other negative technological externalities.[33]

Benefits and costs are not limited to this list nor are all the benefits and costs from the list always realized in every project implemented. Depending upon the nature and objective of the project, certain components of the benefit and cost list will be more relevant than others.

5.2.3 Non-Monetary And Monetary Impacts

There are two categories of project implementation repercussions: the non-monetary and the monetary impacts. The differences between the two types are evident, since non-monetary impacts are those for which monetary values have not and/or cannot be established.

5.2.3.1 Non-Monetary Impacts

This type of weighting is due to a combination of characteristics and perspectives. The major notion is that the project effects are not marketable because of "intrinsic characteristics" that are unique and not amendable for marketing. However, there are also some project effects which have market feasibility, yet are not looked upon as marketa-

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[33] Ibid. p.53.

ble. This perspective stems from the incompatibility of society's tastes with certain project effects. Due to a combination of these factors, certain specific project effects will lack monetary valuation through the inability to become acceptable by the market structure <u>or</u> just by being totally overlooked by the political mechanism (government).

Although some project ramifications do not have explicit monetary values by either process (market or governmental) this does not necessarily imply that the effects are non-quantifiable. Many environmental impacts are attributable to project implementation and they fall into the non-monetary quantifiable category of impacts. The weight with which an analyst tags a "non-monetary" impact displays the desirability or non-desirability of the consequences acquired from project implementation. The ease of deriving a weight of a particular project impact forecasts the ease of evaluating the relative desirability or non-desirability of the project impacts.

5.2.3.2 Monetary Impacts (Direct And Indirect)

A more tangible aspect of project impacts are the monetary impacts. These consist of two classifications;

i) the direct monetary impacts which include market and non-market valued impacts,

ii) the indirect monetary impacts.

The term monetary impacts refers to project impacts which are expressable in "traditional" monetary values. As discussed previously, these impacts are benefits if they contribute to society and are costs if they prove to be detrimental to society.

Direct monetary impacts are divided into two types. The first type is the market valued impacts. This classification has a variety of categories for which "market-related" valuations are feasible even if the impacts themselves are not marketed. The one trait that links these categories together is the use of market prices as a foundation. These categories are demonstrated by Bromley, Schmid and Lord's _Public Water Resource Project Planning and Evaluation_: _Impacts, Incidence, and Institutions_

> The first instance exists where project outputs are intermediate goods into a further production process. The project outputs may not be directly marketed themselves but it is possible to deduce backwards from the good which _is_ marketed and determine the derived demand for the output of the project. For convenience we refer to this method as the _intermediate-good_ method.
>
> A second technique exists where _inferences from price-quantity behavior_ can be made and a demand schedule subsequently estimated. An example of this approach is the Hotelling-Clawson method to the valuation of recreation supplied by the public sector. From these demand curves, inferences are often made as to the quantity of use of a site at alternative prices for entrance and then valuation estimates are based on this.
>
> A third case is that of _market analogies_ where there exists an equivalent private product which has a market price and it _is_ marketed. An example would be a private campground facility equivalent to that made available by the public sector where the price of the former is used (with some caution) as a guide to the valuation of the latter.... In summary then, the technique whereby willingness to pay is deduced from final product values is largely applicable for producer goods, while the latter two are more appropriate for consumer goods and

services provided by the project.[34]

As stated previously, these valuations use the conceptual base of market prices. However, when a valuation is made without using the market as a base, it is accomplished using nonmarket valuation methods. When dealing with these types of impacts, the derivation of monetary valued terms are achieved by either; i) governmental intervention i.e., explicit public pricing or ii) using the alternative cost concept.

Having government officials designate monetary values appears to be one of the more uncomplicated forms of evaluation of an explicit monetary evaluation. However, problems do arise since this type of evaluation assesses the consumer's willingness to pay a particular price without deriving these prices from market structures. On some occasions the government arbitrarily sets a price without any technical reasons. This leaves this type of evaluation susceptible to abuse, since its analytical base is weak.

Another method of dealing with non-market valued impacts is the alternative cost concept. This is a non-market concept since its foundation is based on the costs and not the market prices. In fact, the alternative cost concept may become a cost minimization problem rather than the evaluation of benefits and/or costs. Problems arise when the project is unique, i.e., there would be nothing to be compared or contrasted. Another problem arises if an analyst justifies a project by comparing it to a more expensive alternative and views the costs of the

[34] Daniel W. Bromley, A. Allan Schmid and William B. Lord Public Water Resource Project Planning And Evaluation: Impacts, Incidence, And Institutions (School of Natural Resources, University of Wisconsin, Madison, 1971) pp. 13, 15.

more expensive alternative as benefits if it is not undertaken. This is summarized by Bromley, Schmid and Lord's paper:

> In summarizing the issue of alternative costs, the following seems appropriate. If monetary figures are to be used as "benefits" and "costs," then one is using these concepts for reaching decisions about certain potential courses of action. When it is necessary to resort to real or imagined alternatives to conjure up "benefits," the rationale of the decision process is called into serious question; this is true particularly when the undertaking will be built anyway. That is, when a specific project purpose is going to be included regardless of an expression of effective market demand (such as recreation sites or power generation facilities), then no valuable information is generated by using as a surrogate for "benefits" the market cost of the cheapest alternative means of achieving those same project purposes. It then follows by definition that "benefits" exceed "costs" and nothing is gained in the way of valuable information to make reasoned judgments.... where there has already been a prior decision to include the particular aspect (or purpose), then no effort should be made to give the impression that the decision is based on market valued benefits; the purpose should be included if it is the least costly means of achieving the desired output and no other claims made for it. This is the familiar notion of cost-effectiveness--so common in military budgeting matters.[35]

In short, this summary suggests that if a project is to be implemented regardless of its benefits and costs then monetary valuation adds nothing to the analysis. As a result, the analysis follows a cost-effectiveness or cost minimization approach.

Another type of impact is the indirect monetary impact. These include the "income changes which are not reflected in the difference between the 'with and without' income of the immediate purchasers or users of the project output.[36] In essence, it is the secondary benefits and costs accrued from project implementation. Some of the characteristics

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[35] Ibid. p.18.

[36] Ibid. p.18.

of the indirect monetary impacts (secondary benefits and costs) are illustrated by Bromley, Schmid and Lord's working paper:

> If the decision unit encompassed all related activities (perfectly vertically integrated) then there would be few, if any, indirect effects. But this obviously is not the case. That is, farmers receive more gross and net income; with the former they buy productive factors which may generate net indirect monetary effects, while possibly generating net indirect effects with the latter through purchases of consumption items. These are traditionally labeled "induced." Another aspect is the possibility of net increments to income earned by individuals owning factors (labor, land, captial) employed in the construction or maintenance of the project. A third possibility is the incremental net income earned in project-related activities such as processing of products grown with project water. These latter effects are traditionally termed "stemming."
>
> Theoretically, all of these can be traced for many steps or rounds. For example, an increased demand for a given productive input leads to new demand for inputs needed in its production. The web of interactions also may include consumer spending by the earners of these new incomes. But it is crucial to recognize that unless new personal income is generated someplace, there can be no indirect benefits which are net to the nation. Unless recreationists receive higher incomes directly attributable to the project, their increased expenditures represent transfers from one form of consumption to another.[37]

New personal income must be generated in some way somewhere before it is to be considered an indirect monetary benefit.

In conclusion, it has been found that the benefits and costs of project implementation are not as clear cut and evident as were first thought. Depending on the project, the impacts considered must be expressed using monetary values derived for them and in the case of non-monetary impacts, weights must be derived to aid in the assessment of their impact on society.

[37] Ibid. p.19.

Chapter VI

COST-BENEFIT ANALYSIS RESULTS

In the preceding chapter, cost-benefit analysis was suggested as an appropriate methodology for assessing project feasibility. This analysis was suggested because of the nature of investments plus gains and costs resulting from implementation of various projects. The projects under study display the characteristic of large initial capital outlays for project implementation in which the benefits and costs are realized over extended periods of time.

A full cost-benefit analysis has not been implemented in this study. However, the general methodology has been used. The general methodology was appropriate since the objective was to develop a rule for preliminary assignments of industries to communities with water as a decision criterion.

Once the general community/industry designation was completed, the next step was the evaluation of the 'optimal' community/industry combination, if any existed. This was done by implementing the significant maximum net present values generated from the cost-benefit analysis.

This chapter will begin by re-establishing the various industry location variables.

First is the identification of each community's water supply system situation. Secondly, the identification of water requirements of various types of agriculturally based secondary processing industries. The third component is the identification of primary production in various Agro-Manitoban regions.

Once these components are identified, there is an evaluation of the three to assess the compatibility of the secondary processing industry to the other two components, i.e., primary production and water system capabilities.

In the process of analysing these components, some communities will be screened out because of their lack of suitablity for the industry, i.e., lack of primary product and/or processing resource (water).

The next step in this chapter is the determination of the economic impact of industrial implementation. That is, the designation of cost-benfit components and the implementation of a partial cost-benefit analysis.

6.1 WATER SUPPLY IDENTIFICATION

In evaluating the appropriateness of a community to a particular type of water-intensive industry, there must be an identification of the water supply system's limitations and shortcomings. The first step is to determine the appropriate renovations to upgrade a particular municipal water system to meet increased industrial water usage requirements. This can be accomplished by referring to Chapter Three in which there is a ranking of the nineteen communities under study and their water system shortcomings. Due to recent renovations; Carman, Boissevain, Beausejour, Souris, Neepawa, Brandon and Morden do not need any significant water system supply changes. However, as suggested in that chapter (p.37):

> The present water systems of these communities seem capable. However, it depends on the type of industrialization to be implemented. Water intensive industries may require an increase in the buffer capacity (water storage) to meet peak requirements.

The type of renovation chosen will be dependent upon the additional strain which the respective industries will put on the municipal water supply system. The comparisons will be executed using the 'peak months' usage data, when the municipal system will be under the most stress. This occurs in the summer months.[38] The system has to be capable of meeting maximum load or changes to the system will be required.

Some of the changes suggested to upgrade the systems are shown in Appendix D and are listed as follows:

Community	Changes Required
Melita	150,000 I.G. reservoir
Deloraine	150,000 I.G. reservoir
Boissevain	150,000 I.G. reservoir

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[38] There are several reasons for peak usage months being the summer months. First, a portion of the water consumed stems from the agricultural nature of the community, i.e., some water is sold in bulk form (stock watering or household usage) to surrounding farms. Secondly, the agriculturally based water-intensive secondary industry will be working at full capacity during these months, since their primary goods are available (grown) in this period. Finally, the major proportion of water used is consumed by one of the most seasonal water-intensive domestic activities -- lawn watering. In fact, there have been instances of limited water supply where a community has limited lawn watering usage to facilitate the water intensive industries and other essential functions in the community.

Souris	500,000 I.G. reservoir and treatment plant expansion
Minnedosa	150,000 I.G. reservoir
Portage La Prairie	1,000,000 I.G. reservoir
Altona	500,000 I.G. reservoir and treatment facility
Morris	Water treatment plant expansion
Winkler	500,000 I.G. reservoir and another well
Steinbach	150,000 I.G. reservoir and another well

6.2 POTENTIAL WATER USAGE

When dealing with a processing resource such as water, it is necessary to identify the water requirements of a type of secondary processing industry. This is important in the evaluation of an agricultural service centre's ability to accommodate such needs. The industries under study and their water requirements/quarter are illustrated by Table 13.[39]

[39] *Figures acquired from actual quarter usage data from each community's water usage record.

TABLE 13

Industrial Quarterly Water Usage Figures

Corn processing - 234 million imperial gallons/quarter to process 20,000 bushels of corn/day.

French fry plant - 33 million imperial gallons/quarter.

Soup producers - 30 million imperial gallons/quarter.

Ethanol distillers - 12-15 million imperial gallons/quarter.

Ingredient powder processor - 7-8 million imperial gallons/quarter.

Oilseed processor - 6-7 million imperial gallons/quarter.

Potato processor - 800,000 to 1 million gallons/quarter.

Poultry processor - 800,000 to 4 million gallons/quarter.

6.3 IDENTIFICATION OF PRIMARY PRODUCTION

As discussed previously, there must be ample primary product production to justify the implementation or expansion of a particular type of secondary processing firm. Therefore, to assist in choosing the appropriate type of industry, there will be an evaluation of primary production in each region. The agricultural service centre(s) which service each region will be used as a possible secondary processing site.

Aggregate production acreage of each community's own district and adjacent districts were evaluated in Appendix B. As a result, not all of these industries were appropriate for every community. Table 14 specifies which of the communities met the requirements set by this study for industry implementation[40]

[40] **Corn processing is a water-intensive industry. However due to the exorbitant amount needed, municipal water supply systems changes will be too costly to fulfill the water requirements. It is only feasible

TABLE 14

Potentially Optimal Sites

Industry type – / Communities	Soup	Ethanol	French Fry	Oilseed	Poultry	Ingredient	Potato
Melita		X		X			
Deloraine		X		X			
Boissevain		X		X			
Virden							
Souris			X		X		E
Brandon			X		E		X
Minnedosa		E			X	X	
Neepawa		X			X	X	
Russell				E		X	
Dauphin							
Portage La Prairie	E		E		X	E	X
Altona	X	X	X	E	X		X
Carman	X	X	X	X	X		E
Morden	X	X	X	X	E		X
Morris	X	X	X	X	X		X
Winkler	X	X	X	X	X		E
Steinbach					E		
Beausejour							
Selkirk							

X - potential sites
E - sites with existing industry type

From Table 14 it is observed that some communities did not meet the criteria for any of the chosen industries. The communities of Selkirk, Beausejour, Dauphin, Russell and Virden do not meet the criteria of this study.[41]

Some of the other communities which failed the criteria have primary agricultural production but not enough (critical primary product acreage as suggested by Appendix B) to justify locating a secondary processing plant in the community.

The existing processing plants of the secondary industries have also been distinguished on Table 14. This type of indicator has two uses. First, to supply a guideline which this study can follow in setting the criteria for appropriate primary product acreage. Secondly, it illustrates the communities that are readily available for expansion of an existing plant or implementation of a new plant. At times expanding a plant or locating a new plant in a community that has an existing plant will be easier, since the community has already been introduced to this type of industry.

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if it has its own water treatment plant i.e., processing plant must locate near or over a large water source. Due to the nature of this requirement, corn processing implementation will not be pursued any further in this study. That is, none of the locations under study have access to a source of water capable of meeting corn processing demands.

[41] Although these sites are inappropriate for the processing this study has focused on, they may meet other industrial criteria which have not been suitable for this particular study. Such an example would be the abundant acreage of alfalfa in the districts surrounding Dauphin. Since this study is concentrating on <u>water-intensive</u> agriculturally based secondary industry, alfalfa processing has been disregarded i.e., not water intensive enough. As a result, Dauphin has been disregarded as an appropriate site.

Although the Russell area does not have sufficient local oilseed acreage to justify an oilseed processing plant, there is a plant close by at Harrowby. This site was used to take advantage of Saskatchewan oilseed production. Since primary production from Ontario, Saskatchewan and the United States cannot in general be relied upon as a source of raw material for processing, Russell is deleted from this analysis, as are other sites that require out of province sources of raw material. Now that both the industries and communities have been designated by Table 14, the appropriate water systems renovations/changes can be assessed and exhibited for each community as well as the other components for cost-benefit analysis.

6.4 COMPONENTS OF ANALYSIS

Since the cost-benefit analysis method has been shown, (i.e., the previous chapter), it is now appropriate to define the components involved in the cost-benefit analysis of the study.

I) Costs -

i) Municipal water renovation costs (Table 15).

ii) Costs associated with building a secondary agricultural processing facility (Table 16).

The above costs have been standardized using the 'Construction Price Indexes (1982).' Therefore they will be relative to the study year, i.e., 1982 (Appendix D).

iii) Variable water supply costs - this stream of costs (Tables 17 and 18) are the costs accrued from supplying municipal water from year to year for the 'potential' industrial use, i.e., the industries under study. The costs are essentially chemical costs, filtering costs, etc.

Although a cost such as operations and maintenance does exist, it will not be included in the analysis. The omission of these costs is due to two reasons; first, the theoretical life of a water renovation project is approximately 50 years i.e., before any major maintenance costs are required. As a result, the life of the project coincides with the life stream of benefits. Secondly, daily operations and maintenance will likely be required regardless of whether there is an increasing water usage. Since this type of variable cost is not the direct result of an implementation of increased industrialization (i.e., they exist regardless of project implementation), it is not to be included in this analysis.

2) Benefits -

i) Water revenue - from the sale of water for agriculturally based secondary industrial use. This is illustrated by Tables 19 and 20.[42]

ii) Return on Industrial Investment - this is the return/year on initial industrial asset (cost of building secondary processing facility). This figure is before taxes or dividends. It is the best indicator which reflects the benefits accrued to the region, i.e., due to the public investments shown. The method with which this is derived is shown by Appendix F. The results are illustrated by Table 21.

The return on investment/year is a derived value. It multiplies the profit/output ratio by the inversed capital output ratio. This results ina profit/capital ratio. It was not possible to acquire and predict all variable costs and returns involved in processing for the next 50 years. Therefore the most recent data (1980) for the various processing industry groups were used.

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[42] Both the price and costs per 1000 litres or gallons have been acquired from the Prairie Provinces Water Board's Water Demand Study <u>Municipal And Industrial Current And Historical Water Uses - Manitoba</u> (November 1982). Appendix E.

TABLE 15

Indexed Water Renovation Costs (1982)

Communities	$
Melita	446,981.62
Deloraine	588,723.29
Boissevain	446,981.62
Souris	1,714,353.50
Brandon	none
Minnedosa	446,981.62
Neepawa	none
Portage La Prairie	1,134,957.00
Altona	1,928,124.40
Carman	none
Morden	none
Morris	929,054.59
Winkler	905,281.34
Steinbach	566,964.06

*Table derived from Appendix D.

TABLE 16

Indexed Secondary Processing Firm Implementation Costs (1982)

Industry Type	$
Soup	25,000,000.00
French fry	21,928,747.00
Ethanol	20,000,000.00
Oilseed	36,532,950.00
Ingredient	2,983,135.80
Potato	484,843.05
Poultry	487,106.00

*Table derived from Appendix D.

TABLE 17

Annual Cost Of Supplying Water To Various Industries/Year

Industry Type		French fry	Soup	Ethanol	Oilseed
Q x 1000 I.G.		92,850	119,070	60,000	25,377
Community Cost $/1000 I.G.					
Melita	.91			54,600	23,093
Deloraine	4.27			256,200	108,360
Boissevain	1.59			95,400	40,400
Souris	1.73	160,631			
Brandon	.86	67,781			
Minnedosa	.55			33,000	
Neepawa	1.36			81,600	
Portage La Prairie	.82	76,137	97,637		
Altona	2.77	257,195	329,824	166,200	70,294
Carman	1.41	130,919	167,889	84,600	35,782
Morden	.91	84,494	108,354	54,600	23,093
Morris	.91	84,494	108,354	54,600	23,093
Winkler	2.14	198,699	254,810	128,400	54,307
Steinbach	.73				

TABLE 18

Annual Cost Of Supplying Water To Various Industries/Year

Industry Type		Ingredient	Potato	Poultry
Q x 1000 I.G.		21,990	2,437	11,520
Community Cost $/1000 I.G				
Meltita	.91			
Deloraine	4.27			
Boissevain	1.59			
Souris	1.73		4,216	19,930
Brandon	.86		2,096	9,907
Minnedosa	.55			6,336
Neepawa	1.36			15,667
Portage La Prairie	.82	18,032	1,998	9,446.4
Altona	2.77	60,912	6,751	31,910
Carman	1.41	31,006	3,436	16,243
Morden	.91	20,011	2,218	10,483
Morris	.91	20,011	2,218	10,483
Winkler	2.14	47,059	5,215	24,653
Steinbach	.73			8,410

TABLE 19

Potential Revenue Received From Sale Of Water To Various Industries/Year

Industry Type	-	French fry	Soup	Ethanol	Oilseed
Q x 1000 I.G.		92,850	119,070	60,000	25,377
Community Price $/1000 I.G.					
Melita	.91			54,600	23,093
Deloraine	3.86			231,600	97,955
Boissevain	1.32			79,200	33,498
Souris	1.32	122,562			
Brandon	.73	67,781			
Minnedosa	.32			19,200	
Neepawa	.41			24,600	
Portage La Prairie	1.05				
	.50	46,425	59,535		
Altona	1.60	148,560	190,512	96,000	40,603
Carman	1.32	122,562	157,172	79,200	33,498
Morden	.55	51,068	65,489	33,000	13,957
Morris	1.23	114,206	146,456	73,800	31,214
Winkler	2.04	189,414	242,903	122,400	51,769
Steinbach	.40				

TABLE 20

Potential Revenue Received From Sale Of Water To Various Industries/Year

Industry Type -		Ingredient	Potato	Poultry
Q x 1000 I.G.		21,990	2,437	11,520
Community Price $/1000 I.G.				
Melita	.91			
Deloraine	3.86			
Boissevain	1.32			
Souris	1.32		3,217	15,206
Brandon	.73		1,779	8,410
Minnedosa	.32			3,868
Neepawa	.41			4,723
Portage La Prairie	1.05		2,559	12,096
	.50	10,995		
Altona	1.60	35,184	3,899	18,432
Carman	1.32	29,027	3,217	15,206
Morden	.55	12,095	1,340	6,336
Morris	1.23	27,048	2,998	14,170
Winkler	2.04	44,860	4,972	23,501
Steinbach	.40			4,608

TABLE 21

Return on Industrial Investment/Year

Industry Type	$
French fry	1,431,388.10
Soup	2,253,662.50
Ethanol	3,402,650.00
Oilseed	2,384,670.00
Ingredient	194,722.70
Potato	31,647.89
Poultry	20,783.84

* Profit return/year is before taxes and dividends.

Once the indicator of profit was derived, it was applied to the cost which was relevant to this study, i.e., initial capital cost of implementing a particular secondary processing industry. The result was a return on investment(profit)/year. These costs, returns and initial capital costs were unique for each processing industry group in this study. As a result, the derived return on investment values will vary from industry to industry.

6.5 IMPLEMENTATION OF COST-BENEFIT ANALYSIS AND RESULTS

A present value computer program package was employed to determine the maximum present value and benefit/cost ratio figures. The resulting data are illustrated by Tables 22-25.

The internal rate of return was determined by implementing the internal rate of return function of the Interactive Financial Planning System program. The resulting figures are shown by Tables 26 and 27.

TABLE 22

Maximum Net Present Values

	French fry	Soup	Ethanol	Oilseed
Melita			4,514,040	42,375,088
Deloraine			4,877,340	42,610,496
Boissevain			4,659,910	42,437,200
Souris	27,224,192			
Brandon	25,166,992			
Minnedosa			4,638,330	
Neepawa			4,580,410	
Portage La Prairie	26,569,488	24,570,096		
Altona	28,073,392	26,274,800	7,405,500	44,123,488
Carman	25,242,288	23,188,562	4,115,690	41,948,688
Morden	25,468,000	23,478,096	4,261,620	42,010,400
Morris	25,828,400	23,678,000	4,823,170	42,784,000
Winkler	26,155,888	24,104,592	5,026,380	42,856,192
Steinbach				

NOTE: ALL VALUES ARE NEGATIVE IN THE ABOVE TABLE

This study assumes the return on investment/year is in effect every year for the life of the project (50 years), but that the only major costs incurred are the initial sunk cost. The only other cost in the life of the project is the variable cost of water and its impact tends to be nullified by the variable benefit (price of water) accrued every year.[43]

The internal rate of return illustrated on Tables 26 and 27 was the rate of return by the 50th year. This 50th year rate of return is a significant cut off point, since the full life of the project is 50

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[43] Implicit assumption is that all other costs are invariant among sites and can thus be ignored in calculating 'optimal' location.

TABLE 23

Maximum Net Present Values

	Ingredient	Potato	Poultry
Melita			
Deloraine			
Boissevain			
Souris		2,279,780	2,415,090
Brandon		559,303	671,697
Minnedosa			1,127,400
Neepawa			756,775
Portage La Prairie	4,622,020	1,686,330	1,769,290
Altona	5,583,520	2,510,240	2,707,700
Carman	3,441,510	558,421	667,554
Morden	3,494,980	564,356	695,563
Morris	4,289,370	1,478,460	1,554,040
Winkler	4,348,770	1,463,900	1,573,850
Steinbach			1,259,400

NOTE: ALL VALUES ARE NEGATIVE IN THE ABOVE TABLE

years.

As a reminder, the criterion for an acceptable internal rate of return is that the rate must be greater than or equal to the chosen social discount rate of 10%.

Fortunately, the internal rate of return analysis is an appropriate type of analysis for the public investment projects under study. However, this is not necessarily the case for all types of investment project analysis. Examples of some of the internal rate of return weaknesses are summarized in Alan Randall's Resource Economics :

TABLE 24

Benefit/Cost Ratios

	French fry	Soup	Ethanol	Oilseed
Melita			0.8734	0.3385
Deloraine			0.8703	0.3441
Boissevain			0.8706	0.3391
Souris	0.3395			
Brandon	0.3492			
Minnedosa			0.8692	
Neepawa			0.8708	
Portage La Prairie	0.3337	0.4588		
Altona	0.3364	0.4558	0.8058	0.3311
Carman	0.3567	0.4835	0.8840	0.3417
Morden	0.3439	0.4708	0.8789	0.3396
Morris	0.3502	0.4772	0.8665	0.3371
Winkler	0.3582	0.4826	0.8633	0.3386
Steinbach				

TABLE 25

Benefit/Cost Ratios

	Ingredient	Potato	Poultry
Melita			
Deloraine			
Boissevain			
Souris		0.1211	0.1183
Brandon		0.3499	0.2813
Minnedosa			0.1645
Neepawa			0.2329
Portage La Prairie	0.2861	0.1545	0.1434
Altona	0.2705	0.1131	0.1154
Carman	0.3693	0.3599	0.3268
Morden	0.3476	0.3449	0.2599
Morris	0.3177	0.1743	0.1684
Winkler	0.3316	0.1839	0.2022
Steinbach			0.1537

TABLE 26

Internal Rates Of Return

	French fry	Soup	Ethanol	Oilseed
Melita			0.1444	0.0569
Deloraine			0.1414	0.0561
Boissevain			0.1436	0.0567
Souris	0.0506			
Brandon	0.0576			
Minnedosa			0.1440	
Neepawa			0.1453	
Portage La Prairie	0.0528	0.0761		
Altona	0.0467	0.0696	0.1316	0.0533
Carman	0.0570	0.0807	0.1473	0.0577
Morden	0.0560	0.0797	0.1469	0.0577
Morris	0.0560	0.0794	0.1418	0.0553
Winkler	0.0541	0.0773	0.1406	0.0559
Steinbach				

The internal rate of return criterion has fallen into disfavor, for three reasons. (1) Internal rates of return are not easy to calculate, without the use of computers. (2) More important, the internal rate of return criterion may derive ambiguous results, when used in comparing projects whose time streams of benefits and costs are quite different. For projects in which (without discounting) benefits are less than costs in the early time periods, greater than costs in intermediate time periods, and less than costs in later time periods, it is impossible to calculate a unique internal rate of return. (3) When a project may be built at any one of several sizes, the optimal size is not the size that maximizes P.[44] When capital funds are unconstrained, the optimal size is that for which incremental P equals the social discount rate. When capital funds are constrained, optimal size for each acceptable project is that for which incremental P equals incremental P for all the other acceptable projects; and the determination of optimal size is no simple calculation.[45]

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[44] P is the internal rate of return.

[45] Alan Randall Resource Economics An Economic Approach to Natural Resource and Environmental Policy (Grid Publishing, Inc., Columbus,Ohio, 1981) p.215.

TABLE 27

Internal Rates Of Return

	Ingredient	Potato	Poultry
Melita			
Deloraine			
Boissevain			
Souris		*****	*****
Brandon		0.0569	0.0283
Minnedosa			*****
Neepawa			*****
Portage La Prairie	0.3560	*****	*****
Altona	0.0214	*****	*****
Carman	0.0565	0.0569	0.0290
Morden	0.0547	0.0529	0.0212
Morris	0.0424	0.0045	*****
Winkler	*****	0.0039	*****
Steinbach			*****

***** - Marks the potential sites that have a negative internal rate of return.

To further illustrate the problem of not being able to calculate a unique internal rate of return, one can turn to the Treasury Board's Benefit-Cost Analysis Guide:

> There are also difficulties in using the internal rate of return as an investment criterion when the internal rate of return for a project is not unique. This problem can arise when there is more than one sign change in the net benefit stream for a project. Since investment costs are mostly concentrated in the first years of a project's life, the net benefit stream in these years will usually be negative. Subsequently, when the project is in operation, its net benefit stream usually becomes positive as current benefits exceed current operating costs. However, the time-stream of project benefits may again become negative if, for instance, large replacement costs are required for capital equipment at fixed intervals. In such instances of more than one sign change in a project's net benefit stream over time, multiple solutions may occur in calculations of the project's internal rate of

> return. In such circumstances, there are obvious difficulties in using the internal rate of return as an investment criterion. Where the social discount rate is specified, calculation of neither the net present value nor benefit-cost ratio of a project is subject to similar indeterminacy.[46]

Although the problem of acquiring a unique internal rate of return does not exist with the study at hand, other inadequacies do exist. One such inadequacy is analysing projects that have different scales. That is, even though a smaller project may have a greater internal rate of return than a larger project, the larger project would be preferable if it results in a larger positive change with respect to the present value of net benefits.

Problems exist with another aspect of cost-benefit analysis, i.e., the benefit/cost ratio. This is also exhibited by the Treasury Board's guide;

> Nor does the benefit-cost ratio convey enough information to indicate which project among competing investments is the most socially worthwhile. The benefit-cost ratio is, after all, only a ratio, and ignores the relative sizes of competing projects.[47]

Therefore, the best indicator as stated by the Treasury Board's guide;

> The fundamental criterion for investment in circumstances of choice is unambiguous: the investment(s) should be chosen which maximizes net present value.[48]

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[46] Planning Branch Treasury Board Secretariat Benefit-Cost Analysis Guide (Canada 1976) p.29.

[47] Ibid. p.31.

[48] Ibid. p.31.

However, in the cost-benefit results, it is observed that all the net present values are negative. The cost-benefit ratio fails to pass the critical value of one. As a result none of the community/industry combinations were viable.

From the internal rate of return analysis, ethanol appeared to be one of the better types of project investment. Certain problems arise which are unique to this type of agriculturally based secondary processing industry. These are associated with the primary product which is used to produce ethanol (corn and barley). An increased demand for corn and barley in ethanol production will be economically detrimental to the other uses of corn and barley and will have an effect on the other agricultural sectors. As a result, the demand drives up the prices for corn and barley. This is due to the costs involved with the production of ethanol. This is illustrated by;

> Previous research on this issue concludes that gasohol production is not currently economically viable, given current relative factor and product prices and alcohol production technology (Tyner and Bottum). With alcohol distilled from grain costing considerably more than the current wholesale price of gasoline, a subsidy would be required to make alcohol competitive on a cost basis with gasoline.[49]
>
> The research findings indicate that alcohol production levels below 2.0 billion gallons do not result in serious dislocations in the agricultural sector. As the level of alcohol production increases and more grain is required corn prices rise significantly, stocks fall to extremely low levels, exports decline, and government expenditures increase greatly.[50]

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[49] Meekhof, Tyner and Holland U.S. Agricultural Policy And Gasohol: A Policy Simulation (American Journal of Agricultural Economics Volume 62 #3 August 1980) p. 408.

[50] Ibid.

If the production costs of ethanol declined, higher returns on investment may result. The higher returns on investment may be enough to make the present value positive and this type of industrial implementation viable.

Although all the community/industry combinations failed, it was observed that the greatest potential for any type of industrial development lies in Carman and Morden, shown by the 'best' derived cost-benefit values. This is a result of I) Carman and Morden not requiring any specific modifications to their municipal water system for increased usage and, II) both communities meeting the criterion for locating sites within their regions (i.e., production acreage criterion) for every type of agriculturally based secondary processing dealt with in this study. These two factors combined make both these communities the most appropriate with respect to optimal potential water-intensive industrial location.

Chapter VII

SUMMARY, IMPLICATIONS AND INFERENCES

7.1 SUMMARY

The objective of this research study was to focus on the implications of increased municipal water availability for secondary processing industrial use. More specifically, could regional development be encouraged by increased industrialization via municipal water supply system renovations.

As illustrated in Chapter II, there are various trains of thought with respect to regional development. Briefly, they consist of increasing resource availability, advancing technology, expanding markets, conquering space and building institutions.

It was realized an agricultural service centre played an important role in regional development. As a result, the emphasis was on a method of stimulating agricultural service centre growth. The concentration was on industrial growth, since industrial growth is synonymous with agricultural service centre development. This in turn led to another aspect of economic growth, namely the factors influencing location of an industry. More specifically, aspects of location theory were dealt with to provide this information. Various components of industrial location were discussed. These ranged from labor to primary product availability. If the other components supporting increased industrialization were in order, i.e., a sound infrastructure, the study focused on primary product availability.

The industries were agriculturally based water intensive secondary processing industries. This study focused on agricultural primary product availability and treated water availability. The municipal water system must be capable of meeting industrial water demands. At the same time, there must be enough primary production in the area to justify locating a secondary processing firm.

From the various sites chosen, it was discovered that some of their municipal water supply systems were not adequate for the location of a water intensive secondary processing firm. Certain types of primary production were exclusive to particular growing regions.

Water availability was the next aspect studied. Water is used in some form in all aspects of domestic, commercial and industrial activity. It is a critical component. However, considering it is vital to various aspects of life (i.e., sustenance, cleaning, processing, etc.) it tends to be undervalued. This is expressed by the price of water. The undervaluation is due to society's overly optimistic view of an ever abundant supply of low-cost, treatable water. A derivation of an opportunity cost may reflect the true value of usable water better.

Combining a constrained municipal water supply system with an increase in water-intensive industries will lead to certain problems. An insufficient availability of treated water would arise. To accommodate the appropriate industries, alleviation of these constrained water systems was required. Various types of municipal water system renovations were suggested to relieve the added stress on the system. The changes were designated, as were the associated costs of these changes.

It is not economically rational to implement municipal water supply system renovations for every community. Nor is it feasible to install all the potential industries. Therefore, it is necessary to weigh the benefits and costs derived from the municipal water supply system changes and various industry implementations. The extent to which costs and benefits play a role in industrial location is shown by partial cost-benefit analysis. Cost-benefit analysis is relevant if the various theories and components previously presented are consistent. In summary these are:

a) regional development is dependent upon a combination of 'growth theories' and agriculturally based secondary industrial growth in regions with limited nonagricultural potential;

b) rural communities are sensitive to economic growth. The sensitivity is due to i)the nature of their production (agricultural) ii)multiplier in effect, since most of the production is exported; and

c) the rural community has a 'healthy' infrastructure (i.e., with respect to the ability to support economic growth).

If all these situations exist, the partial cost-benefit analysis will evaluate the deviations in the economy which will trigger[51] economic growth. In essence, the cost-benefit analysis assessed the impacts ac-

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[51] H.W. Fowler and F.G. Fowler The Concise Oxford Dictionary (Oxford University Press, Toronto, 1966) p.1390 describe the verb to trigger as '...set in action, initiate or precipitate.'

crued if project implemenation were in effect.

The costs included the capital costs of introducing an industrial firm, as well as initial water renovation costs and variable costs. This is due to the realization that the benefits accumulated were not a result solely of water supply system renovation. For benefits, a general benefit indicator was implemented for cost-benefit analysis. This indicator is the return on investment/year to the region. This return on investment reflected the general economic gains to the region.[52]

Unfortunately, the derived benefits were not enough to offset the high initial capital outlay of both firm implementation and water renovation costs. As a result, none of the community/industry combinations appeared to be capable of contributing to regional economic growth.

7.2 IMPLICATIONS FROM THE RESULTS

I) Water-intensive industries are dependent upon treated water availability. If treated water supply is insufficient it can stunt economic growth (assuming water-intensive industries are the only possible growth stimulant).

II) From the cost-benefit analysis, it has been shown that water is constraining enough to make potential food processing industries locate elsewhere. Sites that required no immediate renovations to their municipal water supply system coupled with a solid supply of primary production, were optimal industrial location sites.

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[52] The derivation of a percentage profit return indicator was needed due to the inability of the price of water to reflect a true value of treated water.

III) The return on investment/year of an industry must be large enough to outweigh the costs associated with locating an industrial firm (e.g., high firm implementation costs, water supply system renovation costs).

7.3 INFERENCES

Various extensions and limitations have arisen as a result of this study. In essence they consist of factors that have either been overlooked or not fully accounted for and can be used to extend the analysis for further study. They consist of;

i) including agricultural production from regions east, west and south of the Manitoban borders,

ii) using more specific benefits such as increased employment, and spin-off industries from project implementation,

iii) a quantitative perspective of the multiplier effect on the region,

iv) analysing whether the water supply system would also be able to facilitate the increased domestic, commercial and industrial usage resulting from the initial increased industrialization,

v) looking at other infrastructure constraints,

vi) looking at other industrial and nonindustrial candidates as growth stimulants,

vii) more specific measure of expected output (net returns).

Appendix A

THE 19 AGRO-MANITOBAN COMMUNITIES

A.1 CENTRAL REGION

Altona

This town lies 113 km south of Winnipeg and is north of the United States boundary by 10 km. Altona services the prime agricultural area which surrounds it and is known as the heart of the Pembina triangle. The surrounding land produces a variety of crops such as; sunflowers, canola, corn, sugar beets, strawberries, other fruits and cereal grains. Several large poultry, dairy and hog farms operate in this area also.

Altona is dependent upon the United States to supply its water. Water is supplied from a pipeline that runs north from Neche, N.D. to Altona. The community of Neche, N.D. has the first right to the supply of water. More specifically, water will not be available to Altona until Neche, N.D. has met its own demands. This can be a problem, since in peak demand months the water supply system may not be able to accommodate both communities. If a water shortage is apparent, Altona will immediately feel the repercussions of limited availability of water. Even without a drought, the plant has trouble keeping up with the consumption of water.

Winkler

This town is situated approximately 75 miles southwest of Winnipeg and 14 miles north of the United States border. Winkler is located in the core of the Pembina triangle. The surrounding area is noted for the most moderate climate in Manitoba. This climatic condition is the basis for the area's variety of crops and livestock (i.e., corn, sunflowers, sugar beets, canola, peas, potatoes, canning crops, dairy, hogs, chickens, eggs, etc.). Winkler also has a wide range of industries from mobile homes, metal castings and steel truck boxes, to concrete mixers and other manufactured goods.

The raw water is supplied from a groundwater aquifer that has limited capacity. This is due to the chance of saltwater intrusion if the water is depleted past a certain level. The problem of a salty water source can be alleviated if the new wells are sparsely located. Conversely, if the new wells are too densely located, a salt water problem will occur. This would be due to overextraction at one point (this in turn would draw up the salt water). Another constraining factor to increased water availability is the limited amount of water storage capacity within this community.

Carman:

Carman is located 80 km southwest of Winnipeg on the Boyne River in the Northern portion of the Pembina triangle. As a result of being in this intensely farmed area, it too has a variety of crops and livestock, i.e., cereal grains, sunflower, canola, potatoes corn, sugar beet, flax, peas, poultry, cattle and hogs.

The Boyne River and the Stephenfield Reservoir (located 16 km west of Carman) are the sources of raw water. The flow is regulated by the Stephenfield Dam. Previously, the weak link to the water supply system was the inability to treat enough water for community use. There is enough storage capacity. Filling the storage facilities is the only criterion that could not be fulfilled. However, with the recent implementation of a new treatment plant which has resulted in increased treatment capacity, there does not seem to be any constraining factor for meeting current and possibly increased future demands.

Morden:

Morden is located approximately 113 km southwest of Winnipeg. This community is the regional service centre for the eastern portion of the intensely farmed Pembina triangle. As mentioned in the previous communities, Morden also services a wide variety of crop and livestock farms.

The water source is situated in Lake Minnewasta and the PFRA Reservoir. Treatment capacity and storage capacity are not the constraining factors. The most immediate improvement needed seems to be the quality of the water, i.e., improved filtration is needed. Otherwise, the supply is more than adequate to meet the demands.

Morris:

This trading centre services a flourishing grain growing area and is the home of a school bus manufacturer as well as a power tool industry and a wine bottling firm. The community is 56 km south of Winnipeg.

Raw water is obtained from the Red River. Storage availability was questionable, but with the implementation of a 390,000 gallon reservoir there, is ample storage. The most noticable problem is the periodic inadequate water treatment. This is due to a high demand and the poor quality of water supplied. Therefore it has been suggested that the water treatment plant is a constraint to increased supply.

Portage La Prairie:

This community is located 84 km west of Winnipeg. The land is level and highly fertile in the Portage district. This area, known as 'Portage Plains,' produces cereal grains, potatoes, sugar beet, livestock, sunflowers, carrots, canola, asparagus, onions, etc. Other than clothing, electrical cable, canvas products and dairy products, the industrial sector is mainly comprised of potato processing and soup producers.

Raw water is supplied from the Assiniboine River. The treatment facility that services this portion of the river has the capacity for treating five million gallons of water per day. However, even at peak seasons, Portage La Prairie requires the plant to run, at most, three million imperial gallons per day. This is due to the three million imperial gallons/day limit that the water pipe size imposes on Portage la Prairie. That is, the distribution lines can only facilitate three million imperial gallons/day of treated water pumped at anytime. Portage La Prairie needs more storage capacity and also needs water softening, i.e., a pre-treatment basin.

A.2 INTERLAKE REGION

Selkirk:

Although only 29 km north of Winnipeg, the community is a manufacturing, sporting, transportation and shopping centre. Manufacturing stems from the steel related industries established there. Agriculturally, the Selkirk area has market gardening, cereal crops, special crops and forage.

Both the Red River and underground wells supply Selkirk with raw water. There is an ample water supply, although water storage is a problem. The storage capacity consists of a mere 112,000 Imperial gallons. Water supply treatment seems to be sufficiently adequate. Before demand can be increased the storage problem must be alleviated.

A.3 EASTERN REGION

Steinbach:

Located 64 km southeast of Winnipeg, this community has its industry based on the farming in the surrounding area, i.e., creamery, flour mill, poultry processing. There is also millworking, concrete products, light industries and boat manufacturing as well as a retail service for Winnipeg, i.e., car dealerships.

The community is serviced by two wells. The treatment facility has the capability of producing approximately 2.2 million gallons/day (i.e., if there existed a strong enough booster to increase the volume of water going through the plant). Obviously, this facility is not even close to full capacity use since it operates between 650,000 to 900,000 gallons/day. The major supply problem of Steinbach stemmed from its lack of water storage capacity and its need to develop a third well.

Beausejour:

This community is situated 61 km northeast of Winnipeg. The major industry in this district is agriculture. Two industries near town which are significant are a tyndall limestone quarry and a peat moss harvester.

Wells serve as the source of raw water here. There does not seem to be any significant constraining factor as far as the water supply system is concerned.

A.4 SOUTHWEST REGION

Boissevain

This community is located 272 km southwest of Winnipeg, 76 km south of Brandon. Its economy is agriculturally based, eg. canola, sunflowers, vegetables and cereal grains. Cattle, hog and poultry production are also prevalent.

The Boissevain Reservoir services this community with raw water. The water supply system facilitates Boissevain adequately. There are no immediate problems that are apparent.

Deloraine:

Deloraine is located 113 km southwest of Brandon and 298 km southwest of Winnipeg. This agricultural service centre accommodates mixed farming (cereal grains, sunflowers, corn, grass seeds) and livestock production.

Raw water is acquired from the Turtlehead Reservoir. During peak months, the water treatment plant generates the largest capacity volume possible, i.e., 65 imperial gallons/minute, for a 10 hour day. The capacity limitation seems to be the most constraining factor. To meet present and possible future demands, the capacity of volume through the plant must be increased.

Melita:

This community services the southwest corner of Manitoba. The surrounding district has crops of field peas, corn, potatoes, cereal grains, various livestock, sunflowers, spices and mustard. In addition, oil is extracted from this area.

Melita's source of raw water comes from five wells. The most needed change in its water supply system is its storage capacity. To be capable of meeting any type of future demands, the water storage facility must be increased.

Virden:

Virden, located 291 km from Winnipeg and 76 km east of Brandon has two major industries. These consist of agriculture (mixed farming, cereal grains, livestock and poultry, flour milling, feed manufacturing), and oil production since Virden lies on Manitoba's main oil field.

A well serves as a raw water supply for Virden. Minimal storage seems to be the most limiting constraint. An indication is the tower frequently running dry. In addition, two thirds of the reservoir must be kept on hand for firefighting. Therefore, increased storage capacity is needed. An additional well is also required. There is little sense in having increased storage capacity if it cannot be filled.

Souris:

Souris is located 238 km from Winnipeg and 48 km southwest of Brandon. Industries range from a cheese plant to 'agate' processing. Dairy farming, cattle feedlot and hog operations are also prevalent, as are cereal grain, potato and special crop production.

The sources of water available to Souris are wells and the Souris River. There are no apparent constraining factors or problems with the current water supply system.

Brandon:

This city is the agricultural, commercial and industrial centre for eastern Saskatchewan and western Manitoba. Brandon is 209.2 km west of Winnipeg and facilitates the Manitoban southwestern and the Saskatchewan southeastern fertile farm area. As a result, the economy of Brandon is largely built upon agriculture and agriculturally based industries. However, there are other industries established in Brandon which do deviate from the normal agricultural accent. Examples of these additional industries are; electrical equipment manufacturing, metal products fabrication, needle trades, printing and publishing, etc.

The city has ample acreage for further development of present industries or for adding new industries. This acreage is the result of Brandon's foresight in setting up several industrial parks for continued industrial development.

The source of raw water for Brandon is the Assiniboine River. During its peak usage months, the plant ranges from 65 to 70% of full capacity, i.e., approximately 7 million gallons/day. It was found that the treatment plant was the critical link to the system, since there was only enough storage for approximately one days use. However, it needs continuous filling in order to meet future demands. No immediate problems of the municipal water supply system are apparent.

Minnedosa:

Minnedosa is 48 km north of Brandon and 209 km northwest of Winnipeg. Large industries in this community are agricultural implement production and a gasohol distilliery. This agricultural service centre accomodates an area which is involved mainly in mixed farming and livestock production.

Minnedosa draws from two sources of raw water, namely 3 municipal wells and Minnedosa Lake. Two plants treat the raw water drawn (i.e., treatment plant 1 and treatment plant 2). The most constraining factor in this community's water supply system is the treatment facility. More specifically plant number 1 is too small in design to meet all of Minnedosa's demands.

Neepawa:

Located 109 km northwest of Winnipeg, this community services a local rural economy which relies upon cereal grain crops and livestock production.

Whitemud River and Lake Irwin supply raw water to this community. The treatment plant is capable of 300,000 gallons per day. However, it runs 50% of capacity during peak months. Storage capacity was the problem, but now, with implementation of a 500,000 gallon overhead storage tank, there do not seem to be any immediate limiting constraints.

A.5 NORTHWEST REGION

Russell:

The community of Russell is located 354 km northwest of Winnipeg and 16 km east of the Manitoba-Saskatchewan boundary. Russell services an area where grain crops and canola are predominant. Some cattle are also produced in this area.

Raw water was supplied by two wells until 1965. Since then, Conjuring Creek has been the major supplier of raw water. Although Russell should have a larger treatment plant, the most immediate constraint is the storage capacity. They need more storage in order to serve as a buffer in case the treatment plant must be closed down for servicing.

Dauphin:

This community services an area where agriculture is the backbone of the rural economy. This district produces cereal grains, special crops, forage crops and livestock. Dauphin is located 338 km northwest of Winnipeg. Industries include a feed mill, concrete plant, alfalfa plant and a milk processing plant.

The sources of water supply here are Edwards Lake and Vermillion Reservoir. The water treatment consists of a coarse screening and a booster system. In short, a treatment facility does not exist. As a result, the quality of water is poor. This leads to a reservoir almost half filled with sediments and aquatic growth. The most constraining factor is the lack of a water treatment facility.

Appendix B

PRIMARY PRODUCTION

Primary production is an important aspect in secondary processing firm location. Evidently, secondary processing is not possible without primary product resources.

In developing a criterion for firm location, this Appendix illustrates the amount of primary production in various nearby agricultural census divisions. Agricultural service centres in these divisions are illustrated as well. The following Tables[53] are an aggregation of production in both the initial census division and the adjacent census divisions.

The following is a legend for the Tables; 1) Acres, 2) Hectares, 3) Number of Farms Reporting, 4) Number, 5) Number of farms reporting, ------- = none, xxxxxxx = unreported number.

[53] Tables are an aggregation of the tables presented in the Census Of Agriculture In Manitoba (1981).

TABLE 28

Census Division #5 - Includes Melita, Deloraine, Boissevain (affects Divisions #4,6,7)

Wheat (total area)	1)	531,295	Potatoes	1)	4
	2)	215,007		2)	2
	3)	1,745		3)	3
Oats (for grain)	1)	63,860	Sugar beets	1)	-------
	2)	25,843		2)	-------
	3)	860		3)	-------
Barley (for grain)	1)	214,496	Dry field peas	1)	1,005
	2)	86,803		2)	407
	3)	1,279		3)	9
Mixed grain	1)	4,585	Dry field beans	1)	-------
	2)	1,855		2)	-------
	3)	70		3)	-------
Corn (for grain)	1)	6,091	Vegetables	1)	55
	2)	2,465	(total area)	2)	22
	3)	51		3)	10
Rye (for grain)	1)	39,867	Tree fruit	1)	2
	2)	16,134	(total area)	2)	1
	3)	351		3)	3
Buckwheat area	1)	4,761	Cultivated berries	1)	-------
	2)	1,927	and grapes	2)	-------
	3)	60		3)	-------
Flaxseed	1)	127,306			
	2)	51,519	Cattle	4)	110,986
	3)	931		5)	1,239
Soybeans	1)	400			
	2)	162	Pigs	4)	39,082
	3)	6		5)	253
Sunflowers	1)	49,456			
	2)	20,014	Sheep	4)	3,733
	3)	246		5)	33
Corn for silage	1)	1,674			
	2)	677	Horses and ponies	4)	3,020
	3)	27		5)	511
Alfalfa	1)	67,392			
	2)	27,273	Hens and chickens	4)	89,501
	3)	815		5)	550
Rapeseed	1)	72,058			
	2)	29,161	Turkeys	4)	2,512
	3)	432		5)	115
Oats (for fodder)	1)	6,250			
	2)	2,529	Geese	4)	912
	3)	135		5)	104
Mustard seed	1)	4,641			
	2)	1,878	Ducks	4)	2,644
	3)	32		5)	94

TABLE 29

Census Division #6 - Includes Virden (affects Divisions #5,7,15)

Wheat (total area)	1)	182,530	Potatoes	1)	2
	2)	73,867		2)	1
	3)	755		3)	1
Oats (for grain)	1)	56,828	Sugar beets	1)	-------
	2)	22,997		2)	-------
	3)	603		3)	-------
Barley (for grain)	1)	76,715	Dry field peas	1)	60
	2)	31,045		2)	24
	3)	566		3)	1
Mixed grain	1)	5,301	Dry field beans	1)	-------
	2)	2,145		2)	-------
	3)	61		3)	-------
Corn (for grain)	1)	3,885	Vegetables	1)	6
	2)	1,572	(total area)	2)	2
	3)	16		3)	2
Rye (for grain)	1)	12,172	Tree fruit	1)	-------
	2)	4,926	(total area)	2)	-------
	3)	109		3)	-------
Buckwheat area	1)	1,911	Cultivated berries	1)	10
	2)	773	and grapes	2)	4
	3)	20		3)	1
Flaxseed	1)	23,742			
	2)	9,608	Cattle	4)	73,750
	3)	240		5)	781
Soybeans	1)	75			
	2)	30	Pigs	4)	15,433
	3)	2		5)	191
Sunflowers	1)	8,165			
	2)	3,304	Sheep	4)	576
	3)	42		5)	20
Corn for silage	1)	1,866			
	2)	755	Horses and ponies	4)	2,130
	3)	25		5)	322
Alfalfa	1)	46,149			
	2)	18,676	Hens and chickens	4)	46,430
	3)	493		5)	343
Rapeseed	1)	8,056			
	2)	3,260	Turkeys	4)	1,063
	3)	72		5)	75
Oats (for fodder)	1)	6,226			
	2)	2,520	Geese	4)	XXXXXXX
	3)	142		5)	51
Mustard seed	1)	1,702			
	2)	689	Ducks	4)	XXXXXXX
	3)	17		5)	53

TABLE 30

Census Division #7 - Includes Souris, Brandon (affects Divisions #5,6,8,15)

Wheat (total area)	1)	244,723
	2)	99,036
	3)	1,076
Oats (for grain)	1)	44,275
	2)	17,917
	3)	618
Barley (for grain)	1)	191,332
	2)	77,429
	3)	966
Mixed grain	1)	4,243
	2)	1,717
	3)	56
Corn (for grain)	1)	20,164
	2)	8,160
	3)	96
Rye (for grain)	1)	19,517
	2)	7,898
	3)	250
Buckwheat area	1)	4,100
	2)	1,659
	3)	65
Flaxseed	1)	43,807
	2)	17,728
	3)	415
Soybeans	1)	230
	2)	93
	3)	5
Sunflowers	1)	22,039
	2)	8,919
	3)	154
Corn for silage	1)	3,297
	2)	1,334
	3)	46
Alfalfa	1)	50,022
	2)	20,243
	3)	673
Rapeseed	1)	39,245
	2)	15,882
	3)	307
Oats (for fodder)	1)	4,736
	2)	1,917
	3)	101
Mustard seed	1)	4,483
	2)	1,814
	3)	34

Potatoes	1)	11,747
	2)	4,754
	3)	50
Sugar beets	1)	-------
	2)	-------
	3)	-------
Dry field peas	1)	5,025
	2)	2,034
	3)	80
Dry field beans	1)	575
	2)	233
	3)	7
Vegetables	1)	22
(total area)	2)	9
	3)	11
Tree fruit	1)	8
(total area)	2)	3
	3)	6
Cultivated berries	1)	6
and grapes	2)	2
	3)	2
Cattle	4)	75,301
	5)	891
Pigs	4)	53,406
	5)	226
Sheep	4)	1,806
	5)	38
Horses and ponies	4)	2,586
	5)	381
Hens and chickens	4)	281,428
	5)	374
Turkeys	4)	67,882
	5)	62
Geese	4)	XXXXXXX
	5)	57
Ducks	4)	XXXXXXX
	5)	65

TABLE 31

Census Division #15 - Includes Minnedosa, Neepawa (affects Divisions 4,6,7,8,9,16,17)

Wheat (total area)	1)	413,550	Potatoes	1)	278
	2)	167,358		2)	113
	3)	2,264		3)	5
Oats (for grain)	1)	55,679	Sugar beets	1)	-------
	2)	22,532		2)	-------
	3)	1,042		3)	-------
Barley (for grain)	1)	325,720	Dry field peas	1)	1,601
	2)	131,814		2)	648
	3)	1,975		3)	20
Mixed grain	1)	4,201	Dry field beans	1)	100
	2)	1,700		2)	40
	3)	83		3)	2
Corn (for grain)	1)	2,727	Vegetables	1)	2
	2)	1,104	(total area)	2)	1
	3)	24		3)	2
Rye (for grain)	1)	12,454	Tree fruit	1)	-------
	2)	5,040	(total area)	2)	-------
	3)	177		3)	-------
Buckwheat area	1)	1,087	Cultivated berries	1)	1
	2)	440	and grapes	2)	-------
	3)	21		3)	2
Flaxseed	1)	41,748			
	2)	16,895	Cattle	4)	105,167
	3)	450		5)	1,620
Soybeans	1)	99			
	2)	40	Pigs	4)	47,748
	3)	4		5)	506
Sunflowers	1)	3,902			
	2)	1,579	Sheep	4)	3,390
	3)	33		5)	31
Corn for silage	1)	1,021			
	2)	413	Horses and ponies	4)	3,182
	3)	27		5)	631
Alfalfa	1)	73,174			
	2)	29,612	Hens and chickens	4)	288,096
	3)	1,028		5)	773
Rapeseed	1)	81,829			
	2)	33,115	Turkeys	4)	2,537
	3)	695		5)	184
Oats (for fodder)	1)	6,460			
	2)	2,614	Geese	4)	9,525
	3)	202		5)	147
Mustard seed	1)	9,966			
	2)	4,033	Ducks	4)	XXXXXXX
	3)	101		5)	145

TABLE 32

Census Division #16 - Includes Russell (affects Divisions #15,17,20)

Wheat (total area)	1)	190,237
	2)	76,986
	3)	1,084
Oats (for grain)	1)	32,665
	2)	13,219
	3)	667
Barley (for grain)	1)	111,280
	2)	45,033
	3)	885
Mixed grain	1)	1,894
	2)	766
	3)	33
Corn (for grain)	1)	90
	2)	36
	3)	3
Rye (for grain)	1)	6,079
	2)	2,460
	3)	84
Buckwheat area	1)	185
	2)	75
	3)	2
Flaxseed	1)	4,291
	2)	1,737
	3)	58
Soybeans	1)	5
	2)	2
	3)	1
Sunflowers	1)	65
	2)	26
	3)	1
Corn for silage	1)	545
	2)	221
	3)	7
Alfalfa	1)	36,638
	2)	15,636
	3)	603
Rapeseed	1)	25,252
	2)	10,219
	3)	240
Oats (for fodder)	1)	6,150
	2)	2,489
	3)	175
Mustard seed	1)	7,982
	2)	3,230
	3)	68

Potatoes	1)	1
	2)	-------
	3)	1
Sugar beets	1)	-------
	2)	-------
	3)	-------
Dry field peas	1)	500
	2)	202
	3)	8
Dry field beans	1)	-------
	2)	-------
	3)	-------
Vegetables	1)	1
(total area)	2)	-------
	3)	2
Tree fruit	1)	-------
(total area)	2)	-------
	3)	-------
Cultivated berries	1)	1
and grapes	2)	-------
	3)	1
Cattle	4)	62,612
	5)	902
Pigs	4)	5,529
	5)	209
Sheep	4)	829
	5)	27
Horses and ponies	4)	2,038
	5)	355
Hens and chickens	4)	55,803
	5)	509
Turkeys	4)	1,233
	5)	141
Geese	4)	958
	5)	92
Ducks	4)	1,540
	5)	92

TABLE 33

Census Division #17 - Includes Dauphin (affects Divisions #8,15,16,20)

Wheat (total area)	1)	265,944	Potatoes	1)	5
	2)	107,624		2)	2
	3)	1,810		3)	3
Oats (for grain)	1)	75,305	Sugar beets	1)	-------
	2)	30,475		2)	-------
	3)	1,304		3)	-------
Barley (for grain)	1)	157,395	Dry field peas	1)	1,782
	2)	63,695		2)	721
	3)	1,330		3)	23
Mixed grain	1)	9,335	Dry field beans	1)	30
	2)	3,778		2)	12
	3)	159		3)	1
Corn (for grain)	1)	342	Vegetables	1)	13
	2)	138	(total area)	2)	5
	3)	7		3)	7
Rye (for grain)	1)	13,029	Tree fruit	1)	-------
	2)	5,273	(total area)	2)	-------
	3)	215		3)	1
Buckwheat area	1)	25,800	Cultivated berries	1)	61
	2)	10,441	and grapes	2)	24
	3)	378		3)	10
Flaxseed	1)	37,821			
	2)	15,306	Cattle	4)	135,742
	3)	491		5)	1,719
Soybeans	1)	420			
	2)	170	Pigs	4)	23,882
	3)	10		5)	516
Sunflower	1)	585			
	2)	237	Sheep	4)	5,026
	3)	8		5)	63
Corn for silage	1)	1,556			
	2)	630	Horses and ponies	4)	2,878
	3)	19		5)	605
Alfalfa	1)	109,855			
	2)	44,457	Hens and chickens	4)	124,999
	3)	1,214		5)	925
Rapeseed	1)	55,900			
	2)	22,622	Turkeys	4)	24,716
	3)	524		5)	193
Oats (for fodder)	1)	15,190			
	2)	6,147	Geese	4)	1,513
	3)	383		5)	185
Mustard seed	1)	3,693			
	2)	1,495	Ducks	4)	XXXXXXX
	3)	53		5)	151

TABLE 34

Census Division #9 - Includes Portage La Prairie (affects Divisions #3,4,8,10,14)

Wheat (total area)	1)	150,852	Potatoes	1)	3,191
	2)	61,048		2)	1,291
	3)	637		3)	16
Oats (for grain)	1)	16,002	Sugar beets	1)	3,224
	2)	6,500		2)	1,305
	3)	256		3)	36
Barley (for grain)	1)	85,313	Dry field peas	1)	11,648
	2)	34,525		2)	4,714
	3)	526		3)	135
Mixed grain	1)	6,013	Dry field beans	1)	6,628
	2)	2,433		2)	2,682
	3)	73		3)	45
Corn (for grain)	1)	16,730	Vegetables	1)	1,050
	2)	6,770	(total area)	2)	425
	3)	83		3)	19
Rye (for grain)	1)	6,550	Tree fruit	1)	3
	2)	2,651	(total area)	2)	1
	3)	119		3)	2
Buckwheat area	1)	7,623	Cultivated berries	1)	91
	2)	3,085	and grapes	2)	37
	3)	105		3)	14
Flaxseed	1)	39,286			
	2)	15,898	Cattle	4)	36,465
	3)	380		5)	456
Soybeans	1)	792			
	2)	321	Pigs	4)	35,431
	3)	18		5)	119
Sunflowers	1)	15,197			
	2)	6,150	Sheep	4)	53
	3)	97		5)	5
Corn for silage	1)	5,376			
	2)	2,176	Horses and ponies	4)	1,275
	3)	86		5)	151
Alfalfa	1)	33,308			
	2)	13,479	Hens and chickens	4)	191,225
	3)	372		5)	182
Rapeseed	1)	21,855			
	2)	8,844	Turkeys	4)	44,220
	3)	193		5)	23
Oats (for fodder)	1)	2,752			
	2)	1,114	Geese	4)	XXXXXXX
	3)	53		5)	31
Mustard seed	1)	243			
	2)	98	Ducks	4)	2,001
	3)	6		5)	35

TABLE 35

Census Division #3 - Includes Carman, Morris, Morden, Winkler, Altona
(affects Divisions #2,4,8,9,10,11,14)

Wheat (total area)	1)	423,156	Potatoes	1)	14,182
	2)	171,245		2)	5,739
	3)	1,993		3)	32
Oats (for grain)	1)	21,086	Sugar beets	1)	19,254
	2)	8,533		2)	7,792
	3)	415		3)	315
Barley (for grain)	1)	176,059	Dry field peas	1)	57,575
	2)	71,249		2)	23,300
	3)	1,496		3)	659
Mixed grain	1)	7,442	Dry field beans	1)	8,276
	2)	3,012		2)	3,349
	3)	131		3)	102
Corn (for grain)	1)	90,521	Vegetables	1)	1,197
	2)	36,633	(total area)	2)	484
	3)	404		3)	40
Rye (for grain)	1)	12,805	Tree fruit	1)	40
	2)	5,182	(total area)	2)	16
	3)	140		3)	20
Buckwheat area	1)	15,089	Cultivated berries	1)	73
	2)	6,106	and grapes	2)	29
	3)	264		3)	13
Flaxseed	1)	84,225			
	2)	34,085	Cattle	4)	42,391
	3)	1,001		5)	992
Soybeans	1)	2,314			
	2)	936	Pigs	4)	121,361
	3)	31		5)	592
Sunflowers	1)	81,029			
	2)	32,791	Sheep	4)	785
	3)	740		5)	41
Corn for silage	1)	11,190			
	2)	4,528	Horses and ponies	4)	1,217
	3)	145		5)	241
Alfalfa	1)	21,015			
	2)	8,504	Hens and chickens	4)	942,749
	3)	515		5)	581
Rapeseed	1)	65,859			
	2)	26,652	Turkeys	4)	XXXXXXX
	3)	633		5)	36
Oats (for fodder)	1)	1,167			
	2)	472	Geese	4)	XXXXXXX
	3)	41		5)	62
Mustard seed	1)	2,024			
	2)	819	Ducks	4)	3,244
	3)	27		5)	80

TABLE 36

Census Division #2 - Includes Steinbach (affects Divisions #1,3,10,11,12,13)

Wheat (total area)	1)	213,983	Potatoes	1)	524
	2)	86,596		2)	212
	3)	951		3)	25
Oats (for grain)	1)	24,407	Sugar beets	1)	4,698
	2)	9,877		2)	1,901
	3)	392		3)	55
Barley (for grain)	1)	121,465	Dry field peas	1)	4,647
	2)	49,155		2)	1,881
	3)	850		3)	52
Mixed grain	1)	17,466	Dry field beans	1)	273
	2)	7,068		2)	110
	3)	215		3)	4
Corn (for grain)	1)	14,559	Vegetables (total area)	1)	296
	2)	5,892		2)	119
	3)	98		3)	42
Rye (for grain)	1)	5,359	Tree fruit (total area)	1)	1
	2)	2,169		2)	-------
	3)	59		3)	1
Buckwheat area	1)	10,338	Cultivated berries and grapes	1)	37
	2)	4,184		2)	15
	3)	120		3)	16
Flaxseed	1)	23,358			
	2)	9,453	Cattle	4)	64,316
	3)	242		5)	1,064
Soybeans	1)	473			
	2)	191	Pigs	4)	161,738
	3)	11		5)	482
Sunflowers	1)	20,952			
	2)	8,479	Sheep	4)	3,342
	3)	113		5)	75
Corn for silage	1)	6,911			
	2)	2,797	Horses and ponies	4)	1,073
	3)	144		5)	288
Alfalfa	1)	71,246			
	2)	28,832	Hens and chickens	4)	2,527,160
	3)	892		5)	568
Rapeseed	1)	13,467			
	2)	5,450	Turkeys	4)	259,007
	3)	101		5)	75
Oats (for fodder)	1)	4,172			
	2)	1,688	Geese	4)	XXXXXXX
	3)	129		5)	89
Mustard seed	1)	440			
	2)	178	Ducks	4)	XXXXXXX
	3)	3		5)	92

TABLE 37

Census Division #12 - Includes Beausejour (affects Divisions #1,2,10,11,13,14)

Wheat (total area)	1)	106,729	Potatoes	1)	211
	2)	43,192		2)	85
	3)	731		3)	19
Oats (for grain)	1)	19,025	Sugar beets	1)	-------
	2)	7,699		2)	-------
	3)	389		3)	-------
Barley (for grain)	1)	38,369	Dry field peas	1)	1,927
	2)	15,527		2)	780
	3)	372		3)	27
Mixed grain	1)	4,457	Dry field beans	1)	1,017
	2)	1,804		2)	412
	3)	60		3)	11
Corn (for grain)	1)	5,289	Vegetables	1)	300
	2)	2,140	(total area)	2)	121
	3)	29		3)	20
Rye (for grain)	1)	841	Tree fruits	1)	-------
	2)	340	(total area)	2)	-------
	3)	17		3)	1
Buckwheat area	1)	2,174	Cultivated berries	1)	41
	2)	880	and grapes	2)	16
	3)	38		3)	12
Flaxseed	1)	11,668			
	2)	4,722	Cattle	4)	19,049
	3)	179		5)	442
Soybeans	1)	50			
	2)	20	Pigs	4)	25,780
	3)	1		5)	150
Sunflowers	1)	2,782			
	2)	1,126	Sheep	4)	XXXXXXX
	3)	15		5)	26
Corn for silage	1)	1,987			
	2)	804	Horses and ponies	4)	669
	3)	19		5)	139
Alfalfa	1)	21,068			
	2)	8,526	Hens and chickens	4)	107,190
	3)	376		5)	324
Rapeseed	1)	4,816			
	2)	1,949	Turkeys	4)	XXXXXXX
	3)	36		5)	30
Oats (for fodder)	1)	1,520			
	2)	615	Geese	4)	XXXXXXX
	3)	55		5)	32
Mustard seed	1)	505			
	2)	204	Ducks	4)	XXXXXXX
	3)	4		5)	27

TABLE 38

Census Division #13 - Includes Selkirk (affects Divisions #11,12,14)

Wheat (total area)	1)	89,186	Potatoes	1)	689
	2)	36,092		2)	279
	3)	651		3)	57
Oats (for grain)	1)	6,773	Sugar beets	1)	93
	2)	2,741		2)	38
	3)	183		3)	1
Barley (for grain)	1)	42,017	Dry field peas	1)	1,193
	2)	17,004		2)	483
	3)	354		3)	16
Mixed grain	1)	2,344	Dry field beans	1)	35
	2)	949		2)	14
	3)	44		3)	1
Corn (for grain)	1)	2,799	Vegetables	1)	267
	2)	1,133	(total area)	2)	108
	3)	15		3)	55
Rye (for grain)	1)	785	Tree fruits	1)	2
	2)	318	(total area)	2)	1
	3)	16		3)	2
Buckwheat area	1)	805	Cultivated berries	1)	21
	2)	326	and grapes	2)	8
	3)	13		3)	9
Flaxseed	1)	12,324			
	2)	4,987	Cattle	4)	16,053
	3)	163		5)	330
Soybeans	1)	90			
	2)	36	Pigs	4)	17,594
	3)	2		5)	112
Sunflowers	1)	1,425			
	2)	577	Sheep	4)	755
	3)	3		5)	14
Corn for silage	1)	587			
	2)	238	Horses and ponies	4)	562
	3)	13		5)	90
Alfalfa	1)	19,239			
	2)	7,786	Hens and chickens	4)	60,637
	3)	299		5)	206
Rapeseed	1)	12,454			
	2)	5,040	Turkeys	4)	XXXXXXX
	3)	84		5)	20
Oats (for fodder)	1)	440			
	2)	178	Geese	4)	XXXXXXX
	3)	21		5)	34
Mustard seed	1)	718			
	2)	291	Ducks	4)	XXXXXXX
	3)	8		5)	34

Appendix C

ANNUAL INDUSTRIAL TREATED WATER USAGE

The following are the various existing types of agriculturally based secondary processing industries (1981) and the Manitoban communities they are in. The annual water usage figures of each of these industries are illustrated in imperial gallons.[54] The communities are listed in alphabetical order as are the industries.

[54] The water usage figures were derived from actual industrial water usage data from the municipal offices of the various communities.

TABLE 39

Industries, Industrial Water Usage And Their Communities

Community	Annual Treated Water Usage I.G. (1981)
Altona	
C.S.P. Foods Limited (oilseed)	25,376,370
Beausejour	
Beausejour Bakery	17,600
Cam's Auto & Farm Parts	6,420
Boissevain	
Boissevain Abattoir (slaughter house)	65,060
Boissevain Bakery	75,830
Boissevain Farm Equipment	28,740
Boissevain Processor	18,180
J.H.R. Farmland Equipment	129,600
Brandon	
Behland Wicks (grain bins)	656,990
Brandon Meat Market	193,470
Burns Foods Limited	-------
Canadian Livestock Co-op	231,940
Codville Co-op	8,979
Dutch Mill Bakery	10,237
Federated Co-op Feed Mills	77,925
Feed Rite Mills Western Limited	72,754
Lindenberg Seeds Limited	15,266
Macey Foods (poultry processor)	4,778,710
Manitoba Co-op Dairies	10,073,077
McGavin Toastmaster	5,651
Meat Management Limited	5,964
Modern Dairies	945,850
Old Dutch Food	1,948
Plains Industry Limited (livestock trailer)	8,739
Prairie Liquid Feeds	38,790
Western Grocers	361,470
Wheat City Seed	3,676
Shurgrow Farm Services	149,326
Carman	
A & M Soil Services	59,790
Carman Agricultural Services	26,200
Carman Bakery	72,050
Carman Farm Equipment	27,070
Carman Frosted Foods	211,230
Carman Vegetable and Storage	614,540
Dufferin Feed Service	308,440
ED McEachen Potato Processor	18,500
RC McGregor Hatchery	22,300
Seedex Canada	55,970

Dauphin	
Alfalfa Processors	15,572
Central Meat and Cold Storage	74,123
Dauphin Alfalfa	66,648
Inter-Mountain Meat Processor	113,988
Maneo Cheese Plant	13,983,707
Modern Hatcheries	37,996
Peterson's Bakery	723,789
Western Bakery	275,936
Deloraine	
JAS Sander (meats)	27,680
Melita	
Melita Bakery	48,400
Souris Valley Processors (meat processing)	148,800
Minnedosa	
Mohawk Oil (ethanol distillary)	15,000,000
Morris Rodweeder	1,959,700
Penner's Bakery	83,600
Morden	
Farm King (agricultural equipment)	308,000
Morden Creamery	96,000
Morden Fine Foods (Best Pack - Vegetable Processor)	8,986,830
Pembina Poultry Packer	11,519,950
Morris	
Canada Packers	310,000
Neepawa	
Case Power & Equipment	34,881
Clarks Bakery	348,814
Neepawa By Products	31,767
Neepawa Creamery	784,832
Neepawa Food Processor	2,250,349
Traill Meats (meat processing)	229,844
Portage La Prairie	
Campbell Soup Company Limited	119,070,000
Canadian Food Product (lab.)	424,000
Kroeker Farms Limited	298,000
Manitoba Dairy Co-op Limited	454,000
McCain Foods Limited	92,850,000
Portage Co-op	1,586,000
Portage Creamery	900,000
Woodstone Foods (ingredient powder)	21,990,000
Russell	
Banner Bakery	-------
Banner County Meats	115,700
Parkland Feeds	3,600

Selkirk	
Lakeland Dairies	564,000
Souris	
Potato Plant	744,344
Superior Cheese Plant	2,342,400
Superior Whey Plant	1,203,700
Steinbach	
Friendly Family Farms (poultry & feed)	33,600
Steinbach Flour Mills	467,100
Steinbach Hatchery	347,000
Virden	
Draper Farm Equipment	4,460
Kert Flour Mills	125,830
Randolph's Bakery	56,370
Winkler	
Four Seasons Potato	2,436,500
Kroeker Farms	3,524,850
Lode King (farm equipment)	107,620
Monarch Machinery (cultivators)	7,376,400
Southern Manitoba Potato	2,398,530
Winkler Feed Services	155,420
Winkler Potato	63,930
Winkler Wholesale Meat	559,900

Appendix D

STANDARDIZATION OF COSTS

Standardization of both costs and benefits are required before a comparison of the two is possible. This appendix uses Statistic Canada's Construction Price Statistics index to fulfill the objective of standardization.

Water treatment renovations and agricultural processing firm implementation have fallen under the "industrial buildings" category from the Non-Residential Building Construction Material Price Indexes. The annu-

TABLE 40

Annual Price Indexes (1971=100)

Year	Index
1971	100.0
1972	105.7
1973	114.7
1974	139.6
1975	151.3
1976	162.8
1977	173.1
1978	188.9
1979	219.4
1980	244.3
1981	273.6
1982	297.5

al price indexes that will be used are as follows; To standardize costs into a standard pricing scheme, i.e.,1982 (study year), the indexes must be used as follows;

(annual index of study year - annual index of construction year) /(annual index of construction year) = % change from construction year to the study year. When this % change is added to the appropriate construction year price, it will result in study year prices (1982). The

TABLE 41

Percentage Change From Construction Year to Study Year

Year	Percentage change for 1982
1980	(1982 index - 1980 index)/ 1980 index =
	(297.5 - 244.3)/ 244.3 = .217765 or 21.7765% change
1979	(297.5 - 219.4)/ 219.4 = .3559708
1978	(297.5 - 188.9)/ 188.9 = .5749074
1976	(297.5 - 162.8)/ 162.8 = .8273956
1975	(297.5 - 151.3)/ 151.3 = .9662921
1974	(297.5 - 139.6)/ 139.6 =1.1310888
1971	(297.5 - 100.0)/ 100.0 =1.975
1970	(1971 index - 1970 index)/ 1970 index =
	(169.6 - 156.1)/ 156.1 = .086483 for 1971

year and the corresponding percentage change are as follows;

D.1 MUNICIPAL WATER SYSTEM RENOVATIONS REQUIRED

This section illustrates the renovations that are is required to meet increased industrialization. The following table shows the communities, the renovations required and the associated cost. The costs are figures acquired from P.F.R.A. and are in terms of the year they were implemented elsewhere. These costs are standardized in a later table.

The next table will illustrate the standardization of the sunk costs in industry introduction.

TABLE 42

Municipal Water System Renovations

Community	Changes Required	Costs	Year
Melita	150,000 I.G. inground single cell reservoir	283,814.54	1978
Deloraine	150,000 I.G. inground single cell reservoir	283,814.54	1978
	Treated volume increase	90,000.00	1978
Boissevain	150,000 I.G. inground single cell reservoir	283,814.54	1978
Souris	Water treatment plant expansion	762,917.80	1980
	500,000 I.G. overhead storage reservoir	644,869.00	1980
Brandon	none		
Minnedosa	150,000 I.G. inground single cell reservoir	283,814.54	1978
Neepawa	none		
Portage La Prairie	1,000,000 I.G. inground two cell reservoir	932,000.00	1980
Altona	500,000 I.G. reservoir	644,869.00	1980
	Water treatment facility	725,646.15	1978
Carman	none		
Morden	none		
Morris	Water treatment plant expansion	762,917.80	1980
Winkler	500,000 I.G. reservoir	644,869.00	1980
	Well drilling and development	44,886.65	1974
	Well pumping equipment	12,371.00	1975
Steinbach	150,000 I.G. inground single cell reservoir	283,814.54	1978
	Well drilling and development	44,886.65	1974
	Well pumping equipment	12,371.00	1975

TABLE 43

Standardized Water Renovation Costs (1982)

Community	Year	Costs (1982) $
Melita	1978 283,814.54 + 163,167.08 =	446,981.62
Deloraine	1978 373,814.54 + 214,908.75 =	588,723.29
Boissevain	1978 283,814.54 + 163,167.08 =	446,981.62
Souris	1980 1,407,786.80 + 306,566.69 =	1,714,353.50
Minnedosa	1978 283,814.54 + 163,167.08 =	446,981.62
Portage La Prairie	1980 932,000.00 + 202,956.98 =	1,134,957.00
Altona	1980 644,869.00 + 140,429.90 =	785,298.90
	1978 725,646.15 + 417,179.34 =	1,142,825.50
		1,928,124.40
Morris	1980 762,917.80 + 166,136.79 =	929,054.59
Winkler	1980 644,569.00 + 140,429.90 =	785,298.90
	1974 44,886.65 + 50,770.787 =	95,657.43
	1975 12,371.00 + 11,954.00 =	24,325.00
		905,281.34
Steinbach	1978 283,814.54 + 163,167.08 =	446,981.62
	1974 44,886.65 + 50,770,787 =	95,657.43
	1975 12,371.00 + 11,954.00 =	24,325.00
		566,964.06

TABLE 44

Standardization Of Industrial Sunk Costs

Industry	Year	Costs (1982) $
French fry	1976 12,000,000.00 + 9,928,747.20 =	21,928,747.00
Oilseed	1980 30,000,000.00 + 6,532,950.00 =	36,532,950.00
Ingredient	1979 2,200,000.00 + 783,135.76 =	2,983,135.80
Vegetable	1976 500,000.00 + 413,697.80 =	913,697.80
Potato	1970 1971 1971 150,000.00 + 12,972.54 = 162,972.45 1971 162.972.45 + 321,870.60 =	484,843.05
Poultry	1980 400,000.00 + 87,106.00 =	487,106.00
Ethanol		20,000,000.00
Soup		25,000,000.00
Corn		70,000,000.00

*The above initial sunk cost figures were acquired from the Manitoban Department Of Economics.

Appendix E

THE PRICE OF TREATED WATER IN VARIOUS COMMUNITIES

This appendix illustrates the pricing structures for the various communities covered in this study. With regards to the following table, costs are the costs to the consumer, i.e., price of each 1000 I.G. unit.

TABLE 45

Communities And Their Municipal Water Consumption Prices

Communities	Consumption Above Minimum I.G.	Cost/1000 $ - I.G.	Minimum Consump.	Quarterly Charge ($)
Melita (Dec/65)				
Residential	6,000-120,000	1.41	6,000	12.00
Industrial	over 120,000	.91		
Deloraine (July/77)				
All users	3,000-14,999	4.50	3,000	18.90
	15,000-100,000	4.14		
	over 100,000	3.86		
Boissevain (April/76)				
All users	3,000-20,000	1.86	3,000	15.00
	20,000-80,000	1.55		
	over 80,000	1.32		
Souris (Jan/79)				
All users	3,115-15,574	2.82	3,114	12.10
	15,575-155,749	2.50		
	155,750-622,999	2.23		
	over 622,999	1.32		
Brandon (1978)				
All users	3,115-31,143	1.18	3,114	9.00
	31,144-622,883	.96		
	over 622,883			
Minnedosa (67-78)				
All users	15,000-30,000	.73	15,000	15.00
	30,000-209,999	.55		
	210,000-1,499,997	.32		
	over 1,499,997	----		
Neepawa (74-78)				
All users	4,983-31,143	1.55	4,983	14.06
	31,144-311,441	1.36		
	311,442-6,222,870	1.18		
	over 6,222,870	.41		
Portage La Prairie (76-78)				
All users	1,000-50,000	1.91	4,000	14.60
	50,000-499,998	1.45		
	499,999-3,999,991	1.05		
	over 3,999,991	.50		
Altona (Sept/76)				
All users	3,000-20,000	3.05	3,000	18.15
	20,000-129,999	2.50		

	130,000-499,999	2.05		
	over 499,999	1.60		
Carman (June/77)				
All users	3,000-14,999	1.86	3,000	11.65
	15,000-100,000	1.55		
	over 100,000	1.32		
Mordon (Mar/76)				
All users	3,000-20,000	1.45	3,000	12.00
	20,000-99,999	1.14		
	100,000-499,999	.95		
	over 499,999	.55		
Morris (Sept/63)				
All users	3,000-15,000	1.86	3,000	5.55
	over 15,000	1.23		
Winkler (Jan/79)				
All users	3,000-18,000	2.23	3,000	14.22
	18,000-250,000	2.13		
	over 250,000			
Steinbach (1965)				
All users	12,000-50,000	.95	12.000	15.66
	50,000-250,000	.64		
	over 250,000	.40		

Appendix F

RETURN ON INVESTMENT FOR VARIOUS INDUSTRIES

This appendix deals with the derivation of an economic impact indicator, more specifically, the return on investment/year for the various agriculturally based secondary processing industries.

The derivation is as follows; {value added - (salaries and wages)}/(value of shipments and other revenue) = profit/output.

profit/output * 1/(capital/output) = profit/capital.

profit/capital * capital/year = profit return on investment/year.

The above components and figures were acquired from Statistics Canada's Selected Principle Statistics Of The Manufacturing Industries and Capacity Utilization Rates In Canadian Manufacturing.

TABLE 46

Profit/Output

Industry	Profit/Output Ratio
#108 French fry Oilseed Ingredient Potato	= (79,090 - 19,908) / 349,945 = .1690609
#103 Soup	= (34,306 - 11,630) / 97,122 = .2334795
#1012 Poultry Processor	= (15,793 - 8,396) / 66,935 = .1105102
#1092 Ethanol (distillary)	= (429,140 - 121,290) / 698,638 = .4406431

* Ethanol figures taken from 'national level' table since provincial data were not available.

** The classification #'s were acquired from Statistics Canada's "Industrial Classification Manual."

TABLE 47

Profit/Capital

1/(capital/output) = 1/(2.59) = (output/capital) = .3861004

Industry type (profit/capital)	(profit/output)		(output/capital)		(profit/capital)
#108	.1690609	*	.3861004	=	.0652745
#103	.2334795	*	.3861004	=	.0901465
#1012	.1105102	*	.3861004	=	.042668
#1092	.4406431	*	.3861004	=	.1701325

TABLE 48

Return On Capital Investment/Year - Industry

Industry	Capital Investments		Profit/Capital Ratio		Returns/Year
French fry	21,928,749	X	.0652745	=	1,431,388.10
Oilseed	36,532,950	X	.0652745	=	2,384,670.00
Ingredient	2,983,135.8	X	.0652745	=	194,722.70
Potato	484,843.05	X	.0652745	=	31,647.89
Soup	25,000,000	X	.0901465	=	2,253,662.50
Poultry	487,106	X	.042668	=	20,783.84
Ethanol	20,000,000	X	.1701325	=	3,402,650.00

* The derived figures are before taxes, dividends, etc...

Appendix G

This appendix shows an example of the partial cost-benefit process implemented in the study.

Community/Industry = Melita/Oilseed

Cost- Benefit Components:

I) Costs	i) water renovation (1982)	-446,981.62
	ii) oilseed firm initial cost	-36,532,950.00
		--------------
	total initial investment	-36,979,931.62
	iii) cost of water/year	-23,093.00
II) Benefits	i) return on industrial investment/year	2,384,670.00
	ii) revenue from water sales/year	23,093.00
		--------------
	benefits/year	2,407,763.00

j = index of year concerned

n = number of years (50 years)

i = social discount rate (10%)

Present value of benefits:

$$b_j/(1+i)^j = b_o/(1+i)^o + b_1/(1+i)^1 + \ldots b_n/(1+i)^n$$

Present value of costs:

$$c_j/(1+i)^j = c_o/(1+i)^o + c_1/(1+i)^1 + \ldots c_n/(1+i)^n$$

Net present value of a project

$$b_j/(1+i)^j - c_j/(1+i)^j = (b_j - c_j)/(1+i)^j =$$

$$(b_o - c)/(1+i)^o + \ldots + (b_n - c_n)/(1+i)^n$$

Cost-benefit ratio

$$\frac{b_j/(1+i)^j}{c_j/(1+i)^j}$$

Internal rate of return

$$b_j/(1+r)^j - c_j/(1+r)^j = 0$$

Using derived cost-benefit components:

Present value of benefits:

$$b_j/(1+i)^j = 0/(1+.1)^o + 2{,}407{,}763/(1+.1)^1 + \ldots 2{,}407{,}763/(1+.1)^{50}$$

Present value of costs:

$$c_j/(1+i)^j = -36{,}979{,}931/(1+.1)^o + -23{,}093/(1+.1)^1 + \dots$$

$$-23{,}093/(1+.1)^{50}$$

Net present value of a project

$$b_j/(1+i)^j - c_j/(1+i)^j = (b_j - c_j)/(1+i)^j = (b_o - c)/(1+i)^o + \dots$$

$$+ (b_n - c_n)/(1+i)^n$$

$$= -4{,}638{,}330$$

Cost-benefit ratio

$$\frac{b_j/(1+i)^j}{c_j/(1+i)^j} = .8692$$

Internal rate of return

$$b_j/(1+r)^j - c_j/(1+r)^j = 0$$

In the 50th year r = internal rate of return = .1440 i.e., this is the only derived cost-benefit value of the three derived values which has successfully passed its set significant critical value of 10% or .10.

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