CHAPTER
6

# Province of Saskatchewan Irrigation Outlook Scenario Evaluation Results

## Input-Output Analysis based Economic Impacts of New Irrigation Development on the Saskatchewan Economy

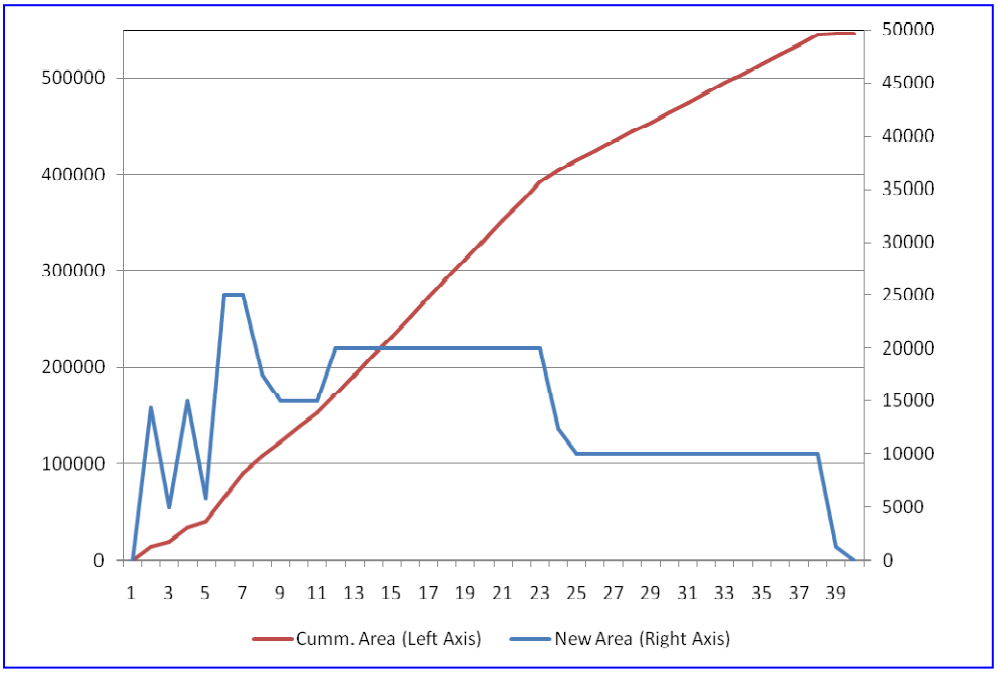
New irrigation development in the province of Saskatchewan was planned in various areas surrounding the Lake Diefenbaker and in other regions with available infrastructure. Details on these developments were based on various engineering reports (reported in Chapter 4 and Volume I of this Report), as well as expert opinion. Irrigation of land and adoption of suitable crop mix on these lands was allowed to progress during the year immediately following the end of construction. It was assumed that producers would be able to adopt at the rate of 10,000 acres per annum in these project areas until the entire designed area is achieved.

Since some of the larger projects were broken down into several phases, each of them was assumed to start adoption of irrigation as soon as it is completed. In areas, where the total size of the development in a given phase was smaller than this level, the entire area was converted into irrigation during the first period following completion of water supply infrastructure. The total time period over which irrigation development takes place is 40 years. During the first year, there is no conversion to irrigation since water supply infrastructure is under construction. During the next 38 years, dryland areas are converted to irrigation until a total of 546,089 acres of dryland has been converted to irrigation. There are no further areas to adopt irrigation in the last year of the study period. The time path of this development is shown in Figure 22. The figure shows total area under irrigation in a given year, as well as new areas being converted from dryland to irrigation in that year.

The graph of the incremental area brought under irrigation during the 40 year period suggests that during the initial period (years 1-5) rate of change is slower, although in some years it reached the target (assumed) 10,000 acres per project region. By year 12, a number of projects are completed and the rate of increase in irrigated area is around 20,000 acres per annum. By year 25, conversion returns back to 10,000 acres per annum.

For the purposes of this analysis, economic impacts of the new irrigation development were estimated only for this 40 year period. Although the economic impact of these irrigated area would extend much beyond the next 30 to 50 years since their first adoption, this period was not included. Thus, the total economic impacts as shown in this chapter are somewhat of an underestimate.

**Figure 22 Trend of development in irrigated area in the Province of Saskatchewan**




## Overview of Economic Impact Analysis

Economic impacts of irrigation development in the province of Saskatchewan were estimated by considering four types of activities: One, construction of new off-farm water supply infrastructure; Two, on-farm irrigation development; Three, forward-linkages of irrigated production in the region on other farms; and, Four, further value-added activities resulting from irrigated farms and / or those with forward-links with irrigated farms. Forward-links in this context include those activities that use the output of irrigation and add further value to it. As an example forages are typically grown under irrigation, although a portion is also grown under dryland conditions. Another farm may purchase this forage for its cow-calf operations. These farms would be called forwardly-linked activity farms. However, the livestock produced by these farms would have to be processed. These firms would be called forwardly-linked non-farm industries related to irrigation development in the province. Implicitly assumed is that these activities would not last in the absence of irrigation in the region.

Each of the four activities listed above have two distinct types of expenditures that create economic impacts: One, investment expenditures, and Two, Operations and Maintenance (O&M) expenditures. Investment phase involves construction of new infrastructure, plants, machinery and equipment (the O&M phase). Thus, in total eight separate activities create the total economic impact of irrigation. The assumption here is that none of these expenditures and development would take place in the absence of irrigation.

Economic impacts were estimated primarily at the provincial level in Saskatchewan. Although through trade relationships that exist between Saskatchewan and other provinces, irrigation would also affect the rest of Canada and the world. Full analysis of all geographic impacts was not completed since other provincial input-output models were not available to the project.

The economic indicators that were used for assessing economic impacts were:

- Change in the level of sales of various industries – called Output Impact;
- Change in the level of gross domestic product of the province – called GDP Impact;
- Change in the personal income (through payment of wages and salaries, plus profits of unincorporated farm and non-farm businesses) in the province – called Income Impact; and,
- Change in the employment level in the province – called Employment Impact.

Total economic impacts measured as each of the four economic indicators listed above were composed of three types of impacts: Direct impact; Indirect Impact, and Induced impacts. The definition of these has been provided in the Technical Annex.

## Disaggregation of Total Economic Impact for a Given Indicator

The total economic impact of irrigation on a given economic criterion is a sum of several types of impacts. First, each economic activity contributed to total impact in three ways: direct spending of money (called direct impacts), impacts through purchases of goods and services from other industries (called indirect impacts), and through re-spending of earned income (called induced impacts). These impacts, shown in Table 37, are associated with each of the sets of economic activities related to irrigation development. In total, nine separate sets of activities were identified. Four of these were related to capital investment by various economic agents, while the remaining five with operations and maintenance (O&M) phase activities. These relate to development of irrigation water supply systems and delivery of water infrastructure, on-farm irrigation activities, forward-linked farm enterprises with irrigation, and forward-linked non-farm enterprises. The latter two types of activities were called "Building Blocks" of economic development. A summary of these building blocks is presented in Table 38.

Value added building blocks were introduced to the evaluation scenario on the availability of raw materials for processing. For example, cow-calf operations require forage and feed grains. To consider the number of such operations, supply of forage and feed grains both from new and existing irrigation, and dryland production were included. The number of these blocks was adjusted as the supply of raw material increased. Similarly non-farm enterprises were introduced in the region as supply of their own raw material from the forward-linked farm enterprises (both irrigated and dryland farms) was sufficient to sustain such a plant. The basic assumption made here was that demand for these products exists and development of these enterprises is feasible.

A dynamic crop mix in the province was introduced, with modifications every ten-years. (Table 39) All crops were combined into five groups – cereal, oilseeds, pulses, vegetables, and forages. Modifications to the crop mix were based on the demand for agricultural products, as well as by the requirements for each selected building block. During the early period (years 1-10) the province was assumed to produce more forages and potatoes, based on the current crop mix. Over time, the proportion of cereals increased to meet the requirements of cow-calf operations, and feedlots. This increase came by reducing the share of production under canola and potatoes although actual acres may continue to grow.

**Table 37 Composition of Total Economic Impact of Irrigation in the Province on Saskatchewan's Economic Indicator**

| Source | Type of Impact | | |
|---|---|---|---|
| | Direct | Indirect | Induced |
| **Investment Phase** | | | |
| Off-farm Water Supply Development | X | X | X |
| On-farm Irrigation Equipment Investment | X | X | X |
| Farm-Level Forward-Linked Enterprises | X | X | X |
| Non-farm Level Forward-Linked Enterprises | X | X | X |
| **Operations and Maintenance (O&M) Phase** | | | |
| Off-farm Water Supply O&M | X | X | X |
| On-farm Irrigation Equipment O&M | X | X | X |
| On-farm Irrigation Production | X | X | X |
| Farm-Level Forward-Linked Enterprises Operations | X | X | X |
| Non-farm Level Forward-Linked Enterprises Operations | X | X | X |

**Table 38 "Building Blocks" included in the Economic Impact Assessment of Irrigation**

| Forward-Linked Farm Enterprises | Forward-Linked Non-farm Enterprises |
|---|---|
| Cow-Calf Production | Cattle Slaughtering and Meat Processing Plant |
| Small Feedlots (with 500 head of cattle) | |
| Large Feedlots (with 10,000 head of cattle) | |
| Dairy Enterprises | Cheese Factory |
| Hog Barns | Hog Slaughtering and Meat Processing Plant |
| Potato Storage Sheds | Potato Processing Plant |
| Vegetables Market Gardens | Vegetable Packing |
| | BioFuels |

## Study Framework and Model

The framework for study is presented in Technical Annex. The study model used for economic impact assessment was an input-output model based on Saskatchewan transactions for the year 2003. This is the latest year for which a transactions table was available from Statistics Canada. These tables follow the Rectangular Input-Output model framework. In other words, an industry can produce more than one commodity (goods and services). In total three tables were obtained from Statistics Canada – Technology table, Market share table, and Final Demand table. In addition, Saskatchewan's trade pattern table and commodity margins were also obtained from Statistics Canada.

**Table 39 Change in the Crop Mix under the Irrigated Area of the Province of Saskatchewan**

| Crop Category | Crops Included | Proportion of Total Area during Years | | | |
|---|---|---|---|---|---|
| | | 1-10 | 11-20 | 21-30 | 31-40 |
| Cereals | Spring Wheat, Durum Wheat, Barley | 11.95 | 40.00 | 42.50 | 45.00 |
| Oilseed | Canola | 4.27 | 1.00 | 0.50 | 0.50 |
| Pulses | Dry Peas, Dry beans, Lentils | 1.41 | 0.30 | 0.30 | 0.30 |
| Vegetables | Potatoes | 34.17 | 18.70 | 16.70 | 14.20 |
| Forages | Silage, Alfalfa | 48.20 | 40.00 | 40.00 | 40.00 |
| **Total** | | **100.00** | **100.00** | **100.00** | **100.00** |

The Final model contained 73 commodities, 31 industry groups (called sectors), and four final demand agents. An Economic Impact Simulation Model was developed to estimate impact of irrigation development on the Saskatchewan economy. The inputs into the model were requirements of various commodities for each of the nine sets of activities listed in Table 37. These expenditures are direct expenditures and equivalent to the direct impact of the activity.

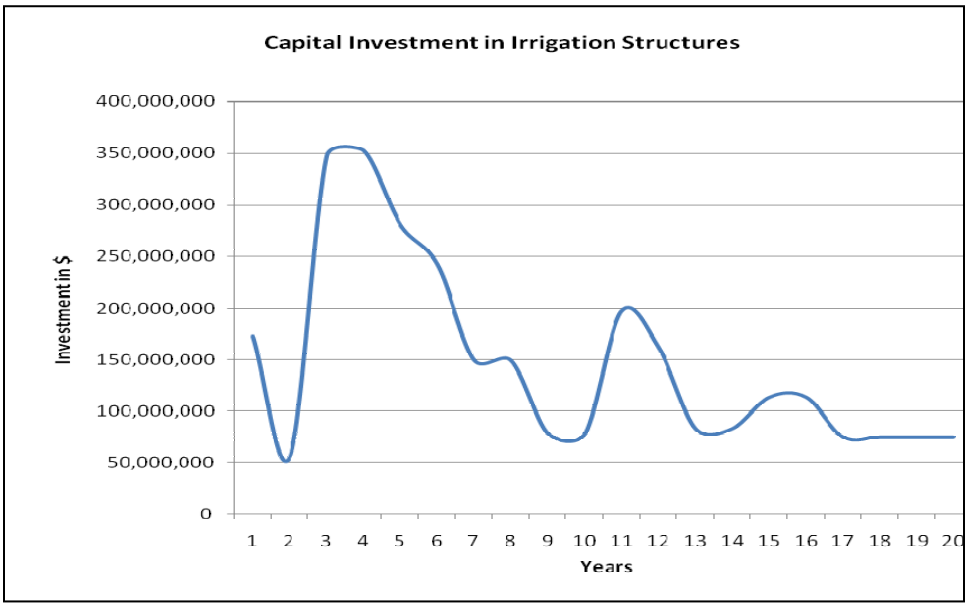
## Results of Economic Impact Analysis: Investment Phase

The investment phase, shown in Table 37, involved four separate, but related, types of investments. The first and foremost is the decision to develop more irrigation in the province which leads to new infrastructure development off-farm and delivery of water to farms. This expenditure is described first, followed by the other three types of investments listed.

### Development of Off-farm Water Supply Infrastructure

The development of off-farm water supply infrastructure extended over the first 20 year period. During this time, all the proposed irrigated areas in the scenario were planned to have received water from Lake Diefenbaker or related sources. This investment does not take place at an even pace, but is lumpy in nature, as shown in Figure 23. The pace of investment is higher during the first ten years, with maximum investment being slightly over $350 million per annum in some years. During the later part of the period, the pace is slower, with only a few years requiring over $100 million per annum for these activities.

**Figure 23 Estimated Trend in Direct Investment for Development of Off-Farm Water Supply Infrastructure for the Province of Saskatchewan**




Total investment requirements for this purpose, as shown in Table 40, is $2.96 billion or about $148 million annually over the 20 year period. This investment would result in an increase in irrigated area. The cost of developing this infrastructure was, on average, $5,415 per acre. It should be noted that these values are in 2007 dollars, and may increase in the future due to inflationary pressures. These values were also discounted to convert them into present day values using 1%, 3% and 5% discount rates. These discounted values are discussed and shown in the Technical Annex to this report. The proposed level of investment for these infrastructures would bring a significant amount of economic impacts on the provincial economy. These impacts were estimated for sales of goods (called output of various industries), gross domestic product at market prices, household income, and employment. The total economic impacts are presented in Tables 40 to 43. Impacts of off-farm water supply infrastructure are presented in row 1 of each of these tables.

The total impact of water supply development on the sales of all industries in the province was estimated to be $7.5 billion. This additional production would result in a gain of $2 billion to the provincial GDP; provide income to Saskatchewan households of $1.15 billion and create 44,353 person-years of employment. It should be noted that these jobs are temporary in nature and would only last as long as investment expenditures continues.

## On-Farm Investment Triggered by Irrigation Development

Once the infrastructure to deliver water to the boundary of farms is developed, farmers have to invest in equipment to deliver that water to the crops. Today this is typically done with sprinkler irrigation systems. The assumption is made that farmers would purchase pivots, to service a quarter section of land at a time. None of these areas were allowed to have flood irrigation to improve water use efficiency so necessary in today's context of water scarcity in an era of growth and global warming.

Centre pivots were used for this type of sprinkler irrigation. The cost of such equipment was estimated at $625 per acre. Total investment required for this equipment for the 40 year period was estimated at $369 million, or on average, a little over $9 million per annum (Table 40). This investment will bring forth a total impact on value of goods and services sold by $624 million. This would add another $161 million to the economy in terms of household income, which are included in the additional $247 million worth GDP for the province (Tables 40 and 41). Change in employment created by this type of investment is estimated to be 4,506 person-year equivalent jobs, or about 115 person-years (in person full-time equivalent) in the province.

### Investment by Forward-linked Farms

Irrigated production is assumed to be used by other farms in the province for further value-added activities. Direct investment by such firms over the 40 year period was estimated at $515 million, or about $13 million per annum (Table 41). These expenditures would create a total boost on the sale of goods and services in the province of a little over one billion dollars through production of goods for these investments (indirect impacts) and through re-spending of wages and salaries and profits of unincorporated businesses (induced impacts). Gains in the household incomes and GDP were estimated to be $161 and $305 million, respectively (Table 42 and 43).

### Investment by Forward-Linked Non-farm Businesses

Following the new value-added activities of various farms in the province, a number of agri-processing firms were introduced in the province. These firms would also spend money on construction of their plants and for purchase of machinery and equipment needed for processing. As shown in Table 40, another $239 million is invested by these firms, which results in additional sales of goods and services of about half a billion dollars. Corresponding gains in household incomes were estimated at $64 million, and the provincial GDP increased by $130 million (Tables 42 and 43).

Once all these investment have taken place, the provincial economy's economic activity (as measured by level of sales) is boosted by almost $10 billion, its GDP by $2.8 billion, and income of households by $1.5 billion. Employment gains over the 40 year period are estimated at 58,155 full-time equivalent jobs. The output (sales of goods and services) were examined in terms of distribution of the total by type of income – Direct, indirect or induced. Figure 24 shows that indirect impacts tend to be the largest category of impact, constituting roughly 47% of the total impacts. Examined in terms of source of impacts, investment in water supply development infrastructure leads the list, as shown in Figure 25. About 77% of the total impacts are on account of these expenditure, with farm level irrigation equipment related investment being the next highest at 12% of the total.

**Table 40 Total Economic Impacts on Sales of All Industries in Saskatchewan from Capital Investment Phase of Saskatchewan Irrigation Development and Associated Infrastructure, Total for 40 Year Period, Million Dollars**

| Investment Type | Direct | Indirect | Induced | Total |
|---|---|---|---|---|
| Off-farm Water Supply | $2,957 | $3,714 | $795 | $7,466 |
| On-farm Investment | $369 | $134 | $121 | $624 |
| Farm Level Forward-Linkages | $515 | $503 | $116 | $1,134 |
| Non-farm Level Forward-Linkages | $239 | $213 | $44 | $496 |
| **Total Project** | **$4,080** | **$4,564** | **$1,076** | **$9,720** |

**Table 41 Total Economic Impacts on Gross Domestic Product of Saskatchewan from Capital Investment Phase of Saskatchewan Irrigation Development and Associated Infrastructure, Total for 40 Year Period, Million Dollars**

| Investment Type | Direct | Indirect | Induced | Total |
|---|---|---|---|---|
| Off-farm Water Supply | $104 | $1,515 | $462 | $2,081 |
| On-farm Investment | $108 | $69 | $70 | $247 |
| Farm Level Forward-Linkages | $29 | $197 | $78 | $305 |
| Non-farm Level Forward-Linkages | $9 | $95 | $26 | $130 |
| **Total Project** | **$251** | **$1,876** | **$635** | **$2,763** |

**Table 42 Total Economic Impacts on Household Income in Saskatchewan from Capital Investment Phase of Saskatchewan Irrigation Development and Associated Infrastructure, Total for 40 Year Period, Million Dollars**

| Investment Type | Direct | Indirect | Induced | Total |
|---|---|---|---|---|
| Off-farm Water Supply | $0.0 | $897.4 | $254.6 | $1,152.0 |
| On-farm Investment | $83.3 | $38.8 | $38.6 | $160.7 |
| Farm Level Forward-Linkages | $9.4 | $119.3 | $36.9 | $165.6 |
| Non-farm Level Forward-Linkages | $0.1 | $49.5 | $14.1 | $63.7 |
| **Total Project** | **$92.8** | **$1,104.9** | **$344.2** | **$1,541.9** |

**Table 43 Total Economic Impacts on Employment of Saskatchewan from Capital Investment Phase of Saskatchewan Irrigation Development and Associated Infrastructure, Total for 40 Year Period, Person-years**

| Investment Type | Direct | Indirect | Induced | Total |
|---|---|---|---|---|
| Off-farm Water Supply | 13,602 | 22,176 | 8,575 | 44,353 |
| On-farm Investment | 2,068 | 1,145 | 1,293 | 4,506 |
| Farm Level Forward-Linkages | 2,454 | 2,932 | 1,253 | 6,639 |
| Non-farm Level Forward-Linkages | 1,078 | 1,130 | 449 | 2,657 |
| **Total Project** | **19,202** | **27,383** | **11,570** | **58,155** |

Figure 24 Distribution of Total Economic Impacts on Sales of Goods and Services in Saskatchewan from Provincial Level Irrigation Related Investment, by Type of Impacts

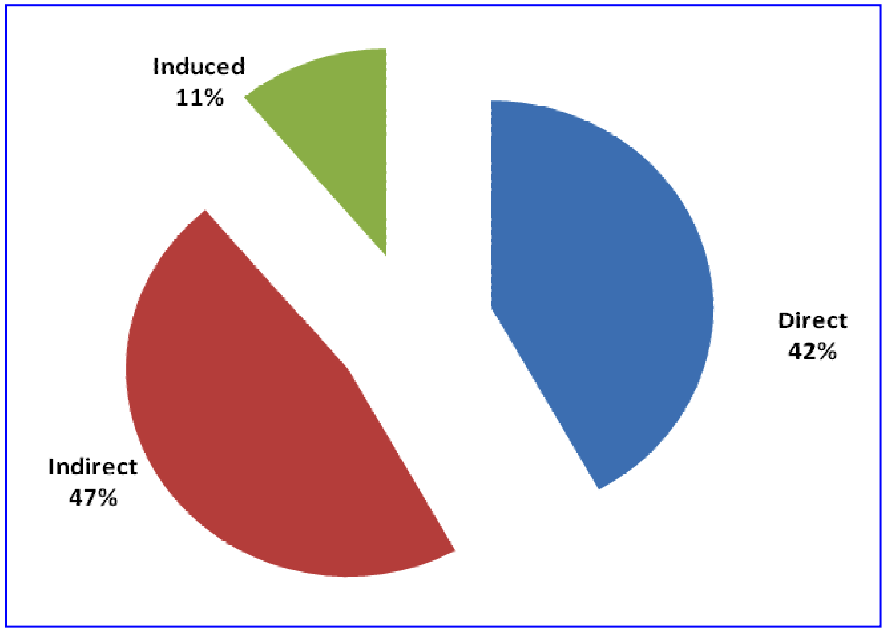
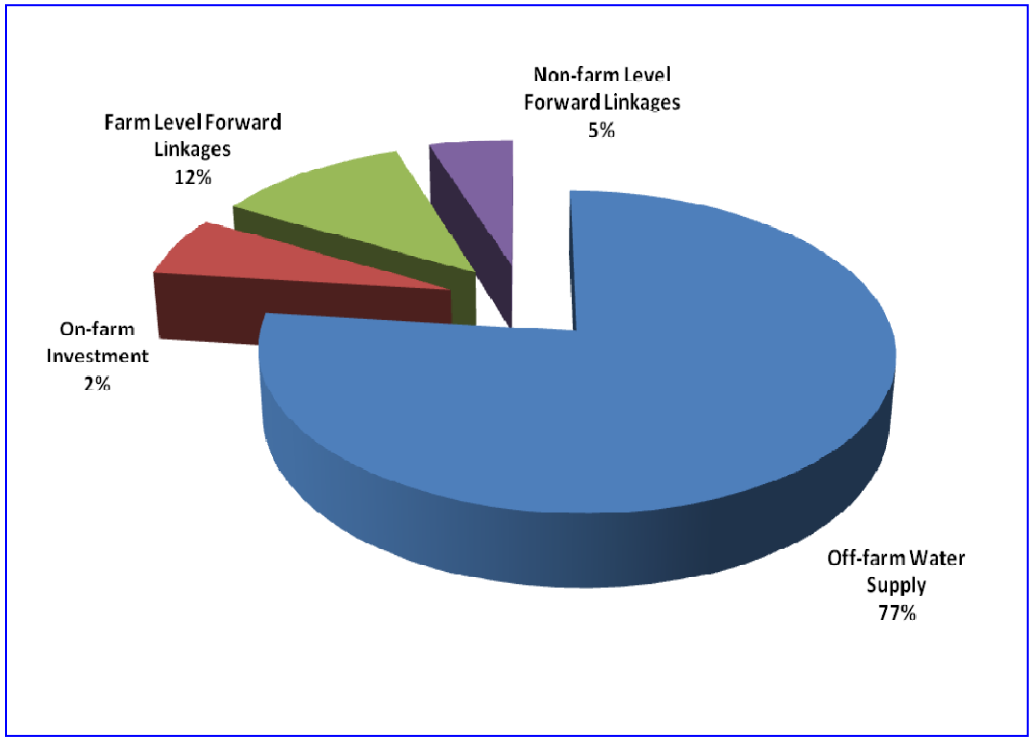



Figure 25 Distribution of Total Economic Impacts on Provincial Sales of Goods and Services from the Provincial Level Related Investment by Source of Investment



## Results of Economic Impact Analysis - Operations and Maintenance Phase

Investment in various infrastructures, construction of buildings, purchase of machinery and equipment start the process of production of additional goods and services in the province of Saskatchewan. To undertake these economic impacts, details on the nature of these activities were gathered. Five sets of economic activities were identified (Table 37). Since operation of pivots is a part of irrigated production, they were combined with other operating costs into a single irrigation production activity. Economic impacts for each activity was estimated and are described below.

### Off-farm Water Supply Operations and Maintenance

Once the irrigation infrastructure (canals, smaller dams, and other water delivery mechanisms), have been completed, these have to be maintained over the 40 year period. This involved hiring of workers for their operation, and purchasing inputs required for repairs and regular maintenance. Over the project period, this amounted to $48 million of expenditures, which brings forth a total change in goods and services sold in the province of $117 million (Table 44), in GDP by $40 million, including $16 million as household income, to a total of 424 full-time equivalent worker-years (Tables 45 to 47).

### Farm Level Production of Irrigated Crops

The production of irrigated crops is the main driving force for all economic development activities in the evaluation scenario. Change in irrigated production was measured net of dryland production. Thus, these results show gains in the value of agricultural production over and above a situation if the same parcels of land stayed under dryland production systems. The crop mix for dryland and irrigated production was also distinctly different and was taken into account.

Economic impacts were estimated using farm level budgets for a given crop under dryland and irrigated production systems. These were weighted by their relative area under various crops typically grown under the two production systems. The total difference in expenditures and revenues for dryland and irrigated agriculture were distributed by major commodities and economic impacts were estimated using the input-output model.

Results for the four economic indicators are shown in Tables 44 to 47. Irrigation of 545 thousand acres of land added $12 billion worth of goods to the provincial economy over the 40 year period (Table 44). On average, every acre of land converted to irrigation added $493.60 per annum to value of sales directly, and $903.40 per acre per annum through direct, indirect and impacts. These amounts are sensitive to the crop mix and do change slightly as the crop mix is modified over time to suit the requirements of the selected building blocks.

Widespread adoption of irrigation adds $7 billion to the GDP of Saskatchewan, including $4.4 billion through wages and other household incomes. These incomes are a result of additional 105,891 person-years (on a full-time equivalent basis) over this 40 year period. On average, this amounts to additional jobs for 2,647 workers per annum over the life of the project period.

**Table 44 Total Economic Impacts on Sales of All Industries in Saskatchewan from Operations Phase of Saskatchewan Irrigation Development and Associated Activities, Total for 40 Year Period, Million Dollars**

| Type of Operations | Direct | Indirect | Induced | Total |
|---|---|---|---|---|
| Off-farm Water Supply Operations | $48 | $57 | $11 | $117 |
| On-farm Irrigated Production (Net of dryland production) | $6,679 | $2,199 | $3,377 | $12,254 |
| Farm Level Forward-Linkages - Operations | $11,915 | $9,987 | $4,293 | $26,195 |
| Non-farm Level Forward-Linkages Operations | $21,618 | $1,293 | $2,139 | $25,051 |
| Total Project Operations and Maintenance | $40,261 | $13,536 | $9,821 | $63,617 |

**Table 45 Total Economic Impacts on Gross Domestic Product of Saskatchewan from Operations Phase of Saskatchewan Irrigation Development and Associated Activities, Total for 40 Year Period, Million Dollars**

| Type of Operations | Direct | Indirect | Induced | Total |
|---|---|---|---|---|
| Off-farm Water Supply Operations | $5 | $29 | $6 | $40 |
| On-farm Irrigated Production (Net of dryland production) | $3,911 | $1,101 | $1,988 | $7,000 |
| Farm Level Forward-Linkages Operations | $3,811 | $3,875 | $2,487 | $10,173 |
| Non-farm Level Forward-Linkages Operations | $15,748 | $664 | $1,684 | $18,097 |
| Total Project Operations and Maintenance | $23,475 | $5,669 | $6,166 | $35,310 |

**Table 46 Total Economic Impacts on Household Income in Saskatchewan from Operations Phase of Saskatchewan Irrigation Development and Associated Activities, Total for 40 Year Period, Million Dollars**

| Type of Operations | Direct | Indirect | Induced | Total |
|---|---|---|---|---|
| Off-farm Water Supply Operations | $1 | $12 | $4 | $16 |
| On-farm Irrigated Production (Net of dryland production) | $2,863 | $463 | $1,090 | $4,406 |
| Farm Level Forward-Linkages Operations | $2,765 | $1,607 | $1,375 | $5,747 |
| Non-farm Level Forward-Linkages Operations | $1,816 | $288 | $685 | $2,789 |
| Total Project Operations and Maintenance | $7,445 | $2,370 | $3,154 | $12,959 |

**Table 47 Total Economic Impacts on Employment in Saskatchewan from Operations Phase of Saskatchewan Irrigation Development and Associated Activities, Total for 40 Year Period, Person-years**

| Type of Operations | Direct | Indirect | Induced | Total |
|---|---|---|---|---|
| | Total for the 40 Year Period | | | |
| Off-farm Water Supply Operations | 24 | 279 | 120 | 424 |
| On-farm Irrigated Production (Net of dryland production) | 55,921 | 14,706 | 35,264 | 105,891 |
| Farm Level Forward-Linkages Operations | 49,292 | 70,084 | 44,914 | 164,291 |
| Non-farm Level Forward-Linkages Operations | 24,752 | 7,930 | 22,779 | 55,460 |
| Total Project Operations and Maintenance | 129,989 | 93,000 | 103,077 | 326,066 |

## Farm-level Forward-Linkage Operations

Irrigated production is only the first, although most significant, foundation to create additional related economic activities. The next round of economic activity is created through other farms, or even the same farms with other enterprises, by using the crops produced for further value added activities. These activities included cow-calf operations and feedlots, using forages and feed grains, and new dairy farms. For these enterprises same procedure as followed to evaluate the adoption of irrigation on a dryland farm. Input requirements for these farms were obtained from secondary sources. These were classified into various commodities for use in the economic impact analysis model. It was assumed that these requirements are not being met currently, and therefore, are new demands on the economic system.

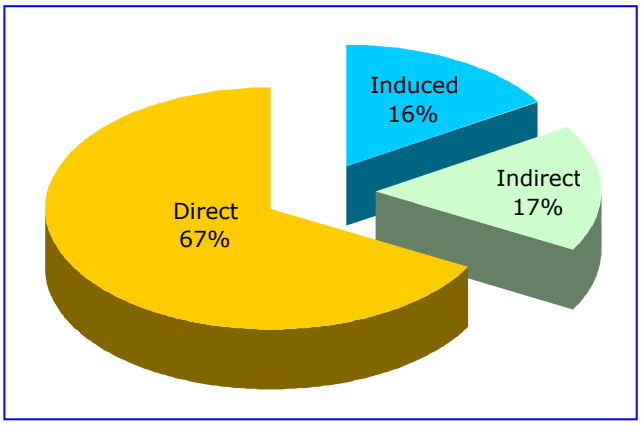
Farm level forward-links to irrigation generated a total of $26 billion worth of goods and services to the provincial economy either directly or through linkages with other industries in the region and through re-spending of the additional incomes earned through this process. This translates into additional GDP worth $10 billion, which included additional household incomes of $5.7 billion. In addition, change in employment through these activities was estimated to be 164,291 person-years (4,107 workers per annum).

## Non-Farm Forward-Linkage Operations

Non-farm forward-linkages are formed from the production of irrigated farms and farms linked in a forward manner to irrigation. Treatment of these businesses was similar to those of the previous enterprises. Details on their input and production were obtained and divided into various commodities for the economic impact model. It was assumed that if goods are already produced, these should not enter into the production process again. For this reason, these were excluded from new final demand created by these enterprises. For example, for a meat slaughtering and processing plant, cattle purchases were excluded since these are already produced by the cow-calf farms and feedlots.

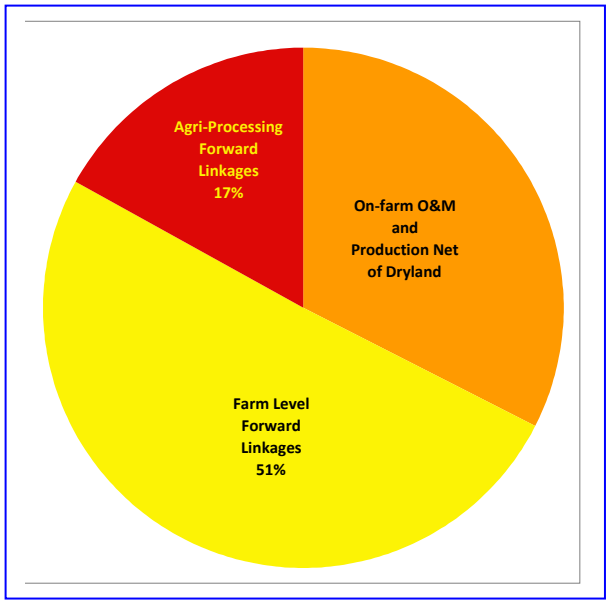
These non-farm forward-linkages add more economic prosperity to the province. Provincial sales of goods and services are higher by $25 billion for the entire 40 year period, with GDP increases of $18 billion, and household income increases of $2.8 billion over the same period. A total of 55,460 person-years of new jobs are also created over this period – about 1,387 jobs per annum per year on average.

**Figure 26 Distribution of Total GDP Increase from Operations Phase of the Irrigation Development in Saskatchewan, by Type of Impact**




Considering all four types of activities listed above, the distribution of total impact on the provincial GDP by type of impacts is shown in Figure 26. This suggests that indirect impacts, in aggregate, account for roughly two-thirds of the total impact. Similarly, based on the distribution of total employment, farm level forward-linkages are the most important contributor to the total economic impact of irrigation development in the Province.

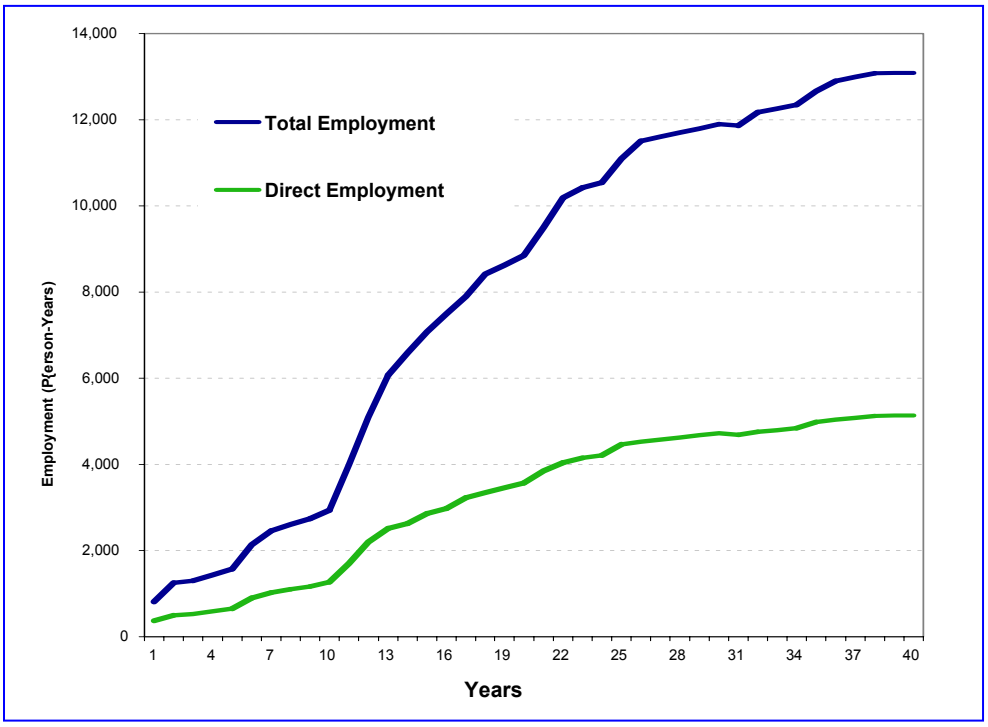
**Figure 27 Distribution of Total Employment by Source, in Saskatchewan Created through Operations Phase of the Provincial Level Irrigation Development, 40 Year Period**




## Total Economic Impacts

If one combines the investment and operations (and maintenance) economic impacts over time, the pattern suggests a slower development during the first ten years, but the pace of development, as shown in Figure 28, increases. This would likely continue in the future, although some of these may be subject to plant renewals, competition with other companies and regions and the availability of water.

**Figure 28 Time Path of New Employment Generated Through Various Activities Related To Irrigation Development in Saskatchewan**



## Cost Benefit Analysis - Summary Results from the Evaluations

The Cost Benefit analysis has been structured to measure the benefits that will arise from the major water project investments for both the agricultural economy and the society at large. That is, once the major $3 billion of regional water investments are made over a twenty year period they will initially lead to on farm investments in irrigation and on farm increases in crop yields. Over time there will be an increase in irrigated agricultural crop supplies to provide for further processing of the crop in the form of increased livestock operations and later agricultural value added activities. The full effect of these developments has been evaluated over a 40 year period.

All of these increased value added and diversification activities require increased investment and generate a steadily growing stream of investments, economic activity and indirect and induced economic effects that benefit household incomes, provincial and national gross domestic products and the natural environment. Thus on-farm investments and on-going operation and maintenance expenditures are made in irrigation equipment including new pivots, pumps, pipes and power consumption will all increase with many other related costs. In time further investments are made in cattle, cow-calf operations and a wide range of food processing activities. The cost benefit analysis has been undertaken with three rates of discounting, 1%, 3% and 5%. Since the project is expected to last over a long forty year period, higher discount rates effectively remove the value of future benefits, effectively reducing the benefits of sustainability. [52]

The Cost Benefit analysis of the returns to the major regional water investments are summarized below in Table 48 and in detail in the Technical Annex. These show the returns to both the Irrigated Agricultural economy and the Diversified Agricultural Development scenario that includes a full range of value added agricultural investments that might be expected. Cost Benefit ratios of the returns to the regional water investments are also shown for the direct impacts of the project and for the impacts on the total economy that includes indirect and induced effects discussed previously.

It is important to note that cost benefit evaluations are based on the future development scenarios described earlier in Chapter 5. The scale of these developments is considered reasonable in the context of both current market conditions and future development prospects. In particular, the growth of the domestic market, expansion in offshore food requirements in Asia and North America and the need to replace over one half a million irrigated acres that will be taken out of production of the next twenty years in the United States, makes the expansion of irrigation in the province a market opportunity.

The Base Case Irrigation Expansion scenario under Cost Benefit Evaluation has involved the regional water investments being completed over a twenty year period and the expansion of the irrigated acreage and investments in value added over a forty year period. The analysis shows that the benefits of irrigation are positive for a purely agricultural economy at each of the three rates of discount considered for the project (1%, 3% and 5%). Cost Benefit ratios provide guidance on the utility of investments to society. Where ratios are greater than 1 the ratio identifies positive returns to society.

Table 48 shows that the cost benefit ratios range from a low of 1.07 at the 5% discount rate for a pure agricultural project to a high of 23.68 for the Agricultural plus Development scenario at the 1% discount rate. Clearly the ratios improve with lower discounts.

[52] Discount rates are discussed in more detail in the methodological framework section of the Technical Annex.

**Table 48 Cost Benefit Ratios of the Returns to Regional Water Investments in Saskatchewan for Irrigated Agriculture and Agriculture plus Value Added Development for the Lake Diefenbaker Irrigation Expansion for Three Discount Rates**

| | COST BENEFIT RATIO AT A 1% DISCOUNT RATE | | COST BENEFIT RATIO AT A 3% DISCOUNT RATE | | COST BENEFIT RATIO AT A 5% DISCOUNT RATE | |
|---|---|---|---|---|---|---|
| EVALUATION SCENARIO | Irrigated Agriculture | Agricultural Diversified Development | Irrigated Agriculture | Agricultural Diversified Development | Irrigated Agriculture | Agricultural Diversified Development |
| **Base Case 40 Year Adoption** | | | | | | |
| **Direct Impacts** | 1.97 | 11.76 | 1.43 | 8.81 | 1.07 | 6.85 |
| **Total Impacts (Including Indirect and Indirect Effects)** | 6.67 | 23.68 | 5.23 | 18.47 | 4.28 | 14.99 |

However, it is critically important to note that all cost benefit ratios are much larger when value added development becomes a part of the irrigation development scenario. That is, the full benefits of irrigation investment cannot be achieved from irrigation investments alone, but should be complemented with a diversified agricultural value added investment stream.

These findings fully confirm the reality of the developments that have occurred in Southern Alberta where major regional water investments have transformed the economy and society of the area between Medicine Hat and Lethbridge. Regional development planning to create the conditions for value added processing development and related developments are all a part of improving the returns to society of major water investments for irrigation.

Finally, the scope of benefits evaluated in the cost benefit assessment was limited to economic and financial costs and benefits associated with the irrigated economy and the development of the diversified building blocks. There are a number of other costs and benefits that could have been included in the analysis that would have included tourism benefits, environmental and wildlife benefits, drought proofing and climate change contributions and their related indirect and induced effects. These were not included in the aggregate analysis given the high rates of return that were already apparent from the evaluation of the irrigated agriculture and the agricultural plus development options. Some of these benefits were discussed separately in Chapter 3. Specific municipal water supply opportunities that would be associated with irrigation expansion are discussed below.

**Less Monetary Benefits from Irrigation**

Photo Credit: Lake Diefenbaker Tourism Committee

## Municipal Water Supply Benefits

The Qu'Appelle Valley and Westside Irrigation Development projects will open up possibilities for improved rural water supplies to some 6,000 people to improve the quality and quantity of their rural water supplies. Twelve communities could be served from the regional water supply systems anticipated for both the irrigation developments from their existing groundwater sources. Communities likely to benefit from improved water supplies are listed in Table 49 along with the irrigation development that could be integrated with the municipal supply.

**Table 49 - Existing and Future Municipal Water Supply Benefits from Lake Diefenbaker Irrigation Development Projects**

| Municipality | Population | | Water Source | |
|---|---|---|---|---|
| | 2001 | 2006 | Existing | Future after Irrigation Development |
| Caronport | 1,040 | 919 | Groundwater | Qu'Appelle Valley - Buffalo Pound Lake |
| Mortlach | 241 | 254 | Groundwater | Qu'Appelle Valley - Buffalo Pound Lake |
| Dinsmore | 337 | 269 | Groundwater | Westside |
| Macrorie | 96 | 78 | Groundwater | Westside |
| Conquest | 163 | 167 | Groundwater | Westside |
| Zealandia | 111 | 90 | Groundwater | Westside |
| Harris | 232 | 187 | Groundwater | Westside |
| Delisle | 884 | 898 | Groundwater | Westside |
| Asquith | 574 | 576 | Groundwater | Westside |
| Kinley | 40 | 35 | Groundwater | Westside |
| Perdue | 372 | 364 | Groundwater | Westside |
| Biggar | 2243 | 2033 | Groundwater | Westside |
| **Total** | **6,333** | **5,870** | | |

Improved municipal water supplies are important for not only the improved water quality that can be offered by the new water supply systems, but also for the potential use of the water for industrial purposes. Many food processing industries have significant water supply requirements and the quality and quantity cannot always be met from groundwater sources.

**Municipal Water Supply**

Photo Credit: AAFC: PFRA