

economic impact of irrigated agriculture in west minnesota

'DISC' Development of Irrigation and Specialty Crops

agricultural experiment station

university of minnesota



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Foreword

The University of Minnesota Agricultural Experiment Station is pleased to release this fourth and last DISC report for use by planners, lending agencies, suppliers, processors, specialty crop producers, irrigators, and other interested people. It complements the three previous reports and should be especially useful for those planning for wide scale irrigation development, who need to know the secondary effects of additional irrigation in an area.

This report was produced by scientists from the Agricultural and Applied Economics Department with some assistance from other disciplines. We especially appreciate the leadership provided by Dr. Maki.

This report concludes the DISC study funded by the 1975 Legislature. We believe the study and four reports have contributed significantly to a better understanding of the impacts of irrigation development in Minnesota and should lead to wise decisions in the future. We appreciate the contributions made by all those associated with the study in its conception, conduct and completion. Any comments about the study, the reports and future needs are invited.

Landis L. Boyd, former Assistant Director
Agricultural Experiment Station, University of Minnesota

Introduction

This is the fourth and final Development of Irrigation and Specialty Crops (DISC) report. The three previous DISC reports were as follows:

- “The Potential for Irrigated Crop Production” February, 1975 (out of print)
- “The Marketing of Fresh and Processed Specialty Crops” February, 1976
- “Water Sources and Irrigation Economics” January 1978

The final publication uses general background information from the first three reports and addresses the very difficult subject of “The Economic Impact of Irrigated Agriculture in West Minnesota.”

This report varies from the earlier ones, which focus on concerns of individual farmers, in that it addresses questions that interest primarily agricultural business, the financial industry, and various governmental agencies. It should greatly assist local governments in all irrigation areas as they make growth policy decisions. For example, information on population increases due to the irrigation growth could help in sizing new sewer trunk lines as municipalities plan new development areas. Also, equipment dealers can project sales and service needs in areas of rapid growth, and, lenders can project their financial requirements for not only the irrigations, but also the direct impact, such as new support business and housing needs, stemming from the projected irrigation impact.

The state wide projected economic impact of irrigation in Minnesota can not be compared to that of such states as Nebraska, Colorado, California, Texas, Oregon, Washington. However, as shown in the report, if irrigation continues to grow as it has in the past few years, the resulting economic multipliers used by economists could be very significant in many of the west central counties.

A report of this nature and content must have the ability to be updated as projections convert to actual data and new projections are established or its value decreases fairly rapidly. Dr. Maki and his colleagues have accomplished this important need by having all data used in the report on computer tape and programmed for relatively easy accessibility to change or update. In just a couple of years, 1980 census and base data could replace the 1970 base data used in this report and new projections to 1990 can be made at considerably less cost and time than this report has taken to produce.

It has been very rewarding to me to serve as the DISC coordinator the past few years. We can only hope that the program produced adequate rewards in return.

E. C. Bather
DISC Project Coordinator

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ABSTRACT

The economic impact of irrigation development in West Minnesota is summarized for four statistics—the gross regional product (GRP) multiplier, the employment multiplier, the gross output multiplier, and the investment multiplier. Each statistic shows the increase in total economic activity associated with one additional unit of agricultural development.

For the 1970-85 period, the economic impact of irrigation development is summarized, for the respective multipliers, as follows:

Investment	5.7
Employment	2.7
GRP	2.2
Gross output	1.6

The largest is the investment multiplier. The smallest is the gross output multiplier. The GRP multiplier is most informative for development planning purposes. It shows the total value added (to gross regional and national product) by \$1 of value added from agricultural development.

The development increment, which shows the total effects of expanded agricultural production from newly irrigated land, is projected as follows (as a percent of the 1970 base):

Gross Output	14.1
GRP	10.9
Employment	6.0

Thus, the projected development increment for the 1970-85 period is equal to 14.1 percent of the 1970 gross output, 10.9 percent of the 1970 gross regional product, and 6 percent of the 1970 employed work force for West Minnesota.

In constant 1970 (and 1978) dollars, the total development increment is as follows:

Gross Output	\$235 (\$388) million
GRP	\$106 (\$175) million
Employment	\$5 (5) thousand

The total increase due to irrigation development is projected at \$235 million for industry gross output, \$106 million for gross regional product, and 5 thousand for total employment.

SUMMARY AND CONCLUSIONS

The total economic impact—direct, indirect and induced—of irrigated agriculture development in West Minnesota is projected at \$106,132,000 (in 1970 dollars) for 1985.¹ This is equivalent to 10.9 percent of the West Minnesota gross regional product in 1970. In 1978 dollars, the equivalent value is \$175,118,000 (using the relative 1978 CPI as an inflation multiplier).

For the 265,000 people projected for West Minnesota in 1985, the \$106,132,000 in total gross regional product converts to per person benefits of \$400 in 1970 dollars and \$660 in 1978 dollars. This benefit would occur largely because of the additional jobs supported by (1) the expanded agriculture-related activity and (2) the expanded household expenditures for locally produced goods and services in the 14-county West Minnesota study region. Thus, the \$400 development increment is in addition to the so-called baseline increase in gross regional product of \$1,734. The 1985 baseline gross regional product per person is projected at \$5,608, which compares with a 1970 estimate of \$3,874—all in 1970 dollars.

The total benefit is much more than the direct impact of irrigation agriculture. Its direct impact on the 1985 gross regional product is projected at \$37.6 million. Because of the conversion of dryland to irrigated land, the direct effect on gross regional product is reduced by \$11,300,000. However, indirect effects

¹The West Minnesota Study Region includes the following counties: Becker, Big Stone, Clay, Douglas, Grant, Hubbard, Otter Tail, Pope, Stevens, Swift, Todd, Traverse, Wadena, and Wilkin.

on agricultural production result in an added gross output of \$21,558,000. Thus, the total change in gross regional product due to irrigation development and originating in the agricultural sector is projected at \$47,858,000. The indirect and induced benefit originating in non-agriculture industries is projected at \$58,274,000. Thus, a \$1,000 increase in gross regional product originating in agriculture is associated with an increase of \$1,218 in the gross regional product originating in non-agricultural industries.

Associated with the net positive effects of irrigation development on the gross regional product is a corresponding increase in total employment. Total 1985 employment under the development option is projected at 98,906 which is 5,359 more than the 93,547 projected under the baseline option. Total agricultural employment in the development option is 2,037 larger than in the baseline option. The non-agricultural employment difference is 3,322. Thus, for each 1,000 additional jobs in agriculture due to irrigation development, 1,631 additional non-agricultural jobs are created.

A third criterion of benefit is the increase in industry gross output associated with the agricultural production based on irrigation. The development increment in agricultural output is projected at \$146,535,000. The development increment in non-agricultural output is projected at \$88,779,000. Thus, an additional \$606 of non-agricultural output is produced when agricultural output is increased by \$1,000 as a result of irrigation development.

Finally, the development increment can be related to output-increasing investment in agriculture. If the annual cost of the irrigated agriculture investment were computed at \$36 (in 1970 dollars), the annual cost of the new output-increasing investment should total \$17,026,000 (of which \$9,365,000 would be due to irrigation development). Thus, an additional \$3,111 of gross regional product would be created by an added \$1,000 of investment cost. For the total economy, \$5,704 of regional gross product would be created per \$1,000 of new investment cost.

Thus, the economic effect of irrigation development is demonstrated by the aggregate multipliers as follows:

Investment (annualized)	5.704
Employment	2.631
Gross regional product	2.218
Gross Output	1.606

Each multiplier is derived from the relationship between the expanded agricultural production associated with irrigation development and the increase in total economic activity.

Each of the multiplier effects was shown earlier as an increase in nonagricultural activity associated with a \$1,000 increase in agricultural activity. These increases were derived simply by using the multiplier to obtain the total effect and, then, subtracting the direct effect from this total. The development increment, on the other hand, is shown in 1970 dollars and, hence, its value will change as the price level changes. For example, if 1978 dollars (using simply the 1978 CPI as an inflation index), were used to derive the development increment in table 8.1, the 1978 values would be 65 percent higher than the corresponding 1970 values, as follows:

Development Increment	1970 \$	1978 \$
Gross Output	\$235,314,000	\$388,208,000
Value Added	\$106,132,000	\$175,118,000
Employment	5,360	5,360

Attempted here is an illustration of the equivalent purchasing power of the development increment dollars.

Measurement of the economic impact of irrigation development in West Minnesota is sought for several reasons. First, the 14-county study region is the leading area of sprinkler irrigation in the state and, because of its light sandy soils and access to abundant water supplies, it has a high economic potential for rapid expansion in irrigated land, given favorable price and production conditions. Second the 14-county study region has a long history of below-average population and economic growth and, therefore, the prospect of improved

conditions for local economic development is a stimulus to business expansion. Third, the study of irrigated agriculture development in the 14-county study region helps identify critical issues in natural resource policy, especially those related to the ownership and management of underground water supplies. This study is a start in assessing energy, as well as water, requirements of irrigated agricultural and related industrial development. Much preliminary work is involved in simply assembling and reviewing data sources and developing analytical capabilities for relating data to decision making.

Besides measurement of irrigation development impact, existing data sources are examined critically with reference to their potential usefulness in building a data base for natural resource management in Minnesota and its planning regions. Four principal sets of statistical series are examined, namely, population, industry employment, personal income, and agricultural production.

Projected population series prepared by the Minnesota State Demographer were used initially as a baseline series. Comparison with the baseline series derived by SIMLAB—the user-interactive computer simulation model of the study region, shows a difference in projected 1985 population of 7,300. Recent historical trends support the lower SIMLAB-based projected 1985 total population of 265,000. U.S. Census estimates for 1974 and 1975, for example, show a very small change in total study region population from 1973 to 1975. Irrigation agriculture development would have a nominal effect on total population. Rather, the number of jobs per person and total labor force participation would increase more than total population.

Development of irrigated agriculture will increase regional economic dependency on agriculture. In 1970, employment in agriculture and food products manufacturing accounted for 67.5 percent of the region's economic base. Without the projected irrigation development, the basic agricultural employment would have declined (as a result of the above-average increases in output per worker and below-average increases in market demand in agriculture). With irrigation development, total agricultural employment is projected at a level which is 2,037 above the baseline level. In the baseline projection, total agricultural employment drops sharply from 21,701 to 11,733, while in the development projection it drops less sharply to 13,770.

Total income payments also are to increase in both the baseline and development options. Total value added, the summary statistic of industry payments to resource owners and an approximation of gross regional product, is projected to increase from \$976,404,000 in 1970 to \$1,486,033,000 in the 1985 baseline projection and \$1,592,156,000 in the 1985 development projection. The estimated 1970 total earnings of \$456,513,000 used in this study is projected to increase to \$711,616,000 in the baseline option and \$752,429,000 in the development option. Earnings per worker are projected to increase from \$5,077 in 1970 to \$7,607 and \$7,608, respectively, in the two projection series. Thus, average earnings are affected only slightly in a shift from the baseline to the development option.

Changes in the agricultural economy are projected to occur, not only in irrigated crop production but, also, in livestock production. Increased livestock production is indicated in both the baseline and the development options. The expanded irrigation of cropland would increase available feed grain supplies and, thus, the potential for additional expansion in livestock production.

Two sets of agricultural projections were prepared. The first set of projections is based on historical relationships and a series of independent assumptions regarding irrigated crop production and livestock production. The second set of projections is based on the interactive computer model of the West Minnesota economy. This model reconciles the independently derived assumptions into internally consistent baseline and development projection series. Comparisons of the two series can be made by inspection of the summaries in the chapter on the agricultural economy and the chapter on the economic forecast.

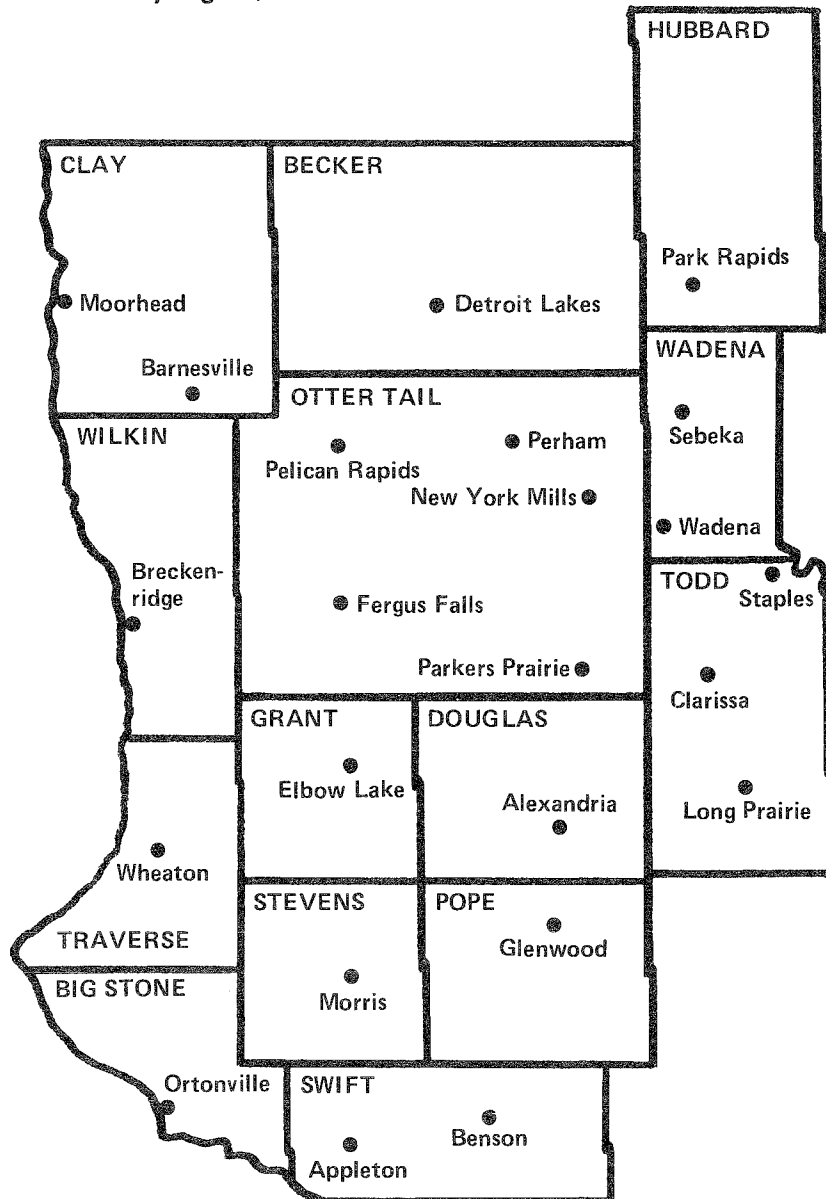
ECONOMIC IMPACT OF IRRIGATED AGRICULTURE IN WEST MINNESOTA²

Wilbur R. Maki, Leonard A. Laulainen, Jr., Mason Chen, and Donald R. Newell³

BACKGROUND

West Minnesota is a 14-county area selected for the study of the economic impact of irrigated agriculture (figure 1.1). The 14 counties are marked by a high degree of dependence on agriculture as a basic industry. Growth or decline in agriculture is important to all industry in the area and to the quality of life experienced by its people.

Figure 1.1. Principal incorporated places and counties in 14-county West Minnesota study region, 1970



²Funding in support of this study was received from the Minnesota Experiment Station Project on Development of Irrigated Specialty Crops (DISC).

³The authors gratefully acknowledge the research assistance of Jim Birkhotz, Mary Porto, and Mike Scipioni.

The 14-county impact study area is marked, also, by diversity in its microcosms of industry and people. To the south and west, agriculture is the basic industry. It is the area of intensive cultivation. Except in the Fargo-Moorhead Metropolitan Area, which included Clay County and several institutions of higher education, almost every household in these seven counties is dependent on agriculture and agriculture-related activity for daily sustenance and well being. When agriculture prospers, so do the people of these seven counties; when it experiences economic adversity, household incomes fall and the local economy suffers.

In marked contrast to the seven southern and western counties are the seven counties to the east—the transitional area of West Minnesota. Manufacturing and recreation-based business share with agriculture the role of basic industry. Generally, in the transitional area agriculture is less prosperous than in the area of intensive cultivation. Agriculture here is, indeed, “transitional.” Farm population has declined markedly in the area while farm size has increased. Still, farms are smaller in the east than in the south and west.

The two areas differ, also, in irrigated agriculture. Except in Swift County, irrigated agriculture is less than 1 percent of total agriculture. In the transitional area, irrigated agriculture is expanding sharply and is projected to continue the dramatic acreage increases of the past decade under one of the two options in this study.

Study Objectives

Study of the economic impact of agriculture must start with the irrigated agriculture itself—present and projected—and the total regional economy in which this development takes place. The objective of this study is, therefore, to delineate with as much detail as necessary the nature and extent of the economic impact of irrigated agriculture development in the 14-county West Minnesota study region. Because irrigated agriculture is selective in its linkage with the total regional economy, as well as individual local communities, it is important to this study to carefully delineate inter-industry and inter-area linkages within the study region. Given these linkages, the next task is to show the economic impact process as it unfolds from the first decision to invest in a farm irrigation system to the final spending of the added income derived from the expansion in total agricultural output.

The focal concern of this study stems from the projected three-fold expansion of irrigated agriculture in West Minnesota. The estimated 92,377 acres of cropland under sprinkler irrigation in 1976 is projected to exceed 331,835 acres in 1985 (table 1.1). The projected levels are based on current knowledge of irrigated agriculture practices and potentials in the 14-county study area and historical price relationships.

Contradictory information exists regarding both base year estimates and target year projections of level and scope of irrigated agriculture development in West Minnesota. For example, the 1974 U.S. Census of Agriculture reports a total irrigated acreage in the study region which is less than 56 percent of the total estimated by Roger Machmeir, Agricultural Extension Engineer, University of Minnesota. Widespread under-reporting of agricultural activity in the 1974 U.S. Census of Agriculture accounts for the wide differences in estimates.

While the U.S. Census of Agriculture data underestimate total irrigated acreage in West Minnesota, they are useful, nonetheless, in showing selected economic characteristics of agriculture in the study region. They show, for example, the sharp increase in both the total irrigated acreage and the average irrigated acreage per farm reporting irrigated acreage. They show also, the importance of irrigated agriculture in total agricultural land utilization.

Agriculture in West Minnesota is marked by the contrasts noted earlier between the area of intensive cultivation and the transitional area. Average size of farm is roughly twice as large in the former as in the latter, regardless of the measures used, whether total land in farms, total cropland or harvested cropland. The proportions of the total land are in farms, total farmland in cropland, and total cropland in harvested cropland also are higher in the area of intensive cultivation than in the transitional area. The expansion of irrigated agriculture,

Table 1.1. Estimated and projected sprinkler irrigated acreage in specified area and county, West Minnesota, 1969-1990

Area & County	Estimated ¹						Projected ²	
	U.S. Census of Agri.		DISC Study				1980	1985
	1969	1974	1973	1974	1975	1976		
	(acres)							
Intensive Cultivation Area:								
Big Stone	90	213	270	270	630	790	2,541	3,973
Clay	508	2,003	2,363	2,798	2,798	2,798	8,140	11,906
Grant	33	350	285	548	1,548	2,156	1,716	3,891
Stevens	166	796	85	508	1,623	2,305	7,061	10,236
Swift	383	2,874	3,710	4,535	7,500	8,223	25,107	38,720
Traverse	0	0	0	0	0	0	1,152	1,773
Wilkin	22	0	100	560	640	1,460	2,603	3,758
Total	1,202	6,209	6,813	9,219	14,739	17,732	48,320	74,307
Transitional Area:								
Becker	486	100	595	945	2,142	3,172	7,299	11,272
Douglas	375	1,292	1,186	1,431	1,431	2,701	6,884	11,865
Hubbard	209	795	1,500	1,624	4,052	6,963	18,670	29,429
Otter Tail	2,809	8,974	11,331	14,852	18,160	21,898	62,499	96,598
Pope	1,754	4,357	7,680	10,975	18,765	22,146	37,575	46,977
Todd	1,720	3,596	4,812	5,335	5,790	8,073	19,025	31,958
Wadena	684	1,811	2,518	4,091	6,221	9,692	19,213	29,429
Total	8,037	20,935	30,622	39,253	56,561	74,645	171,165	257,528
Region	9,239	27,144	37,435	48,472	71,300	92,377	219,485	331,835
State	36,256	76,464	86,156	111,233	174,094	221,521	535,330	809,354

¹Roger Machmeir, Extension Agricultural Engineer, University of Minnesota.

²E.C. Bather, DISC Study Coordinator.

because of its concentration in the transitional area, is likely to increase the average size farm and the proportion of total farmland utilized for crops in this area.

Changes in the average size of farm in the two contrasting areas of West Minnesota are revealed further in a comparison of data for 1964 and 1969—the most recent available—from the 1969 U.S. Census of Agriculture. While farms are becoming larger in West Minnesota, generally, farms larger than 500 acres are increasing in total number only in the area of intensive cultivation. Both small farms and large farms are declining in total number in the transitional area. Related to the decline of large farms is the expansion of non-agricultural land uses, especially for recreation and wildlife.

Demand for non-agricultural uses of land has been greater historically in the transitional area than in the area of intensive cultivation. Here, in West Minnesota, are the early lake resorts which catered to summer vacationists from Minnesota and the Dakotas. Especially in Douglas and Pope Counties, several of the local communities are as vitally dependent on the lake resorts and the tourists for their trade and employment now as in earlier years.

The U.S. Census of Population data for West Minnesota show some of the impact of the earlier recreation activity in present-day settlement patterns. Of the total regional population of 251,644 in 1970, 59 percent resided in the transitional area. Roughly equal numbers lived in the 119 municipalities (i.e., incorporated places) in the region. However, compared with the area of intensive cultivation, twice as many lived on farms in the transitional area and nearly seven times as many lived on rural non-farm land residing outside the incorporated places. The latter include the residents of lakeshore and resort-related communities. This population particularly is likely to exert pressure for expanding the various non-agricultural uses of land. An auxiliary purpose of this study is to show trends in total population as its geographic distribution and the related economic impacts of the population changes.

Study Plan

Given the study purposes, the plan of study is to start with population trends and projections and relate them to the present and future agricultural economy of the study region. For some of the analysis, the 1970 U.S. Census of Population provides a partial data base. The 1970 data base is used, also, in the study of income and employment. It is extended to 1974 in showing recent changes in the total agricultural economy and in calibrating the economic impact forecasting system.

A final summary table shows an alternate data source for updating the 1969 U.S. Census of Agriculture and, also, calibrating the economic impact forecasting system (table 1.1). This summary shows total farms and total land in farms simply for comparison with corresponding totals for 1969 (see, table 1.1). Differences exist, also, in the estimates of farm population, which are acquired from two different sources, namely the 1970 U.S. Census of Population and the 1972 edition of Minnesota Agricultural Statistics. Despite the reporting differences, certain spatial-economic relationships noted earlier are demonstrated in these data series, also.

Individual topics presented in this report are summarized, finally, as follows:

1. Introduction
2. Economic forecast
3. Impact measurement
4. Demographic trends and projections
5. Industry employment
6. Personal income
7. Agricultural economy

The last five topics provide an historical perspective for the study of development impact stemming from the projected expansion of irrigated agriculture in West Minnesota. All of these impacts are examined, in the analysis of the total regional economy and its prospects over the 15-year period to 1985.

ECONOMIC FORECAST

Study findings on the economic impact of irrigated agriculture development are presented in this chapter. The focus here is on the economic forecast. Economic well-being is represented by the level and distribution of (1) gross product and income, (2) employment and unemployment, and (3) labor force and population. The impact of irrigation development is measured in terms of projected changes in the level of each of the principal economic indicators.

Of critical importance in determining total employment impact is the projected acreage under irrigation—219,485 acres in 1980 and 331,835 acres in 1985—and the projected yields and prices. All of these variables were derived from sources outside this report, and given for the projection period. Thus, the overall economic impacts of the projected levels of agricultural development presented in this chapter depend upon the initial assumption regarding the physical and economic conditions for expansion of crop production on newly irrigated land. Given these conditions, then certain sets of consequences are derived by means of a regional economic impact forecasting system which simulates the overall process of economic growth and development in the 14-county study region.

Data representing each of the topical areas presented in the preceding chapters are organized systematically for use in the computer model. This model is user-interactive, and programmed to follow the instructions received from the user-operator. No special programming language is needed in performing the computer simulations of the West Minnesota economy under the two sets of assumptions.⁴

⁴A user manual is available for a user-prepared computer simulation of alternative development options.

Presented in this chapter is the sequence of implementation of the computer model as an area economic forecasting system. The economic forecasts are presented for the base year, 1970, and the forecast year, 1985. The 1970 to 1975 forecasts would be "estimated" insofar as they are based on, and validated by, external estimates of crop and livestock production, employment, population, and income cited earlier.

West Minnesota Overview

An overall, regional perspective on total development impact is presented, first, in a comparison of 1970 and 1985 data on output, input, and employment (table 2.1). Gross output is projected to increase by \$805,322,000—from \$1,673,543,000 to \$2,478,865,000 in the baseline option. This option is used as a standard of comparison. Thus, the difference between the baseline option increase of \$805,322,000 and the development option increase of \$1,040,636,000 in gross output is the measure of total development impact. It is called the development increment in this study. The projected 1985 development increment in total gross output is \$235,314,000.

An alternative measure of development impact is given in the increase in value of total primary inputs acquired by producing sectors from resource owners. This measure is approximately equivalent to the gross regional product. It includes all income payments of local producing sectors to resource owners in the 14-county area. For the 1970-85 period, this measure shows an additional total development impact of \$106,132,000 due to the expanded irrigation option. Of course, the impact on value added by agriculture and related activity is greater than the impact on the rest of the economy.

A third measure of development impact is the change in total employment. Because of differences among industry groups in output per worker and value added per worker, the development impact on employment will not only vary from one industry to the next, but it will differ in its magnitude from the two previous measures. The total (direct and indirect) development impact on employment is given, again, by difference in the employment increases for the two options.

The projected expansion in agricultural yields the additional revenues to finance the private capital formation which is an essential part of the development process. First, however, the increases in business and personal income are converted into increases in business and personal savings. Along with these increases are corresponding increases in business and personal income taxes. Personal consumption expenditures increase, also, but at a slightly lower rate than savings and income taxes. Each of the added indicators of development impact are discussed in this chapter.

West Minnesota Present

For the most part, the following chapters show the recent growth and development of the West Minnesota economy as revealed in historical records. The historical perspective is presented as a basis for assessing the current status of the West Minnesota economy. For practical purposes (i.e., availability of data), West Minnesota "present" is the period, 1970 to 1975.

West Minnesota "present" is characterized by personal income levels which gradually are catching up with the state and national averages, but which experienced a recent sharp decline from an historical high in 1974. The largest fluctuations in income occurred, of course, in the intensive cultivation area where most of the cropland is located. Income levels in the transitional area still lag behind those in the intensive cultivation area and, also, the state and nation. By 1975, real income per person was 20 percent above its 1970 level and 13 percent above its 1972 level in the study region. However, it was 15 percent and 33 percent respectively, below its 1973 and 1974 levels. A further drop is anticipated in the 1976 and 1977 income estimates because of reduced crop prices and yields. The 1970 price levels used in this study are viewed as more closely representing long-term price relationships than the 1975 prices.

Table 2.1. Projected change in industry gross output, value added, and employment in specified industry, baseline and development increment, West Minnesota, 1970-1985

Industry No. Title	Gross Output		Value Added		Employment	
	Baseline Change	Development Increment	Baseline Change	Development Increment	Baseline Change	Development Increment
	(thou. dol.)	(thou. dol.)	(thou. dol.)	(thou. dol.)	(no.)	(no.)
1. Dairy farm products	0	1,961	0	703	-3,339	77
2. Poultry and eggs	5,795	8,319	975	1,400	-745	132
3. Meat animals, misc.	86,975	68,921	14,713	11,658	-1,648	1,099
4. Wheat	36,257	-2,808	23,216	-1,799	-21	-46
5. Other food grains	-477	59	-234	29	-91	2
6. Corn	26,436	5,090	23,000	-4,428	-1,308	-308
7. Other field grains & seed	16,158	10,224	-7,682	4,861	-3,560	310
8. Oil-bearing crops	6,474	-757	2,400	-281	-792	-19
9. Specialty crops	4,790	-2,929	1,874	-1,146	-28	-23
10. Irrigated corn	0	36,658	0	29,776	0	826
11. Other irrigated crops	0	45,973	0	13,356	0	35
12. All other crops	-12,163	-12,995	-5,357	-5,726	-1,965	-47
13. Ag services, for., fish.	2,618	3,189	1,390	1,692	-52	40
14. Iron and ferroalloy ores	0	0	0	0	0	0
15. Nonferrous metals	0	0	0	0	0	0
16. Other mining, quarrying	416	29	255	18	2	1
17. Construction	60,924	8,311	34,148	4,658	471	196
18. Meat products	13,611	1,299	3,217	306	-135	17
19. Dairy products	12,881	813	2,858	181	-286	8
20. Canned products	957	101	504	53	-23	4
21. Flour and other grain prod.	1,164	410	419	147	-3	3
22. Prepared animal feeds	4,767	4,706	851	841	-35	32
23. Bakery products	975	100	685	70	-20	5
24. Sugar	2,292	588	823	212	-18	14
25. Confect. & related prod.	0	0	0	0	0	0
26. Beverages	1,471	161	891	98	-20	4
27. Other food products	1,134	414	510	130	1	11
28. Lumber & furniture	16,283	1,607	7,972	786	295	52
29. Pulp & paper	1,700	165	897	87	12	7
30. Print & publishing	7,847	794	4,772	577	174	41
31. Chem. & allied prod.	2,745	513	1,071	208	-5	5
32. Petroleum refining	0	0	0	0	0	0
33. Stone, clay, & glass	6,140	533	3,579	311	90	58
34. Primary metals	0	0	0	0	0	0
35. Fabricated metals	4,988	506	2,524	237	78	16
36. Machinery, exc., electr.	22,286	24,854	11,294	557	303	26
37. Elec. machinery	4,726	609	2,423	278	36	14
38. Other manufacturing	28,231	4,121	8,908	1,378	-117	82
39. Rail transportation	9,906	1,316	7,761	1,301	-378	34
40. Truck & warehousing	6,348	1,471	5,027	1,165	104	64
41. Other transportation	7,452	899	4,078	493	-83	23
42. Communication	11,652	1,474	9,858	1,247	-215	38
43. Electric utilities	11,414	1,195	5,402	567	-115	13
44. Gas utilities	22,395	454	13,605	276	68	3
45. Other utilities	3,980	548	952	131	57	9
46. Wholesale trade	30,570	5,591	23,958	4,382	147	176
47. Retail trade	83,910	9,699	71,636	8,280	1,238	588
48. Finance, ins. & real estate	50,513	20,657	36,405	14,366	437	128
49. Hotel, pers. & repair serv.	20,995	2,017	14,144	1,359	731	180
50. Business services	14,885	2,438	9,584	1,575	326	86
51. Medical, educational	45,977	5,269	37,932	4,346	1,256	395
52. Other services	26,345	-1,279	16,639	-832	387	70
53. Fed govt. enterprise	14,193	403	11,814	14,336	113	10
54. State, local govt. enter.	32,916	720	19,195	420	440	17
55. Dummy industry	74,780	5,722	74,780	5,722	8,435	900
Total	805,322	235,314	509,629	106,132	8,879	5,360

In 1970, the gross output of the 12 agricultural industries in West Minnesota accounted for as much as 0.9 percent of the corresponding U.S. gross output (table 2.2). For the most part, however, the percentages are less than 0.9 percent of U.S. gross output.

Investment and capital stock requirements of the West Minnesota economy are related directly to industry gross outputs noted earlier. For example, output-increasing investment requirements for the 12 agricultural industries totaled \$22,631,000 in 1970, of which \$14,330,000 were new (i.e., expansionary) and \$8,301,000 was replacement investment. Estimated pollution abatement investment totaled \$460,000 of which \$292,000 was new investment. Both types of investment are essential for industry expansion, although only the output-increasing investment acts as a constraint on production in the computer simulations.

Table 2.2. Estimated gross output, value added and employment of specified industry, West Minnesota, 1970

Industry No.	Industry Title	Gross Output (thou. \$)	Value Added			Employment (no.)
			Earnings (thou. \$)	Other (thou. \$)	Total (thou. \$)	
1	DAIRY FARM	73206.	17188.	9060.	26248.	6140.
2	POULTRY AN	29177.	3411.	1497.	4908.	1013.
3	MEAT ANIMA	105053.	12366.	5404.	17770.	3673.
4	WHEAT	20096.	2456.	10410.	12867.	730.
5	OTHER FOOD	100.	293.	195.	488.	87.
6	CORN	5326.	7185.	39159.	36870.	2134.
7	OTHER FIEL	54133.	12375.	13361.	19548.	3675.
8	OIL REFIN	20497.	3843.	3754.	7597.	1141.
9	SPECIALTY	9123.	159.	3408.	3568.	47.
10	IRRIGATEL	0	0	0	0	0
11	OTHER IRR	0	0	0	0	0
12	ALL OTHER	60908.	10302.	18530.	13570.	3060.
13	AG SERVICE	13413.	1812.	5305.	7118.	357.
14	IRON & FER	0	0	0	0	0
15	NONFERRO M	0	0	0	0	0
16	OTHR MINE	1467.	157.	741.	898.	20.
17	CONSTRUCT	122854.	43234.	25624.	68858.	3854.
18	MEAT PRODU	39558.	5555.	3794.	9348.	845.
19	DAIRY PROD	70365.	6114.	9499.	15614.	1077.
20	CANNED PRO	2080.	841.	574.	1415.	151.
21	FLOUR & OT	2675.	200.	714.	914.	36.
22	PREPARED A	15888.	1003.	1418.	2421.	180.
23	BAKERY PRO	2318.	997.	630.	1627.	179.
24	SUGAR	5340.	1032.	822.	1854.	185.
25	CONFECT. & B	0	0	0	0	0
26	BEVERAGES	3925.	791.	1584.	2375.	147.
27	OTHER FOOD	2003.	434.	332.	767.	78.
28	LUMBER & P	15977.	4761.	3060.	7821.	745.
29	PULP & PAP	3368.	1511.	267.	1777.	193.
30	PRINT & PU	12560.	5012.	2626.	7638.	695.
31	CHEM. & AL	4880.	496.	1331.	1827.	79.
32	PETROLEUM	0	0	0	0	0
33	STONE & CLA	11945.	2945.	4018.	6963.	457.
34	PRIMARY ME	0	0	0	0	0
35	FABRICATED	8544.	2554.	1625.	4180.	357.
36	MACHINERY	17959.	4247.	3793.	8039.	545.
37	ELEC MANUF	7153.	1613.	1068.	2682.	219.
38	OTHR MANUF	57180.	13932.	11318.	25250.	2410.
39	RAIL TRANS	26164.	10998.	9501.	20498.	1314.
40	TRUCK & WA	15250.	7154.	4929.	12083.	831.
41	OTHR TRANS	14506.	4902.	3037.	7939.	632.
42	COMMUNICAT	23109.	7104.	12448.	19551.	1114.
43	ELECTRIC U	23400.	4259.	6763.	11022.	475.
44	GAS UTILIT	77445.	4591.	42457.	47047.	512.
45	OTHER UTIL	10893.	1775.	830.	2605.	198.
46	WHOLESALE	62101.	20117.	28553.	48669.	2784.
47	RETAIL TR	154956.	54872.	77417.	132289.	13251.
48	FINANCE & IN	92511.	10141.	56236.	15377.	1795.
49	HOTELS, FEP	30909.	15354.	5468.	20822.	3916.
50	BUSINESS S	28019.	5334.	11887.	17222.	1148.
51	MEDICAL & D	68541.	34821.	21726.	56547.	7320.
52	OTHER SERV	36236.	5104.	17782.	22866.	955.
53	FED GOVT E	22230.	5104.	13400.	18504.	753.
54	STATE LOC	57447.	11339.	22161.	33500.	1695.
55	DUMMY INDU	84911.	84911.	-1.	84911.	16669.
	TOTAL	1624955.	456721.	488609.	945330.	89926.

Value added is related to gross outputs (being the residual amount after the value of intermediate purchases and imports is deducted). The two statistical series—total earnings and other value added—show the contribution of each industry to the gross regional product. Dairy farms, for example, accounted for 2.7 percent, or \$26,248,700, of the gross regional product of \$976,404,000 which was produced in the study region.

The industry employment series are presented, also, as an indicator of economic well-being. Both the gross output and the value added series can be related to the total employment series as a measure of industry productivity and role in the total economy. A high productivity export-producing industry, when accompanied by a high earnings per worker, is commonly associated with high per capita income. In West Minnesota, many of the local industries are identified with below-average earnings per worker (even with above-average increases in output per worker). One source of improvement in economic well-being is an increase in agricultural productivity, which is captured by the local agricultural sector in earnings and personal income.

West Minnesota in Transition

A computer simulation of the growth of the West Minnesota economy from 1970 to 1985 provides the next series of summary statements on the total development impact. Year-to-year changes in population, employment, unemployment, gross output, personal consumption, earnings per worker, are summarized for the study region.

Industry Output Effects

First, a baseline option is prepared, starting with the 1970 base year and calibrated from the 1970-75 base period (table 2.3). This option is derived from the baseline projections presented in following chapters and in the preceding section of this chapter. Industry gross output is derived, given the interindustry structure and projected exports, personal consumption expenditures and other final demand components. Earnings (for labor services) and other value added (for capital services and risk-taking) link gross output to personal consumption expenditures, gross private capital formation and other final demand components. For the baseline projection series, industry gross output is projected to increase at an increasing rate to 1985. This accounts for increasing income levels and, subsequently, increasing levels of personal consumption expenditures and employment.

Table 2.3. Selected baseline and development indicators, West Minnesota, 1970-1985

Year	Gross Output		Personal consumption Expenditures (in Region)		Earnings per person (in Region)		Employed Work Force		Population	
	Base-line	Develop-ment	Base-line	Develop-ment	Base-line	Develop-ment	Base-line	Develop-ment	Base-line	Develop-ment
	(mil.\$)	(mil.\$)	(mil.\$)	(mil.\$)	(\$)	(\$)	(thou.)	(thou.)	(thou.)	(thou.)
1970	1,674	1,674	441	441	2,019	2,024	85.2	85.2	252	252
1975	1,849	1,880	485	484	2,267	2,280	83.3	83.2	253	253
1976	1,902	1,944	497	497	2,335	2,357	83.7	83.9	254	254
1977	1,958	2,014	512	514	2,403	2,436	84.0	84.6	254	254
1978	2,019	2,091	528	532	2,477	2,523	84.6	85.6	255	255
1979	2,087	2,177	546	553	2,554	2,615	85.4	86.9	256	256
1980	2,160	2,270	566	576	2,637	2,714	86.3	88.3	258	258
1981	2,238	2,371	588	602	2,725	2,821	87.5	90.0	259	259
1982	2,300	2,455	613	630	2,800	2,916	88.4	91.5	260	260
1983	2,356	2,534	636	658	2,871	3,007	89.2	92.8	262	262
1984	2,417	2,622	659	685	2,946	3,107	90.1	94.4	263	263
1985	2,479	2,714	684	715	3,022	3,210	91.1	95.9	265	265
Total change 1970-85 (pct.)	48	61	55	62	50	59	7	13	5.3	5.3

The development projection series follows the growth trends of the baseline projection series. The accelerated level of agricultural investment and related output expansion assumed in this series results, however, in a gradually increasing development increment. The gross output increment noted earlier is accompanied by a personal consumption increment and also a total earnings increment, which are part of the output multiplier dynamics.

The earnings per worker series is included at this point as a surrogate for personal income. It reveals the combined effects of increasing productivity per worker and changing industry mix on per capita income. The gross output increment noted earlier is associated with an increasing level of total earnings per worker because of related increases in the importance of those industries with above-average earnings per worker.

Employment Effects

Employment effects in the baseline and development options are identified by changes in the employed work force, the level of unemployment, and total population. In the baseline option, an increase of 8,879 in total employment is accompanied by an increase in unemployment and a small increase in total population. Unemployment and labor force participation rates are projected to increase in this option.

In the development option, the 1985 employed work force is projected at 89,906—5,360 above the baseline option.⁵ While the projected labor force participation rate is higher in this option, the unemployment rate is lower than in the baseline option. Investment in irrigated agriculture and related expansion in agricultural and other industry output accounts for the projected increases in employment opportunities. This growth in jobs exceeds the increase in local labor supply, which thus results in lower unemployment levels and higher labor force participation rates as agricultural investment and output expand.

The total annual gross regional product increment of irrigated development, by 1985, exceeds \$106 million. The related increase in employment is nearly 5,400. The incremental value added per worker thus equals \$19,800 (as compared with an average gross regional product per worker of \$15,885 in the baseline option). To convert the 1970 dollars to current dollars, an inflation index (i.e., a projected Consumer Price Index) is multiplied by the projected value. For example, the estimated 1978 CPI is 65 percent above its 1970 level. Hence, the projected 1985 value per worker in the baseline option is \$26,210 in 1978 dollars. For the development option, the corresponding value, in 1978 dollars, is \$26,561 (the incremental value being \$32,670).

West Minnesota Future

The future of West Minnesota beyond 1985 has not been projected in this study. However, the SIMLAB program can be used for this purpose.

In the extended computer simulations, the emphasis would shift from the short-term effects of investment in irrigation systems and the subsequent increases in agricultural outputs to the long-term effects of accumulated increases in output-increasing capital in agriculture and all other industries directly and indirectly affected by the increases in agricultural production.

Much of the projected future expansion in the West Minnesota agricultural economy is associated with expansion of related meat animal production and food processing in the study region. The expansion in meat animal production would increase, not only the local utilization of feed grains, but also imports of feed grains other than corn. The projected increase in corn production assumes an increase in the export of corn. However, because of transportation costs to markets and from producing areas outside the region, the corn production in the study region may provide an increasing proportion of total feed grain requirements in the development option.

⁵In table 2.3, a full-time equivalent agricultural work force is assumed which results in a slightly lower total employment than shown in table 2.2.

Expanded irrigation development is associated, also, with potential expansion of the food and kindred products industry. The development projections show an expansion in the gross output of all food processing sectors. This expansion may or may not require additional food processing facilities. Total new output-increasing investment in the food and kindred products sector (i.e., industry groups 18 to 27) in 1985 is projected at \$567,000 and total investment, including replacement, is projected at \$9,995,000. The corresponding figures for the agricultural sector (i.e., industry groups 1 to 13) are \$8,822,000 and \$42,066,000, respectively. Again, all values are in 1970 dollars.

Further repercussions of the projected irrigation development occur throughout the West Minnesota economy, as noted earlier. However, the question of development costs remains an important consideration in balancing alternative development options with the baseline option. Private costs of irrigation development, for example, include the initial investments in irrigation systems and in related management practices and supporting business services. If the initial investments were \$200 per acre (in 1970 dollars) for the 260,135 acres of new irrigated land, the equipment life was 10 years, and the interest rate was 8 percent, then the average annual cost would be \$36 per acre—a total 1985 cost of \$9.4 million. This compares with a total value added by irrigated agriculture of \$37.6 million. Labor earnings—self-employed and hired—totals \$19.9 million, thus leaving \$17.7 million to cover direct and indirect taxes and return on investment. This set of assumptions deals, of course, with only direct costs and benefits. Indirect costs and benefits accrue from the dynamics of the regional investment and regional employer multipliers. Only part of the aggregate multiplier effects have been shown, namely, the indirect effects on gross regional product, earnings, employment and related social and economic indicators.

IMPACT MEASUREMENT

Expansion of irrigated agriculture in West Minnesota has certain inevitable economic consequences—direct, indirect, and induced. Direct economic consequences of irrigation are simple to identify, measure, and forecast from a given set of assumptions. Given the projected irrigation acreages and crop yields cited in earlier chapters, then the direct economic effects can be identified as (1) the added capital expenditures for irrigation equipment and land development and (2) the added farm production derived from these expenditures. An increase in sprinkler irrigation of 100,000 acres requires an investment of \$40 million or more. Both capital costs and, also, operating costs increase as farm production expands.

The indirect effects are the secondary consequences of the farm expenditures and sales. Farm equipment dealers and farm marketing and processing businesses which serve the farm enterprise also experience growth in the total business activity. The level of activity depends on the location and nature of the business and the amount of linkage with the irrigated farm enterprise. Because of other inter-firm linkages, the secondary effects are diffused among a large number of businesses.

The induced effects are the tertiary consequences of the increase in payrolls and other income payments supported by the direct and indirect effects of irrigated agriculture. They account for the long term effects of farm income expansion as it is diffused through farm household and investment expenditures and, ultimately, through the entire regional economy.

Measurement of the total effects—direct, indirect and induced—of irrigated agriculture is achieved by use of various interindustry transactions tables and a computer interactive program. These technical capabilities bring together a host of economic impact analysis and forecasting models which incorporate the data series presented in preceding chapters. The forecasting models are available on a standby basis for simulating alternative irrigation development options, starting with the two baseline/development options (i.e., with and without the projected increases in sprinkler irrigation presented in earlier chapters).

Input-Output Framework

Regional economic impact analysis and forecasting depends, first, on an accurate representation of the total regional economy in which the projected development takes place. A set of interindustry transactions tables is used in this representation. Included among the tables are the final demand sectors which "drive" the regional economy, the interindustry structure of the region, and the industry output multipliers.

Essential in building a useful set of interindustry transactions tables is a clear and concise definition of the different industries in the region, especially those which are part of the region's economic base. For this study, a standard industry classification system was prepared for a total of 55 market-based interacting sectors (table 3.1). Because an all-inclusive classification system is used, several of the interacting sectors are not located in West Minnesota although they are located elsewhere in the nation.

Table 3.1. Standard industry classification system, West Minnesota Study, 1970¹

No.	Industry Title	Minnesota	1967 U.S. Input-Output		SIC Code (1967 ed.)
		95-sector Input- Output	U.S. Dept. of Commerce 85-sector	U.S. Dept. of Agriculture 60-sector	
1	DAIRY FARM PRODUCTS	1.1	1.01	PT. 5	0132, PT. 014
2	POULTRY AND EGGS	1.2	1.02	PT. 5	0133, 0134, PT. 014
3	MEAT ANIMALS AND MISC.	1.3	1.03	PT. 5	0135, 0136, 0139, PT. 014, 0193
4	WHEAT	2.1	PT. 2.02	2A, 2A	PT. 0113, PT. 0116, PT. 014
5	OTHER FOOD GRAINS	2.2	PT. 2.02	2B,C	PT. 0113, PT. 0119, PT. 014
6	CORN	2.3	PT. 2.02	PT. 3A	PT. 0113, PT. 0119, PT. 014
7	OTHER FIELD GRAIN + GRASS SEED	2.4	PT. 2.02	3B,C,D	PT. 0113, PT. 0119, PT. 014
8	OID-BEARING CROPS	2.5	2.06	4	PT. 0113, PT. 0119, PT. 014
9	SPECIALTY CROPS	2.6	PT. 2.03	PT. 6	PT. 0123, PT. 0119, PT. 014
10	TOBACCO	2.7	2.05	PT. 6	PT. 0114, PT. 014
11	COTTON	2.8	2.07	1	0112, PT. 014
12	ALL OTHER CROPS	2.9	2.04, 2.07	PT. 6	0122, 1092, PT. 014
13	AGR. SERVICES, FOR., FISH.	3.4	3.4	7	07-09, (EXC. PT. 0729, 0722)
14	IRON + FERRO ALLOY ORFS	5	5	8	1011, 106
15	NONFERROUS METAL ORFS	6	6	9	102-105, 108, 109
16	OTHER MINING, QUARRYING	7-10	7-10	10-13	11, 12, 1311, 1321, 14
17	CONSTRUCTION	11, 12	11, 12	14, 15	15-17, PT. 138, 6511
18	MEAT PRODUCTS	15	14.01	PT. 23	201
19	DAIRY PRODUCTS	14.1	14.02-06	PT. 23	202
20	CANNED PRODUCTS	14.2	14.07-13	PT. 23	203
21	FLOUR + OTHER GRAIN PROD.	16.1	14.14, 16, 17	17, 19, 20	204 EXC. 2042
22	PREPARED ANIMAL FEEDS	16.2	14.15	18	2042
23	BAKERY PRODUCTS	14.3	14.18	21	205
24	SUGAR	14.4	14.19	PT. 23	206
25	CONFECTIONARY + HEL. PRODUCTS	14.5	14.20	PT. 23	207
26	BEVERAGES	17.0	14.21-23	PT. 23	208
27	OTHER FOOD PRODUCTS	14.6	14.24-32	22	209
28	LUMBER + FURNITURE	23-26	20-23	28, 30	241-249, 251-259
29	PULP + PAPER PRODUCTS	27, 28	24, 25	31	261-265
30	PRINT. + PUBLISHING	29, 30	26	32	271-279
31	CHEMICALS + ALLIED PROD.	31-34	27-30	33, 34	28
32	PETROLIUM REFINING	35, 36	31	35	29
33	STONE, CLAY + GLASS	40, 41	35, 36	38	32
34	PRIMARY METALS	42, 43	37, 38	39	33
35	FABRICATED METALS	44, 47	39-42	40	34
36	MACHINERY, EXC. ELECTRICAL	48-58	43-52	41	35
37	ELECTRICAL MANUFACTURES	59-64	53-58	42	36
38	OTHER MANUFACTURING	13, 37, 39, 65-71	13, 15-19, 32-34, 59-64	36, 37, 43-45	19, 21, 22, 23, 30, 31, 37-39
39	RAILROAD TRANSPORTATION	73	PT. 65	PT. 46	40, 174
40	TRUCKING + WAREHOUSING	75	PT. 65	PT. 46	42, 473
41	OTHER TRANSPORTATION	72, 74, 76	PT. 65	PT. 46	41, 44-47
42	COMMUNICATION	77, 78	PT. 67	PT. 47	48
43	ELECTRIC UTILITIES	79	PT. 68	PT. 47	491, PT. 493
45	GAS UTILITIES	80	PT. 68	PT. 47	492, PT. 493
45	OTHER UTILITIES	81	PT. 68	PT. 47	494-497, PT. 493
46	WHOLESALE TRADE	82	PT. 69	PT. 48	50
47	RETAIL TRADE	83	PT. 69	PT. 48	52-59, 7396, PT. 8099
48	FINANCE, INS., REAL ESTATE	84, 85	70, 71	49	60-67
49	HOTELS, PERSONAL + REPAIR	86	72	PT. 50	70, 72, 76
50	BUSINESS SERVICES	87	73	PT. 50	73 (EXC. PT. 7396), 81, 89
51	MEDICAL, EDUCATIONAL	90	77	PT. 53	90 (EXC. PT. 8092), 82, 84, 86, 0722
52	OTHER SERVICES	88, 89	74-76	51, 52, PT. 53	75, 78, 79
53	FEDERAL GOV., ENTERPRISES	91	78	54	8
54	STATE + LOCAL GOV.	92	79	55	8
55	Dummy Industry				
56	Total, market-based	1-95	1-85	1-55	
57	Private households	--	--	PT. 57	
58	Federal govt., civilian	--	--	PT. 58	
59	State and local govt.	--	--	PT. 58	

1/ For West Minnesota SIMLAB, sectors 11 and 12 in the Minnesota two-region input-output tables are designated as "irrigated corn" and "other irrigated" (including potatoes, sugar beets, dry beans and alfalfa in speciality crops), respectively.

A total of eight final and three primary input and import sectors are involved in the input-output system.⁶ The final demand sectors show the purchases for end uses of industry output in West Minnesota and, also, in the rest of the nation. In West Minnesota, the largest end use sector is the household. Personal consumption expenditures account for 89.3 percent of total final purchases in the region. Other end uses of local industry output are: gross private capital formation, net inventory change, government purchases (federal, state, and local), and net exports (foreign and rest-of-nation).

Only two primary sectors are listed; they correspond to a household sector and a combined business-and-government sector. Employee compensation is received by households while undistributed business income accrues to the owners of businesses and government. Part of this income is distributed to the business owners as dividend payment while part is paid to government in direct and indirect taxes. Industry purchases of imports depict, finally, the income payments of local industry to businesses outside the study region.

Final Demand Sectors

Measurement of development impact starts with a series of final demand estimates and forecasts. First, the export market shares of local industries are estimated. These estimates show the total exports (including a pro-rata share of foreign exports) of each industry group in the study region. The total regional export for each industry is compared with the corresponding industry gross output for the region and the nation (table 3.2). For example, the total dairy farm exports of \$41,321,000 compare with industry gross outputs of \$73,206,000 in the study region and \$8,198,000,000 in the nation. The regional market share for the farm dairy sector is equivalent to 0.5040 percent of industry gross output in the nation. This compares with a 0.2279 percent market share for the dairy products manufacturing sector. Thus for both sectors, outshipments occur to buyers outside the region. Milk is sold for processing and direct utilization outside the region and dairy products manufactured in the study region also are sold to purchasing sectors outside the region.

Sales of local industry outputs to local final demand sectors are summarized, next, for each industry in the study region (table 3.2). Only a nominal amount (\$189,000) of dairy farm output, for example, is purchased directly for personal consumption. Intermediate purchases thus greatly exceed final purchases of dairy farm output in the study region. In comparison, \$11,313,000 of locally manufactured products are purchased for final use in the study region. Even this total, however, of final and intermediate purchases of locally manufactured dairy products is less than the total exports of this industry. Thus, a large portion of total employment in the two dairy-related industries is engaged in producing for export markets. The two industries are an important part of the economic base of the study region.

Local personal consumption expenditures for all industry outputs totaled \$605,966,000 in 1970, of which \$408,914,000 was spent in the study region. The difference between the two figures is accounted by (1) household purchases of goods and services outside the study region and (2) income payments of households to household workers.

The total personal consumption expenditure is equal to the total personal income of households, less total personal income taxes and total personal savings. In West Minnesota, total personal incomes and total personal savings accounted for 7.2 percent and 3.5 percent, respectively, of total personal income, which, in 1970, was \$678,427,000. Control totals for other final purchases are related to the total personal income level.

⁶Final (local, not export) demand sectors are listed as follows, by sector number:

- 56 Total Intermediate Purchases
- 57 Personal Consumption Expenditures
- 58 Gross Private Capital Formation
- 59 Net Inventory Change
- 60 Total exports
- 61 Federal Government Purchases
- 62 State and Local Government Purchases

Table 3.2. Estimated gross output and demand of specified agricultural industry, West Minnesota, 1970

Industry No. Title	Gross Output		Demand			
	United States (mil.)	Minne- sota (thou.)	Ex- ports (thou.)	Inter- mediate (thou.)	Local	
					Total (thou.)	Final Personal (thou.)
1 DAIRY FARM	8198.	73206.	41321.	31696.	189.	189.
2 POULTRY AN	5408.	29177.	22895.	4375.	1907.	1894.
3 MEAT ANIMA	23897.	105053.	58429.	46443.	181.	179.
4 WHEAT	2400.	20096.	17528.	2457.	111.	149.
5 OTHER FOOD	649.	1000.	652.	343.	5.	16.
6 CORN	4593.	42388.	10529.	31893.	-34.	65.
7 OTHER FIFL	2645.	41118.	15381.	25760.	-23.	10.
8 OIL-SEAPIN	4905.	20497.	17428.	2923.	146.	13.
9 SPECIALTY	5939.	9123.	2235.	4752.	2136.	2131.
10 IRRIGATED	2135.	0	0	0	0	0
11 OTHER IERI	1951.	0	0	0	0	0
12 ALL OTHER	4985.	32664.	45.	30880.	1739.	1691.
13 AG SERVICE	5262.	13413.	3261.	9411.	741.	1011.
18 MEAT PROD	30826.	39558.	11332.	8171.	20055.	19841.
19 DAIRY PROD	17982.	70365.	40985.	17774.	11606.	11313.
20 CANNED PRO	12901.	2688.	687.	245.	1756.	1738.
21 FLOUR & OT	6854.	2675.	344.	1446.	885.	870.
22 PREPARED A	7364.	15808.	120.	15429.	259.	258.
23 BAKERY PRO	8431.	2318.	83.	101.	2134.	2121.
24 SUGAR	4726.	5349.	577.	3912.	860.	856.
25 CONFECT. & R	3307.	-0	0	0	0	-0
26 BEVERAGES	15928.	3923.	728.	302.	2893.	2887.
27 OTHER FOOD	13820.	2003.	201.	997.	805.	798.

A series of industry demand forecasts is available for 1985 from the Minnesota two-region input-output system.⁷ However, projection series from the Minnesota Regional Development Simulation Laboratory, SIMLAB, are derived, first, for the study region. The final demand forecasts include a series of 55 industry forecasts for the U.S. and the study region.

In the preparation of the 1985 West Minnesota final demand forecasts, the projected baseline option is used. This option, because it provides essentially for pre-1975 levels of irrigation development, is the "low" forecast for the study region. The development option is the "high" forecast.

Assumed in the preparation of the forecast series are consistent series of final demand requirements for the two regions—West Minnesota and Rest-of-Nation. These series are keyed to the projected levels of total personal income and related business and government expenditures.

Projected levels of West Minnesota agricultural production, and related non-agricultural activity, are derived from the data presented earlier. The projected production levels are converted into equivalent levels of industry gross output (in constant 1970 prices). Industry output which is in excess of final requirements is shown as net exports. Projected expansion in agricultural production which exceeds the projected growth in total personal income is likely to show as a projected increase in exports from West Minnesota.

In the preparation of the baseline demand forecasts, the crop and livestock categories listed in table 7.7 were regrouped by industry (as listed in table 3.1). The industry regrouping provides for a total of only 12 agricultural sectors rather than the 16 sectors shown later. However, the consolidated industry groups retain much of the commodity differentiation in the later listing.

⁷See: Henry Hwand and Wilbur R. Maki, Users' Guide to Minnesota Two-Region Input-Output System, Agricultural Experiment Station Bul. (in process), University of Minnesota, St. Paul, Minnesota, 1977.

In the baseline option, personal income per person in West Minnesota is measured relative to Minnesota and U.S., as shown below:

Year	Personal inc. per person (dol.)		West Minnesota			
	United States	Minnesota	Personal income		Pers. cons. expend.	
			Per person (dol.)	Total (mil. dol.)	Per person (dol.)	Total (mil. dol.)
1970	3,966	3,859	2,699	680.7	2,410	607.2
1971	4,022	3,872	2,751	702.9	2,446	624.9
1972	4,213	4,018	2,876	739.7	2,566	660.0
1973	4,413	4,469	3,846	995.3	3,188	825.1
1974	4,320	4,306	4,872	1,252.6	3,621	930.9
1975	4,259	4,197	3,250	849.6	2,812	735.1
1980	5,499	5,466	4,207	1,108.5	3,631	956.9
1985	6,280	6,280	5,003	1,362.3	4,273	1,163.6

All data are in constant 1970 dollars. Thus, the recent decline in purchasing power is, in part due to price inflation. In West Minnesota, however, real income increased in the 1973-74 period, but declined in 1975.

For other final demand sectors, e.g., personal consumption expenditures, projected 1985 levels are based on the projected 1970-85 relationships with total personal income, as noted earlier. These assumptions apply, of course, only to the 1985 baseline forecasts from the Minnesota Regional Development Simulation Laboratory.

The second demand forecast series corresponds with the development option. In this option, the projected expansions of irrigated cropland and related agricultural production are converted into corresponding increases in industry gross outputs and final demands. Increases in agricultural production trigger corresponding increases in the production and, ultimately, the consumption of all goods and services in the study region.

Under the development option, export market purchases of locally-produced goods and services expand initially to completely exhaust any increases in agricultural output. In some industries, the production increases are utilized within the region (as in the case of the increase in corn production which is utilized in the livestock and livestock products industries). For these industries, the projected increase in exports is less than the projected increase in gross output.

The production and utilization forecasts in the development option are derived from SIMLAB. Initially, the population and income forecasts of the baseline option are used. The projected increases in agricultural industry outputs under the development option ultimately lead to projected increases in employment, population and regional income. Thus, the projected 1985 levels of final demand are greater under the development option than the baseline option, as indicated by the projected total purchases of each final demand sector.

Interindustry Transactions

The interindustry transactions table for West Minnesota shows the purchases and sales of each industry in the study region. The table is derived from estimates of (1) industry gross outputs and final demands in the study region and (2) industry input requirements, as well as gross outputs and final demands, in the nation as a whole. The Minnesota two-region input-output computer program is used, finally, in the preparation of the West Minnesota interindustry transactions table.

In this study, the interindustry transactions table is used primarily as an economic accounting system for reconciling the annual estimates and projections of regional product and income. Moreover, the degree of external dependence of each industry is indicated in two ways: first, with reference to imports and, second, with reference to exports. Both approaches are essential in reconciling the region's economic accounts each year.

The base-year interindustry transactions table is used directly in SIMLAB in the derivation of the two projection series. The sectoring in the initial two-region input-output is modified, however, by the replacement of the two "unused" agricultural industry groups in West Minnesota (namely, cotton and tobacco) with two new industry groups—"irrigated corn" and "other irrigated crops." The two industry groups provide for a consolidation of the irrigated agriculture development as a means of facilitating the economic impact analysis and forecasting. In the base year, the initial allocation of agricultural production is replaced by a new allocation which focuses on delineation of the two new industry groups with reference to their unique pattern of purchases of, and sales to, other industry groups. SIMLAB is used in the derivation of related statistical series, including annual output multipliers.

The industry structure depicted by the interindustry transactions table determines the intensity and duration of the regional economic impact of irrigated agriculture development in West Minnesota. The proportion of total industry outlays accounted for by imports is directly related to the size of the industry output multiplier (table 3.3). The larger the imports, the smaller the output multiplier. The total regional economic impact of irrigated agriculture development thus depends on the relative importance of imports in each of the agriculture-related sectors of the regional economy.

Production Parameters

Two sets of production parameters are derived from the interindustry transactions table, namely, technical coefficients and output multipliers. The technical coefficients derived from the West Minnesota interindustry transactions table differ from the corresponding U.S. industry coefficients by the amount of imports. Typically, the value of the individual industry coefficient is smaller for the region than for the nation.

The output multipliers are derived from the technical coefficients. The multiplier represents the total industry effect, both direct and indirect, of a \$1 change in final demand for a given industry output.

Technical Coefficients

Derived, first, is a table of so-called technical coefficients which show the input requirements acquired locally by each producing industry in the study region. The derived data represent the value of the input purchases per \$1,000 total outlay of each industry (see column 1, table 3.3). The total value of imports (see column 4, table 3.3) for each purchasing industry is deducted from the industry's total input requirements to obtain the requirements acquired locally. Thus, the larger the level of imports for a given industry, the lower is the derived value of its input requirements acquired from industries in the study region.

The import dependency of each industry is readily ascertained by inspection of its technical coefficients profile, specifically, the level of imports per \$1,000 gross outlay. A high import ratio denotes a high degree of import dependency and, also, a potential for import substitution (which depends, of course, on the location advantages of the study region for these industries).

The two-region input-output computer program generates an import table for each region. These data show the originating (producing) industry for all the input purchases of each industry in the study region. They are available for further study of import substitution opportunities.

Output Multipliers

The total output multiplier, which includes both the direct and indirect effects of a \$1,000 change in final demand on the total regional economy, is derived for each industry in the study region (see column 5, table 3.3). Both the direct effect and the individual industry source of the indirect effect (which is not shown in table 3.3) are derived in the two-region computer program.

Table 3.3. Estimated gross outlay coefficients and final demand multipliers, West Minnesota, 1970

Industry No.	Title	Value Added			Per \$1,000 Final Demand			
		Inter- mediate (dol.)	Earn- ings (dol.)	Other Imports (dol.)	Gross Output (dol.)	Income (dol.)	Employ- ment (no.)	
1.	Dairy farm products	689	183	21	107	1,507	667	.0755
2.	Poultry and eggs	623	44	36	297	1,609	220	.0354
3.	Meat animals & misc.	792	121	11	76	2,035	879	.0925
4.	Wheat	226	279	362	134	1,354	705	.0338
5.	Other food grains	276	212	277	235	1,398	516	.0709
6.	Corn	74	371	499	56	1,110	1,045	.0687
7.	Other field grains & seed	31	211	264	215	1,485	590	.0884
8.	Oil-bearing crops	39	163	208	235	1,597	473	.0572
9.	Specialty crops	39	164	227	216	1,564	573	.0283
10.	Irrigated corn	0	0	0	0	1,000	0	0
11.	Other irrigated crops	452	123	263	162	1,000	0	0
12.	All other crops	384	199	269	147	1,522	603	.0943
13.	Ag services, for., fish.	256	162	369	213	1,391	785	.0529
14.	Iron & ferrous alloy ore	0	0	0	0	1,000	0	0
15.	Nonferrous metals	0	0	0	0	1,000	0	0
16.	Othr mining, quarrying	163	250	362	225	1,231	646	.0147
17.	Construction	285	249	311	155	1,399	1,032	.0807
18.	Meat products	778	48	114	60	2,587	301	.0396
19.	Dairy products	718	77	145	60	2,262	328	.0266
20.	Canned products	427	102	203	268	1,688	309	.0582
21.	Flour & other grain prod.	442	107	235	216	1,641	401	.0216
22.	Prepared animal feeds	424	39	140	397	1,536	249	.0340
23.	Bakery products	239	216	367	178	1,411	563	.0776
24.	Sugar	711	67	150	72	2,390	437	.0681
25.	Confect & related prod.	0	0	0	0	1,000	0	0
26.	Beverages	208	220	386	186	1,313	612	.0389
27.	Other food products	420	80	172	327	1,695	267	.0423
28.	Lumber & furniture	404	227	262	106	1,605	755	.0766
29.	Pulp & paper	248	193	231	328	1,368	502	.0668
30.	Print & publishing	242	305	304	150	1,334	777	.0824
31.	Chem & allied prod.	214	147	227	424	1,397	409	.0224
32.	Petroleum refining	0	0	0	0	1,000	0	0
33.	Stone, clay & glass	244	267	316	173	1,334	661	.0508
34.	Primary metals	0	0	0	0	0	0	0
35.	Fabricated metals	128	244	271	357	1,176	533	.0523
36.	Machinery, exc., electr.	184	282	288	245	1,224	531	.0438
37.	Elec. machinery	246	410	393	49	1,220	491	.0447
38.	Othr manufacturing	233	211	230	326	1,322	702	.0728
39.	Rail transportation	217	314	469	0	1,299	898	.0718
40.	Truck & warehousing	208	320	472	0	1,284	898	.0776
41.	Othr transportation	299	222	327	154	1,426	890	.0772
42.	Communication	154	233	613	0	1,226	1,034	.0791
43.	Electric utilities	437	71	400	92	1,633	732	.0452
44.	Gas utilities	124	91	516	268	1,177	754	.0154
45.	Othr utilities	733	36	203	28	2,110	275	.0551
46.	Wholesale trade	178	335	449	39	1,279	1,220	.1016
47.	Retail trade	146	380	474	0	1,204	1,059	.1190
48.	Finance, ins., real estate	205	125	593	78	1,292	1,392	.0870
49.	Hotels, pers., repairs	226	297	377	100	1,324	697	.1413
50.	Business services	322	263	352	63	1,442	1,032	.0884
51.	Medical, educational	175	452	373	0	1,271	768	.1144
52.	Other services	271	252	380	98	1,376	830	.0509
53.	Fed govt enterprise	168	643	189	0	1,231	854	.0434
54.	State, local govt. ent.	373	583	0	44	1,537	859	.0742
55.	Dummy industry	0	0	0	0	1,887	—	—

The output multiplier is represented in terms of gross output, value added (i.e., income), and industry employment. Because of differing relationships between the three indicators, the output multiplier will differ in its interpretation for each industry. Labor-intensive industry generally yields high income and employment multipliers. Capital intensive industry yields a high income multiplier if the value added from capital utilization accrues to resource owners in the study region. Finally, a low level of imports, as noted earlier, yields a high product multiplier.

Extreme caution is advised in the use of output multipliers, whether based on product, income or employment. Indeed, the potential for misuse exceeds greatly the potential for informative and accurate application of the multipliers in most planning studies. None of the multipliers yield the measure of development impact they allegedly are designed to produce. They are merely non-dated, static indicators of the structure of the regional economy in some base-year, such as 1970. Even if used correctly in a technical sense, they usually are out-dated for most small areas. In most applications, unfortunately, the output multipliers are used improperly in the derivation of total impact because of neglect of the constantly changing mix of industry exports and imports.

In this study, a new set of forecasts of the total regional economy is prepared each year. Development impacts are derived for each year in terms of a host of economic and social indicators, including estimates and projections of agricultural output and income. Consistency among the indicators is achieved by the interindustry transactions table which each year reconciles product and income components in the regional economic accounts. For these reasons, the output multipliers are presented in summary form and only for the base year, 1970. The SIMLAB provides the alternative procedure for measuring development impact which overcomes the stated shortcomings of the output multipliers in impact analysis and forecasting.

Impact Analysis

Differences in levels of industry gross output and exports between base year and target year and between baseline option and development option account for differences in regional development impact. In this chapter, only three economic impact indicators are cited, namely, gross output, employment, and value added. The three economic indicators accurately summarize the total development impact of differential industry growth in productivity per worker and total industry output (as affected by increase in irrigated agriculture).

First, the base year 1970 levels of employment, income and gross output are specified for the West Minnesota economy. To illustrate: Sector 1—dairy products—accounts for a total production-related employment which is equivalent to 4,788 farm operators and hired workers. Income payments of this sector for primary inputs, i.e., labor and capital, total \$26,248,000. Gross output (which is equal to gross outlay in the input-output) totaled \$73,206,000.

Each of the three economic indicators is used in deriving its relationship to changes in gross output in the second step. For each \$1,000 of gross output of farm dairy products, a total of 0.066 farm workers was required in 1970. Total income payments for primary inputs per \$1,000 of gross output was \$204. These ratios are equivalent to the technical coefficients in the input-output tables.

The final step is the derivation of the demand multipliers, which are represented in terms of gross output, income, and employment. Because of differences between the several representations of input-output relationships, the multipliers differ, also. The gross output multiplier represents the total (i.e., direct and indirect) effect on gross output of a \$1,000 change in final demand. To show the total income effect of the \$1,000 change in total final demand, the gross output multiplier is converted into an income multiplier (by use of the input-output ratios in column 9 of table 3.3). Similarly, an employment multiplier is derived to show the total employment impact of the given change in demand.

The three sets of multipliers vary greatly among industries because of differences in the corresponding input-output relationships. While the employment multiplier is large for the dairy products sector, it is small in the poultry products. Employment requirements per \$1,000 of gross output differ greatly in

the two production systems. The income multiplier differs, also, because of differences in employment requirements and earnings per employed person. Thus each of the multipliers, when used with a given change in final demand for the specified gross output, yields a particular measure of total impact on the regional economy.

DEMOGRAPHIC TRENDS AND PROJECTIONS

Selected population trends since 1950 are presented as aggregate demographic indicators of the state of the region. Total population, together with the two major components of population change—natural increase and migration, are measures of the overall impact of underlying economic activity in the region. From the population trends are derived the labor force trends, including indicators of participation in the labor force trends, both male and female.

Population

Total population hovered slightly above the quarter-million mark for the 20-year period from 1950 to 1970 (table 4.1). Since 1970, however, significant population shifts have occurred, particularly in the transitional area.

The two major sources of population change noted earlier are derived from the fundamental population change identity, which is stated as follows: population change is equal to natural increase plus or minus migration. In other words, total population this year, say July 1, 1977, is equal to the total population July 1, 1976, plus population change, which is equal to total births in the intervening 12 month period, less total deaths in the same period, and plus or minus total migration. The algebraic sum of total births and total deaths is called the “natural increase” in population. In West Minnesota, the natural increase has been balanced roughly by out-(i.e., negative) migration since 1950 (table 4.2).

Table 4.1. Estimated and projected population in specified area and county, West Minnesota, 1950-1990

Area & County	Estimated ¹					Projected ²					
	1950	1960	1970	1971	1972 (number)	1973	1974	1975	1980	1985	1990
Intensive Cultivation Area:											
Big Stone	9,607	8,954	7,941	8,200	7,900	7,912	7,800	7,970	7,600	7,600	7,500
Clay	30,363	39,080	46,608	47,600	47,200	46,975	46,600	46,750	51,800	54,400	56,400
Grant	9,542	8,870	7,462	7,500	7,600	7,443	7,500	7,480	7,300	7,300	7,200
Stevens	11,106	11,262	11,218	11,500	11,400	11,478	11,600	11,242	11,600	11,800	11,800
Swift	15,837	14,936	13,177	13,000	13,500	13,236	13,500	13,336	12,900	12,800	12,600
Traverse	8,053	7,053	6,254	6,300	6,200	6,133	6,200	6,156	5,900	6,000	5,900
Wilkin	10,507	10,650	9,389	9,400	9,200	9,165	8,900	8,981	9,300	9,300	9,200
Total	95,075	101,255	102,049	103,500	103,000	102,342	102,100	101,915	105,800	109,200	110,000
Transitional Area:											
Becker	24,836	23,959	24,372	24,900	25,100	25,772	26,700	26,578	25,600	26,700	27,600
Douglas	21,304	21,313	22,910	23,100	23,900	24,402	24,800	25,059	25,900	27,700	29,500
Hubbard	11,085	9,962	10,583	11,100	11,500	11,862	12,500	12,119	12,400	13,300	14,200
Otter Tail	51,320	48,960	46,097	46,800	47,200	47,554	48,300	48,695	47,000	47,700	47,900
Pope	12,862	11,914	11,107	11,300	11,300	11,173	11,500	11,165	11,200	11,300	11,400
Todd	25,420	23,119	22,114	22,600	22,600	22,800	23,500	23,413	22,900	23,600	25,100
Wadena	12,806	12,199	12,412	12,400	12,600	12,707	13,100	13,340	12,700	12,800	12,800
Total	159,633	151,426	149,595	152,200	154,200	156,222	160,400	160,369	157,700	163,100	167,500
Region	254,708	252,681	251,644	255,700	257,200	258,564	262,500	262,284	263,500	272,300	278,100
State	2,982,483	3,413,864	3,804,971	3,860,000	3,877,000	3,887,210	3,917,000	3,916,105	4,076,800	4,252,200	4,421,500

¹Estimates for 1950, 1960 and 1970 from U.S. Census of Population. Estimates for 1971, 1972 and 1974 from: Office of State Demographer, Population estimates for Minnesota Counties 1974, Development Planning Division, State Planning Agency, St. Paul, Minnesota, July, 1975. Estimates for 1973 and 1975 from: U.S. Bureau of the Census, Current Population Reports, Series P-25, No. 671, May, 1977.

²Projected population series are obtained from: Office of State Demographer, Minnesota Population Projections 1970-2000, Division of Development Planning, State Planning Agency, 101 Capitol Square Building, St. Paul, MN 55101, November, 1975.

Table 4.2. Estimated population change in specified area and county, by population change component, West Minnesota, 1950-1974¹

	Change 1950-1974								
	Natural Increase			Migration					
	1950-60	1960-70	1970-74	Total	1950-60	1960-70	1970-74	Total	Total
	(number)								
Intensive Cultivation Area:									
Big Stone	1,261	646	59	1,966	-1,914	-1,659	-200	-3,773	-1,807
Clay	7,264	5,928	1,492	14,684	1,453	1,600	-1,500	1,553	16,237
Grant	1,138	342	-162	1,318	-1,810	-1,750	200	-3,360	-2,042
Stevens	2,117	1,251	182	3,550	-1,961	-1,295	200	-3,056	494
Swift	2,364	1,002	23	3,389	-3,265	-2,761	300	-5,726	-2,337
Traverse	1,369	591	-54	1,906	-1,919	-1,840	0	-3,759	-1,853
Wilkin	2,123	1,123	11	3,247	-2,040	-2,384	-500	-4,924	1,667
Total	17,636	10,883	1,551	30,070	-11,450	-10,089	-1,500	-23,045	7,025
Transitional Area:									
Becker	3,754	2,224	628	6,606	-4,631	-1,811	1,700	-4,742	1,864
Douglas	2,670	1,170	290	4,130	-2,661	427	1,600	-634	3,496
Hubbard	1,232	532	17	1,781	-2,355	89	1,900	-366	1,415
Otter Tail	5,893	2,239	3	8,135	-8,253	-5,102	2,200	-11,155	-3,020
Pope	1,629	419	-7	2,041	-2,577	-1,226	400	-3,403	-1,362
Todd	3,307	1,549	386	5,242	-5,608	-2,554	1,000	-7,162	-1,920
Wadena	2,544	1,522	288	4,253	-3,040	-1,319	400	-3,959	294
Total	20,918	9,665	1,605	32,188	-29,115	-11,496	9,200	-31,421	707
Region	38,554	20,548	3,156	62,258	-40,581	-21,585	7,700	-54,416	7,792

¹U.S. Bureau of the Census, Current Population Series.

Examination of recent population trends for West Minnesota reveals a remarkable shift in the direction of migration for a majority of the 14 counties from strongly negative to slightly positive—a remarkable shift, indeed, because of its relative size. Average annual migration for Becker County, for example, shifted from an out-migration of 463 persons in the 1950-60 decade to an in-migration of 474 persons in the 1970-74 period. This reversal in the direction of migration was repeated for every county in the transitional area and three counties in the area of intensive cultivation.

While migration reversed directions, the natural increase in population declined dramatically. In the 1950-60 decade, the natural increase, with reference to base-year population, was 18.5 percent for the western area and 13.1 percent for the eastern area. By the next decade the percentages dropped to 10.7 and 6.4, respectively. The two areas reached a virtual zero (and even a negative) population growth by the end of 1950-74 period. These shifts are attributed largely to the general decline in birth rates, which are projected to stabilize during the 1970's and 1980's.

Because aggregate indicators, such as total population, mask important details which give variety and uniqueness to an area, an initial task of this study is to break down the totals into special categories, such as age and sex class. This breakdown will show the impact of a declining rate of natural increase on the age composition of population in the "aging" of the resident population.

Both out-migration and in-migration are age-selective. While high-school graduates are leaving, experienced workers and retired persons are moving into the two areas. Thus, the age-composition of population is shifting sharply to an older average age, even older than in the state or nation as a whole.

Shifts in total population and its composition are accompanied by corresponding shifts in services and jobs. Fewer classrooms and teachers are needed because of the sharp drop in school-age population; retirement homes, doctors and nurses are needed for older people. Total private and public outlays per capita are not necessarily reduced. While they decline in some areas, in others they increase sharply.

Agriculture, of course, has a profound impact on the population structure because of its unique requirements for material and personal services. These requirements are manifested, first, in the labor force participation.

Labor Force

The transition from population to labor force is achieved through labor force participation. All persons 16 years and older who are employed or actively seeking employment are part of the labor force. A labor force participation rate shows the level of participation of each age and sex class in the given population in its labor force (table 4.3).

Table 4.3. Estimated and projected population (16 years and older), labor force and labor force participation rate in specified age and sex class, West Minnesota, 1970-1990.

Age and Sex Class	Population ¹					Labor Force					Labor Force Par. Rate				
	Estimated		Projected			Estimated		Projected			Estimated		Projected		
	1970	1975	1980	1985	1990	1970	1975	1980	1985	1990	1970	1975	1980	1985	1990
	(no.)	(no.)	(no.)	(no.)	(no.)	(no.)	(no.)	(no.)	(no.)	(no.)	(pct.)	(pct.)	(pct.)	(pct.)	(pct.)
Male:															
16-24	18,026	24,711	24,701	21,539	17,013	10,119	14,332	14,796	13,311	10,854	56.1	58.0	59.9	61.8	63.8
25-34	11,367	13,113	19,186	25,810	25,828	10,700	12,575	18,476	24,287	24,098	94.1	95.9	96.3	94.1	93.3
35-44	12,115	11,460	12,280	14,143	20,303	11,555	10,749	11,506	13,492	19,471	95.4	93.8	93.7	95.4	95.9
45-64	26,962	26,570	24,721	23,140	23,066	23,261	22,027	20,172	18,767	18,660	86.3	82.9	81.6	81.1	80.9
65 and over	7,021	18,588	19,159	19,397	18,911	4,442	3,866	3,468	3,162	2,856	26.1	20.8	18.1	16.3	15.1
Total	85,491	94,442	100,047	104,029	105,121	60,077	63,549	68,598	73,019	75,939	70.3	67.3	68.6	70.2	72.2
Female:															
16-24	18,064	23,750	23,148	19,882	15,740	7,869	11,828	12,222	10,975	9,224	43.6	49.8	52.8	55.2	58.6
25-34	11,652	13,499	18,744	23,731	23,017	4,281	6,196	9,541	12,459	12,268	36.7	45.9	50.9	52.5	53.3
35-44	12,635	12,129	12,643	14,485	19,775	5,741	6,053	6,713	8,213	11,727	45.4	49.9	53.1	56.7	59.3
45-64	27,230	27,508	26,232	24,900	24,605	11,911	11,938	11,568	11,130	11,294	43.7	43.4	44.1	44.7	45.9
65 and over	18,367	20,770	22,516	23,647	23,799	1,684	1,620	1,666	1,655	1,642	9.2	7.8	7.4	7.0	6.9
Total	87,948	97,656	103,283	106,645	106,936	31,486	37,634	41,710	44,432	46,155	35.8	38.5	40.4	41.7	43.2
All Classes	173,439	192,098	203,330	210,674	212,057	91,563	101,183	110,308	117,451	122,094	52.8	52.7	54.3	55.6	57.6

¹Minnesota Population Projections: 1970-2000, November 1975, and Minnesota Labor Force Projections, July 1976. Reports are available from Division of Development Planning, State Planning Agency, 101 Capitol Square Building, St. Paul, MN 55101.

In West Minnesota, labor force participation is generally low in the dominantly agricultural area because of the low participation of women. Diversity in economic activity increases female participation in the labor force. It also increases the proportion of the total labor force which is unemployed. Thus, in the area of intensive cultivation, both labor force participation rates and unemployment are low. They are higher in the transitional area because of more job opportunities for women and, also, because of the nature of economic activity (which is discussed later in this report).

Derived labor force participation rates for West Minnesota are used in projecting total labor force and its age-sex composition.

This projection series, which corresponds with the published series prepared in the Office of the State Demographer, is designated the baseline projection series in this report. The population and labor force impacts of irrigation development are measured with reference to the baseline projection series. Both series, of course, show the increasing participation of women in the labor force which accounts for the proportionately large projected increases in total labor force in the study region.

Employment Status

Total employment is a function of the total labor force. For the projected labor force series, certain constant levels of military employment and unemployment are assumed for the 1980-1990 period. Both 1970 and 1975 levels are based on currently available data on military and unemployment. The projected labor force series is used in the derivation of the 1975 employment levels. Again, this projection series is designated the baseline series (from which the employment impact of irrigation development is measured).

INDUSTRY EMPLOYMENT

Industry employment in West Minnesota depends in its total magnitude and mix on the size and character of the agricultural economy. Agriculture, being the economic base of the region, provides the basic, or first, dollar in each economic transaction. Non-basic industry, which is the non-export-producing industry, such as resident household services, accounts for the depth of the economy. The magnitude and mix of the so-called residentiary industry determines the size of the regional "multiplier." Hence, both export-producing and residentiary activities must be studied in the determination of the ultimate scope and scale of the economic impact of irrigated agriculture in West Minnesota.

Export-Producing and Residentiary Activities

Export-producing activities bring the first dollar into an area economy because of the origin of these dollars; they come from outside the area and, hence, they provide the currency for payment of goods and services purchased outside the area by area businesses, households and governments. Agriculture, for example, is partly export-producing and partly residentiary. Farm product sales to agricultural processing establishments outside West Minnesota result in the flow of income payments to West Minnesota farmers. On the other hand, when a dairy farmer makes direct sales to local customers, nothing is added to the supply of basic dollars in the area. These sales are totally residentiary. However, when a livestock producer sells beef cattle to a local slaughterer, who in turn sells the beef carcasses to wholesale establishments outside the area, the total integrated activity brings basic dollars into the area. Inter-industry linkage is a critical factor, therefore, in determining the export-producing or residentiary character of a given industry employment.

A rough measure of export-producing employment is a derived statistic termed "excess" employment. By "excess" employment is meant the above-average employment in a given industry in a given area. In this case, the U.S. industry employment levels are viewed as the norm or average against which area industry employment is measured. Percentage distributions of total employment, by industry, are derived for the U.S. and the given area. The positive difference in this percentage is multiplied by total area employment to obtain the "excess" employment contributed by the given industry in the area (table 5.1).

According to the excess employment approach, 64.9 percent of the 1970 West Minnesota economic base was due to agriculture. Agricultural employment accounted for 20.48 percent of total employment in West Minnesota as compared with 3.64 percent for the United States—a 16.84 percent difference. When multiplied with a total employment of 88,387 in 1970, this percentage difference yields an excess agriculture employment of 14,884, which is 64.9 percent of total excess employment. Other industry employment is treated similarly, and, altogether, shows a total economic base which agriculture shares with the forestry and fishery, food and textile products manufacturing, railroad and truck transportation, food stores, eating and drinking places, private households and professional services (the latter including the major public institutions in the region—a state university of Moorhead and a state hospital in Fergus Falls). The impact of the resort industry is represented, in part, by the excess employment in the trade and service sectors. Thus, agriculture, state government and the resort industry account for practically all of the economic base of the region.

Table 5.1. Estimated employment in specified industry, by employment category, West Minnesota, 1970

No.	Industry Title ¹	55-In- dustry Code	Proportion of Total Employment			Excess Employment	
			West Minn. (pct.)	United States (pct.)	Differ- ence (pct.)	Total (no.)	Proportion of Total (pct.)
1.	Agriculture	1-13	20.48	3.64	16.84	14,884	64.9
2.	For. and Fish.	pt. 13	.16	.13	.03	27	.1
3.	Mining	14-16	.23	.82	—	—	—
4.	Construction	17	6.11	5.93	.18	159	.7
5.	Food Prod.	18-27	2.60	1.92	.68	601	2.6
6.	Textile Prod.	pt. 38	.09	1.32	—	—	—
7.	Apparel	pt. 38	.45	1.69	—	—	—
8.	Lumber, Furn.	28	.73	1.34	.61	539	2.4
9.	Printing & pub.	30	1.09	1.82	—	—	—
10.	Chemicals	31	.12	1.36	—	—	—
11.	Machinery, exc. Elec.	36	.68	2.72	—	—	—
12.	Electrical Mach.	37	.14	2.61	—	—	—
13.	Motor Vehicles	pt. 38	.04	1.39	—	—	—
14.	Trans. exc. Mot. Veh.	pt. 38	.74	1.54	—	—	—
15.	Paper Prod.	29	.37	.89	—	—	—
16.	Petroleum Refining	32	.00	.29	—	—	—
17.	Primary Metals	34	.09	1.65	—	—	—
18.	Fabricated Metals	35	.41	2.01	—	—	—
19.	Misc. Manuf.	33, pt. 38	1.13	3.35	—	—	—
20.	Railroads	39	1.31	.87	.44	389	1.7
21.	Trucking	40	1.87	1.48	.39	345	1.5
22.	Other Transp.	41	.58	1.53	—	—	—
23.	Communications	42	1.14	1.47	—	—	—
24.	Elec., Gas, Sani.	43-45	1.46	1.36	.10	88	0
25.	Wholesale Trade	46	3.54	4.07	—	—	—
26.	Food Stores	pt. 47	2.82	2.70	.12	106	.5
27.	Eating & Drinking	pt. 47	4.11	3.30	.81	716	3.1
28.	Other Retail	pt. 47	12.15	10.12	2.03	1,794	7.8
29.	F.I.R.E.	48	3.02	.498	—	—	—
30.	Lodging, Personal	pt. 49	3.03	3.00	.03	27	0
31.	Business & Repair	pt. 49, 50, 52	1.99	3.12	—	—	—
32.	Entertain. & Rec.	pt. 52	.71	.84	—	—	—
33.	Private Households	pt. 55	1.91	1.72	.19	168	.7
34.	Prof. Services	pt. 51	21.06	17.56	3.50	3,094	13.5
35.	Public Admin.	pt. 53-55	3.70	5.44	—	—	—
	Total		100.00	100.00	25.95	22,937	100.0

¹Government employment is included in the industry group which defines the product of this industry, e.g., retail trade includes municipal liquor stores employment.

Sources of Total Employment Change

Another technique—shift-and-share analysis—is used to show the sources of total employment change in a local economy (table 5.2). This technique is derived from a very simple idea, namely, that area employment change is due partly to external factors and partly to internal factors.

The external factors of area employment change are essentially two-national growth and industry mix. These factors are viewed as originating outside the region. They are derived from external data sources. Thus, estimates and projections of both national growth and industry mix effects are based on U.S. rather than local area data sources. Together, the external factors accounted for a change of 16,190 in total employment. Of the two factors, however, industry mix accounted for a net decline of total employment of 3,530.

Only the regional-share effect is attributed to local conditions. Statistically, it is derived from local data series as a residual effect. This effect is projected for each industry in the study region. For the 1970-80 period, this effect was negative for 13 of the 35 industries. In total, however, a net positive effect of 1,014 is shown, which indicates a favorable growth position for the total regional economy relative to the national economy.

Table 5.2. Estimated and projected employment change in specified industry, by source of employment change, West Minnesota, 1970-1980

INDUSTRY	REGIONAL CHANGE DUE TO					1980
	1970	NAT.	IND.	REG.	TOTAL	
No. Title	EMPL.	GROWTH	MIX	SHARE	CHANGE	EMPL.
1 Agriculture	18,104.	4,037.	-6,683.	-2,674.	-5,321.	12,783.
2 For. and Fish	145.	32.	-17.	-148.	-132.	13.
3 Mining	207.	46.	-54.	77.	69.	276.
4 Construction	5,329.	1,188.	-24.	-674.	490.	5,819.
5 Food Production	2,299.	513.	85.	-919.	-321.	1,978.
6 Textile Production	77.	17.	-25.	29.	21.	98.
7 Apparel	401.	89.	-62.	165.	192.	593.
8 Lumber, Furn.	647.	144.	-22.	11.	134.	781.
9 Printing and Publishing	959.	214.	-467.	1,002.	748.	1,707.
10 Chemicals	105.	23.	17.	-64.	-23.	82.
11 Machinery, Ex. Elec.	601.	134.	-107.	518.	545.	1,146.
12 Electrical Machinery	124.	28.	-2.	60.	86.	210.
13 Motor Vehicles	35.	8.	-10.	-9.	-11.	24.
14 Trans. Exc. Mot. Veh.	650.	145.	-163.	469.	452.	1,102.
15 Paper Products	327.	73.	-14.	43.	102.	429.
16 Petroleum Refining	4.	1.	0.	-3.	-2.	2.
17 Primary Metals	82.	18.	-28.	72.	62.	144.
18 Fabricated Metals	361.	80.	13.	31.	125.	486.
19 Misc. Manuf.	1,000.	223.	29.	-330.	-78.	922.
20 Railroads	1,157.	258.	-592.	269.	-65.	1,092.
21 Trucking	1,655.	369.	-102.	295.	563.	2,218.
22 Other Trans.	512.	114.	-64.	250.	299.	811.
23 Communications	1,012.	226.	71.	-159.	137.	1,149.
24 Elec., Gas, Sani.	1,294.	289.	285.	-461.	113.	1,407.
25 Wholesale Trade	3,133.	699.	-88.	234.	845.	3,978.
26 Food Stores	2,493.	556.	188.	82.	827.	3,320.
27 Eating and Drinking	3,636.	811.	-103.	142.	851.	4,487.
28 Other Retail	10,737.	2,394.	424.	1,088.	3,907.	14,644.
29 F.I.R.E.	2,670.	595.	370.	-271.	695.	3,365.
30 Lodging, Personal	2,676.	597.	-297.	572.	871.	3,547.
31 Business and Repair	1,757.	392.	640.	222.	1,253.	3,010.
32 Entertain. and Rec.	631.	141.	8.	-0.	148.	779.
33 Private Households	1,691.	377.	-802.	-609.	-1,033.	658.
34 Prof. Services	18,610.	4,149.	3,963.	2,793.	10,906.	29,516.
35 Public Administration	3,266.	728.	100.	-292.	537.	3,803.
TOTAL	88,387.	19,707.	-3,538.	1,814.	17,991.	106,378.

The 1970-80 projection series shows the largest employment decline for the region in its agricultural industry—a total change of 5,321. This decline is less in later periods than in earlier periods. Employment increases are projected for the 1970-80 and later periods in selected manufacturing industries, resort-based trade and services, and, also, the professional services. Thus, agriculture is projected to decline in total employment and, also, its role as the principal basic industry of the West Minnesota economy. The economy is becoming more diversified and increasingly like the national economy.

The shift-and-share technique provides the forecasting methodology used in the preparation of a preliminary series of industry employment projections, but not the final series. These projections are compared later with the development impact projections derived from the Minnesota Regional Development Simulation Laboratory (SIMLAB).

Employed Work Force

In the preceding discussion of industry employment and labor force, only one concept of employment was presented, namely, the concept of a resident labor force. Industry employment refers to the industry of employment of the resident West Minnesota labor force. The industry may or may not be located in West Minnesota. Of course, because of the cost of commuting and the preferences of local residents for employment in close proximity to their homes, the number of persons employed and the number of jobs should be about the same.

In fact, however, the number of jobs exceeds, in varying degree, the number of employed persons.

The discrepancy between employed persons and jobs is due to multiple job holding. In small areas which are predominantly residential or predominantly industrial, commuting between place of work (in one area) and place of residence (in nearby area) accounts for an additional imbalance between employed persons and jobs. The concept of employed work force is introduced to provide the enumeration of jobs, by place of work.

The geographic distribution of the average employed work force in West Minnesota is presented for the calendar year 1970, rather than a single week in April, 1970 (as in the case of the U.S. Census of Population). The Regional Economic Information System, from which the data are derived, shows average annual employment. An alternate source for work force data is the County Business Patterns which shows so-called "covered" employment for the first quarter of each year. The preferred data source for average annual employment estimates is, therefore, the Regional Economic Information System.

The 1970 employed work force estimates are available for 11 industry groups in the case of wage and salary employment and only two industry groups in the case of proprietorial employment (table 5.3). Significant differences occur between counties in the relative importance of the farm work force, e.g., Clay County with 15.5 percent of total employment in farming and Todd County with 40.5 percent of total employment in farming. In terms of employed work force, the transitional area is more dependent of the two areas on the farm sector.

Table 5.3. Estimated employed work force in specified area and county, by industry, West Minnesota, 1970¹

Area & County	Farm			Non-Farm								Total	
	Proprietors	Wage & Salary	Proprietors	Wage and Salary									
				Mining	Construction	Manufacturing	Trans., comm., util.	Trade	Fin., ins., real est. Services ²	Federal, State & Local			
Intensive Cultivation Area:													
Big Stone	779	94	509	3	79	246	52	347	44	273	49	507	2,982
Clay	1,627	612	1,415	7	978	972	449	3,092	268	2,546	156	2,334	14,456
Grant	1,018	113	507	0	20	39	23	292	44	367	38	476	2,937
Stevens	1,032	139	572	0	65	236	60	444	84	271	88	1,086	4,077
Swift	1,513	297	819	0	43	582	116	689	87	379	92	781	5,398
Traverse	809	123	423	0	17	9	61	282	25	155	40	466	2,420
Wilkin	1,017	178	411	0	57	78	112	363	28	414	44	418	3,120
Total	7,795	1,556	4,656	10	1,259	2,172	873	5,509	580	4,405	507	6,068	35,390
Transitional Area:													
Becker	1,898	222	1,149	0	223	620	411	915	100	1,330	161	1,505	8,534
Douglas	1,894	143	1,336	0	477	698	323	1,464	166	1,023	119	1,315	8,954
Hubbard	603	32	679	0	140	221	73	298	52	293	47	688	3,126
Otter Tail	4,718	487	2,293	9	454	1,449	1,205	2,077	249	2,052	200	2,796	17,989
Pope	1,434	132	612	0	103	229	113	423	40	328	53	551	4,018
Todd	2,749	211	918	0	102	800	228	516	82	467	80	1,159	7,312
Wadena	909	85	714	0	161	340	189	1,000	63	468	62	786	4,777
Total	14,205	1,312	7,701	9	1,660	4,357	2,542	6,693	752	5,961	722	8,796	54,710
Region	22,000	2,868	12,357	19	2,919	6,529	3,415	12,202	1,332	10,866	1,229	14,864	90,100

¹U.S. Department of Commerce, Regional Economic Information System, 1975.

²Including "other" employment.

Trends in employment work force for the two areas show the declining importance of the farm sector in providing jobs for the expanding regional economy. Trade and service employment, particularly, is assuming a larger role in each of the two area economies.

The development impact projections of employed work force are compared with the corresponding baseline projection series (which, in turn, are compared with the baseline employed labor force projections). Again, the derived differences between the two projection series are measures of the regional impact of irrigated agriculture development. The baseline projection shows an increase in total employed work force from 90,037 to 102,697—an increase of 12,660 (table 5.4). This compares with an increase of 20,114 in the development projection series. The additional agricultural work force in the development projection series is due to the additional hired worker requirements of the more labor intensive form of agriculture assumed in the development options.

Table 5.4. Estimated and projected employed work force in specified major industry, West Minnesota, 1970 and 1985

No.	Title	55- Industry Code	Estimated 1970	Projected 1985	
				Baseline	Development
			(number)		
1.	Farm	1-12	21,701	15,711	20,175
2.	Mining	14-16	20	23	23
3.	Construction	17	3,854	4,589	4,807
4.	Manufacturing	18-38	8,633	9,412	9,890
5.	Trans., comm., util.	39-45	5,076	4,758	4,936
6.	Trade	46, 47	16,035	18,680	19,296
7.	Fin., ins., real est.	48	1,795	2,411	2,511
8.	Services	13, 49-52	13,797	17,458	18,186
9.	Government ¹	53-55	19,127	29,658	30,327
	Total		90,037	102,697	110,151

¹Includes private household workers.

PERSONAL INCOME

Changes in the agricultural economy and the level and mix of employment are manifested in corresponding changes in personal income. Included in personal income are (1) wages and salaries and other labor income and (2) property-type income. The latter includes proprietorial income, interest, rent, dividends and transfer payments. Most dramatic has been the recent impact of the agricultural economy on the personal income derived from farming by farm proprietors.

Farm Income

Total farm income is derived from farm marketing and, also, government payments and other income sources (table 6.1). Cash receipts from farm marketings totaled \$328,184,000 in 1970, of which 63.2 percent was derived from livestock. Livestock receipts were more important in the transitional area than the area of intensive cultivation. Only meat animal marketings were approximately equal in total value in the two areas. Crops, on the other hand, were a substantially more important source of income in the area of intensive cultivation than in the transitional area.

Crop price increases resulted in much higher farm incomes in recent years, especially 1973, than in 1970. However, the effects of the price increases were more pronounced in the intensive cultivation area than in the transitional area (table 6.2). During the 1970-73 period, net farm income increased by 363 percent in the west counties as compared to a 212 percent increase in the east counties.

The 1970 farm income levels are compared with 1967 to 1975 income levels to show the direction of change in the farm income components. In both areas, cash receipts from crop marketings increased more than cash receipts from livestock marketings, even before the sharp increases in crop prices in the post-1970 period.

Table 6.1. Estimated farm income and expenditures in specified area and county, West Minnesota, 1970

Area and County	Livestock				Crops					Government Payments	Non-money Income	Gross Income Total	Production Expenses Total	Net Income Total	Corporate Farm & PEA Adjustment	Net Income Farm Proprietors	
	Meat Animals	Dairy	Poultry	Total	Truck Crops and Melons	Fruits & Nuts	Greenhouse & Nurs. Prod.	Forestry Prod.	Other Field Crops								
(\$1,000)																	
Intensive Cultivation Area:																	
Big Stone	7,068	1,597	116	8,781	129	15	—	—	6,802	6,946	1,668	1,472	18,867	12,547	6,320	-152	6,168
Clay	5,255	2,315	699	8,269	362	2	94	15	29,495	29,495	3,620	3,698	45,555	30,389	15,166	-353	14,813
Grant	5,923	2,232	199	8,354	2	2	—	—	8,378	8,382	1,564	2,085	20,385	14,883	5,502	+ 59	5,561
Stevens	17,303	1,333	1,045	19,681	7	8	1	—	8,500	8,516	2,036	2,301	32,534	24,294	8,240	- 33	8,207
Swift	10,268	2,188	7,174	19,630	76	—	—	2	13,795	13,873	3,239	2,953	39,695	28,429	11,266	- 69	11,197
Traverse	3,819	723	361	4,903	—	—	—	—	9,886	9,886	1,737	1,746	18,272	13,477	4,795	+ 52	4,847
Wilkin	2,753	1,458	726	4,937	10	—	60	1	15,151	15,222	2,454	2,798	25,411	18,329	7,082	+ 68	7,150
Total	52,389	11,846	10,320	74,555	586	27	155	18	92,007	92,793	16,318	17,053	200,719	142,348	58,371	-428	57,943
Transitional Area:																	
Becker	6,368	5,357	3,927	15,652	109	20	94	72	5,785	6,080	1,044	2,387	25,123	18,240	6,883	+ 71	6,954
Douglas	6,782	9,585	782	17,149	1	5	7	9	3,111	3,133	971	2,671	23,924	16,804	7,120	+ 71	7,191
Hubbard	1,122	750	343	2,215	7	2	3	50	543	605	353	511	3,784	3,168	516	- 4	512
Otter Tail	17,527	21,219	7,669	46,415	39	26	53	50	10,198	10,366	2,526	5,745	65,052	45,822	19,230	+ 99	19,329
Pope	8,932	6,580	882	16,394	19	31	—	1	4,538	4,589	1,321	2,171	24,475	16,569	7,906	+ 43	7,949
Todd	9,305	14,541	2,046	25,892	9	19	7	25	2,375	2,435	2,435	2,852	32,392	22,314	10,078	+106	10,184
Wadena	2,628	3,327	3,208	9,163	5	23	—	32	688	748	489	789	11,189	8,206	2,983	- 20	2,963
Total	52,664	61,359	18,857	132,880	189	126	164	239	27,238	27,956	7,877	17,126	185,839	131,123	54,716	+366	55,082
Region	105,053	73,205	29,177	207,435	775	153	319	257	119,245	120,749	24,195	34,179	386,558	273,471	113,087	- 62	113,025
State																	

Table 6.2. Estimated farm income and expenditure for specified item, West Minnesota, 1967-1973

Item No.	Title	1967	1969	1970	1971	1972	1973	1974	1975
(\$1,000)									
Livestock									
1.	Dairy farm products	64,582	69,893	73,205	80,489	82,137	97,838	123,855	124,489
2.	Poultry and eggs	18,400	27,674	29,177	27,205	29,295	59,117	43,416	47,781
3.	Meat animals and misc.	97,183	106,621	105,053	110,578	124,040	168,500	141,918	150,646
	Total livestock	180,165	204,188	207,435	218,272	235,472	325,455	309,189	322,916
Crops:									
4.	Other field crops	86,423	98,771	119,245	125,339	135,725	349,924	411,583	268,918
5.	Truck crops and melons	1,092	828	775	806	949	1,061	1,470	1,594
6.	Fruit and nuts	43	127	153	149	188	215	361	313
7.	Greenhouse and forest prod.	616	551	319	555	644	791	763	716
	Total crops	88,174	100,277	120,749	127,849	137,506	351,991	414,177	271,541
	Total cash receipts	268,339	304,465	328,184	346,121	372,978	677,446	723,366	594,457
8.	Government payments	15,052	25,122	24,195	16,792	27,689	16,763	4,564	7,128
9.	Non-money income	28,775	22,156	34,179	29,364	31,421	38,241	43,290	51,146
	Gross Income	312,166	351,743	386,556	392,277	432,088	732,450	771,220	652,731
10.	Production Expenses	226,288	265,125	273,471	280,689	294,023	369,308	435,345	475,660
	Net Income	85,878	86,618	113,087	111,588	138,065	363,142	335,875	177,071
11.	Corporation farm & BEA adj.	-3,730	-248	-62	-2,665	2,298	-77,004	74	85
	Net Farm Income	82,148	86,370	113,025	108,923	140,363	286,138	335,949	177,156

Changes in the value of farm production cited in the preceding chapter are linked to corresponding changes in farm income. This linkage between production and income is the focus of the next chapter on development impact.

Total Income

A detailed presentation of the major sources of personal incomes is available from the Survey Current Business (table 6.3). For the two areas, the total farm income is nearly the same. As a percentage of total earnings, the dependence on agriculture is, of course, larger in the area of intensive cultivation. This area also derives a larger percentage of total personal income—nearly 10 percent—outside the area, namely, Cass County, North Dakota.

The estimates of farm income are different in the two tables because of differences in definition and, also, time of preparation of estimates. Net farm income in 1970 was estimated at \$173,025,000 while the total farm earnings was estimated at \$120,207,000—a difference of nearly \$7 million. For the 1969-1972 period, net farm income changed by 62.5 percent while total personal income changed by 30.7 percent. Because of a lower base-year the annual rate of change in total personal income was higher in the transitional area than in the area of intensive cultivation.

When total earnings are compared for the two areas in relation to total employment, further differences are observed between the two areas. Earnings per worker in agriculture are substantially lower in the transitional area. The lower earnings in the economic base are correlated with lower earnings in trade and service activities. The low per capita income levels noted earlier are derived from the well below-average earnings of the area work force.

Historically, therefore, the per capita income levels in the transitional area in the study region have been low in comparison to those in the area of intensive cultivation, apparently because of low earnings per worker in agriculture. Conversely, high earnings in agriculture, because of being diffused throughout local economy, are associated with high earnings in residential activities. Improvements in agricultural productivity thus lead to increases in total area income and, ultimately, to higher earnings per worker in almost all, if not all, local industries.

Projected total area income, represented by the value added by the 55 industry groups listed earlier, is more than 70 percent higher in 1985 than in the base year, 1970 (table 6.4). In the baseline option, total industry value added (which approximates the gross regional product of West Minnesota in this study) is \$667,342,000 more in 1985 than in 1970, while in the development option it is \$778,028,000 more in 1985 than in 1970—all in 1970 dollars.

Total earnings, namely, industry payments for labor services, including self employed income, are part of total value added. Hence, their projected total earnings levels approximate the increases in total value added. The annual increase in total earnings is the product of the annual increase in total employed work force and total earnings per worker. Both components of the increase in total earnings are projected to increase (as indicated by a comparison of table 5.4 and table 6.4).

Table 6.3. Estimated personal income in specified area and county, by major source, West Minnesota, 1972

4	Farm	Min- ing	Con- struc- tion	Manu- factur- ing	Trans., util.	Trade	F.I.	R.E.	Ser- vices	Government			Total Earn- ings by Place of Work	Less Pers. Con- tribu- tions	Plus Resi- dence adjust.	Net earn- ings by place of work	Plus Pro- perty income	Plus transfer payments	Total Personal Income
										Federal	State	Local							
Intensive Cultivation Area:																			
Big Stone	5.6	2/	.8	1.7 ^{3/}	.6	3.5	.5	1.8 ^{1/}	.6	.1	2.8	17.9	.6	-.2	17.1	4.9	4.4	26.3	
Clay	14.7	2/	11.4	10.5	11.7	22.4	3.1	16.7	1.5	.4	17.4	109.8	5.7	34.6	136.7	27.2	18.2	184.1	
Grant	5.7	2/	.2	.4 ^{3/}	.3	2.9	.6	2.3	.4	.1	2.5	15.4	.5	.7	15.6	4.5	4.4	24.4	
Stevens	7.4	2/	.6	1.9	.6	3.6	.8 ^{2/}	2.1	1.1	.2	8.2	26.5	.9	-.6	25.0	6.3	4.6	35.8	
Swift	9.1	2/	.6	4.8	.9	5.5	1.0	3.5 ^{2/}	.9	.2	4.1	30.7	1.1	.1	29.7	7.6	16.8	44.1	
Traverse	4.6	2/	.3	.1	.7	2.2	.5	1.2	.5	.1	2.5	12.7	.4	.1	12.4	4.2	3.4	20.0	
Wilkin	5.9	2/	1.0	.9 ^{3/}	.9	3.6	.5	2.5	.4	.1	2.4	18.2	.7	.3/	17.5	4.4	4.6	26.5	
Total	63.0	--	14.9	20.3	15.7	43.7	7.0	30.1 ^{2/}	5.4	5.4	44.9	231.2	9.9	34.7	256.0	59.1	46.4	361.2	
Transitional Area:																			
Becker	7.3	2/	2.5	5.4	4.5	7.6	1.1	7.3	1.8	.3	10.6	48.3	2.1	.7	46.9	10.7	13.4	71.0	
Douglas	8.7	2/	5.8	6.5	3.2	11.5	1.8	9.5	1.5	.3	7.8	56.4	2.5	-1.4	52.5	13.1	12.6	78.2	
Hubbard	.4	2/	1.2	1.3	.7	3.4	.7	3.0	.4	.1	3.9	15.1	.7	1.2	15.6	4.5	7.0	27.1	
Otter Tail	22.1	2/	5.7	12.2	12.2	15.3	2.7	14.3	2.7	.7	17.1	105.6	4.2	1.5	102.9	24.0	24.7	151.6	
Pope	9.3	2/	.9	1.3	.8	3.6	.6	4.2	.6	.1	3.4	25.0	.9	1.4	25.5	5.5	5.7	36.8	
Todd	11.9	2/	1.5	6.5	1.5	5.3	1.1	4.5	.9	.3	6.8	40.3	1.5	2.5	41.3	7.1	10.4	58.8	
Wadena	3.0	2/	1.5	2.2	1.5	7.4	.9	2.7	.6	.4	4.5	24.8	1.1	-1.1	22.6	5.1	6.8	34.4	
Total	62.7	--	19.1	35.4	24.4	54.1	8.9	45.5	8.5	2.1	54.1	315.5	13.0	4.8	307.3	49.0	51.9	457.9	
Region	125.7	--	34.0	55.7	40.1	97.8	15.9	75.6	13.9	3.3	99.0	546.7	22.9	39.5	563.3	108.1	98.3	819.1	

1/ U. S. Department of Commerce, Survey of Current Business, May 1974.

2/ Less than \$500,000.

3/ Estimated from other data sources.

Table 6.4. Estimated and projected value added and earnings (in 1970 dollars) in specified industry, baseline and development opinions, West Minnesota, 1970 and 1985

No.	Title	Estimated 1970		Projected 1985						
				Baseline			Development			
		Value Added	Total	Earnings Per Worker	Value Added	Total	Earnings Per Worker	Value A Added	Total	Earnings Per Worker
	(mil. dol.)	(mil. dol.)	(dol.)	(mil. dol.)	(mil. dol.)	(dol.)	(mil. dol.)	(mil. dol.)	(dol.)	
1.	Farm	143,456	69,584 ¹	3,206	279,418	113,839 ¹	7,246	330,722	119,789 ¹	5,937
2.	Mining	898	1,573	7,850	1,180	207	9,000	1,196	210	9,130
3.	Construction	68,858	43,234	11,218	109,272	68,609	14,951	114,480	71,878	14,953
4.	Manufacturing	102,518	54,046	6,260	168,468	90,187	9,582	178,207	94,544	9,560
5.	Trans., comm., util.	120,751	40,785	8,035	174,006	61,187	12,861	178,780	63,443	12,853
6.	Trade	180,959	74,989	4,677	297,144	123,138	6,592	307,382	127,380	6,601
7.	Fin., ins., real est.	66,378	10,142	5,650	110,994	16,959	7,034	124,634	17,666	7,035
8.	Services	124,597	62,428	4,525	218,792	110,515	6,330	229,758	115,117	6,330
9.	Government	136,915	101,356	3,418	253,398	195,188	6,602	258,199	200,119	6,599
	Total or average	945,330	456,721	5,073	1,612,672	780,433	7,599	1,723,358	810,146	7,355

¹Inventory adjustments and transfer payments are excluded from farm proprietor income. Agricultural services are included with Services.

AGRICULTURAL ECONOMY

Agriculture is the primary source of economic support for the study region. It is a dominant part of the economic base in both areas, although in the east it shares its dominance to an increasing extent with manufacturing and recreation-based trade and service industry. The basic role of agriculture in the total economy was discussed in the chapter on industry employment. In this chapter, the structure and performance of the agriculture industry is the focus of analysis and projection.

The agricultural economy of West Minnesota is presented in several parts. First, the use of land for dryland and irrigated crop production is examined. Next, total production of both crops and livestock is studied in the context of the trends and projections in cropland utilization. Finally, the differential impact of irrigated agriculture in the use of cropland and in total production is reviewed. Each of these topics is related subsequently to the discussion of direct and indirect impacts of agriculture-related community development.

Cropland

Total cropland in West Minnesota, as noted earlier, fluctuates year to year from a base-level of approximately 4.3 million acres. Of the approximately 5.7 million acres of land in farms 75 percent of the total is in cropland (table 7.1).

Total land in farms in West Minnesota peaked at 6.3 million acres in the mid-1950's. This total declined until 1973, when it turned around and then reached 6 million acres in 1975. Projected 1980 and 1985 levels are slightly below the 1975 level. The projected levels, although slightly higher than average for the 1970-74 period, decline slightly as a percentage of state totals—from 19.9 percent to 19.2 percent.

Total cropland has declined, also, in recent years. Projected levels show an increase, however, to 4.3 million acres. These increases are less than elsewhere in the state and, hence, the region drops in relative standing from an estimated 19.4 percent of the state total in 1974 to a projected 18.9 percent in 1985.

Introduction of sprinkler irrigation on the scale envisioned in the projections cited earlier (in Chapter 1) will trigger shifts in total cropland utilization. Expansion of irrigated agriculture will occur largely at the expense of dryland

Table 7.1. Estimated and projected land in farms, and cropland, West Minnesota, 1969-1985

Area & County	Land in Farms				Cropland			
	Estimated		Projected		Estimated		Projected	
	1969	1974	1980	1985	1969	1974	1980	1985
Intensive Cultivation Area:								
Big Stone	282,067	263,823	284,800	284,600	242,545	221,556	242,000	241,900
Clay	623,119	616,416	587,000	579,600	537,996	527,609	504,600	498,300
Grant	322,536	301,970	314,000	316,400	283,506	260,689	273,500	275,600
Stevens	336,320	314,792	333,200	334,300	301,923	274,603	294,900	295,900
Swift	433,709	406,588	426,900	427,900	376,893	343,275	265,700	366,600
Traverse	332,128	326,945	358,100	373,200	307,940	291,315	325,500	339,300
Wilkin	445,959	422,530	437,500	442,000	415,101	388,004	393,800	397,900
Total	2,775,838	2,653,064	2,741,500	2,758,000	2,465,904	2,307,051	2,400,000	2,415,500
Transitional Area:								
Becker	448,850	424,656	439,000	439,400	274,956	269,415	273,200	273,500
Douglas	346,576	312,723	326,700	322,700	249,108	224,333	234,600	231,700
Hubbard	134,044	126,269	128,700	127,300	59,128	61,290	59,600	59,000
Otter Tail	997,687	935,335	985,700	991,700	654,514	626,271	653,300	657,300
Pope	356,772	330,826	351,800	352,200	277,190	254,049	271,700	272,000
Todd	469,688	432,265	473,900	478,000	277,887	250,904	277,700	280,100
Wadena	191,534	196,673	205,500	218,400	98,044	99,239	104,400	111,000
Total	2,945,151	2,758,747	2,911,300	2,929,700	1,890,829	1,784,501	1,874,500	1,884,600
Region	5,720,989	5,411,811	5,652,800	5,687,700	4,356,733	4,091,552	4,274,500	4,300,100
State Total	28,845,240	27,455,774	29,055,700	29,559,500	22,311,500	2,056,069	22,378,700	22,766,700

agriculture and, hence, total cropland will be close to the projected levels shown in preceding tables. The geographic distribution of the total irrigated acreage thus determines the local effects of shifts in land utilization from dryland to irrigated agriculture.

Two series of estimates and projections of irrigated acreages have been prepared (table 7.2). First, the total irrigated acreage is presented by area and county. The total acreage is reduced, subsequently, by assumed diversion of total land area to non-cropland uses.

Both the U.S. Census of Agriculture and the DISC Study county estimates of total irrigated acreage are presented for comparison. As noted earlier, the U.S. Census of Agriculture estimates are uniformly lower than the DISC estimates because of the method of reporting specialty land uses.

Trends in the utilization of the total cropland in different crops vary between the two areas. In the area of intensive cultivation, the utilization of cropland for wheat, barley, and soybeans is projected to decline.

The U.S. Census of Agriculture was used in the preparation of the base-year estimates of all crops grown in the study region. (Crops included are those listed in the annual crop statistics reports from the U.S. Department of Agriculture.) The crop estimates show wheat, corn, oats, barley, and soybeans accounting for 77 percent of the cropland in 1974. Hay crops used another 15.2 percent of the total cropland. Most of the wheat, rye, corn (for grain), sorghum (for grain), sugar beets, dry beans, soybeans, flaxseed, and sunflower seed crops is in the area of intensive cultivation while most of the silage corn, oats, hay, and seed crops is in the transitional area. The differences in cropping patterns bring differences in livestock production, also. The latter are discussed in the next section on agricultural production.

Shifts in cropland acreages are projected for the study region in both dryland agriculture and irrigated agriculture (table 7.2). Two agricultural options are

presented—a baseline option and a development option. In the baseline option, 1975 levels of irrigate agriculture development are assumed. In the development option total cropland is shifted from dryland to irrigated agriculture within a specified crop category. Hence, the total cropland acreage represents the projected pattern of cropland utilization under either one of the development options.

Projected cropland utilization is based largely on the currently available studies of crop production in Minnesota.⁸ The projected acreages in the principal crops are derived directly from these studies. Historical relationships are used in the projected levels of minor crops.

Table 7.2. Estimated and projected acreage in specified cropland, by type of agriculture, West Minnesota, 1970-1985¹

No.	1/ Title	Total Cropland 2/				Irrigated Cropland			
		Estimated		Projected		Estimated		Projected	
		1970	1975	1980	1985	1970	1975	1980	1985
(acres)									
5.	Wheat	318,500	939,400	879,300	879,300	0	0	0	0
6.	Rye	34,500	22,200	18,539	18,881	0	0	0	0
8.	Corn	612,500	999,000	740,779	754,454	12,944	41,070	130,380	197,335
a.	Grain	420,100	790,100	566,325	566,325	12,944	41,070	130,380	197,335
b.	Silage	192,400	208,900	174,454	188,129	0	0	0	0
9.	Oats	1,009,100	533,000	741,450	741,450	0	0	0	0
10.	Barley	276,000	364,100	360,525	360,525	0	0	0	0
11.	Sorghum	4,020	3,654	3,051	3,107	0	0	0	0
a.	Grain	720	1,272	1,069	1,081	0	0	0	0
b.	Silage	3,300	2,382	1,989	2,026	0	0	0	0
13.	Fruit Trees	400	135	127	128	47	85	125	125
14.	Hay and Misc. Crops	714,857	705,173	590,530	601,238	9,177	27,433	80,615	121,604
a.	Potatoes	17,640	6,100	5,094	5,188	4,232	2,491	38,099	57,447
b.	Sugar beets	25,200	50,000	42,173	42,951	288	1,032	3,382	5,197
c.	Dry beans	4,020	10,560	8,819	8,982	1,123	3,753	10,492	15,846
d.	Vegetables	3,920	2,311	1,930	1,965	551	1,378	2,000	3,000
e.	Hay	843,800	619,100	517,014	526,559	3,043	8,779	26,642	40,114
(1)	Alfalfa	471,000	464,600	387,990	395,153	3,043	8,779	26,642	40,114
(2)	Other	172,800	154,500	129,024	131,403	0	0	0	0
f.	Seeds	20,277	16,602	15,500	15,593	0	0	0	0
15.	Oil Bearing	535,000	506,000	519,748	523,062	0	0	0	0
a.	Soybeans	335,400	291,000	340,200	340,200	0	0	0	0
b.	Flax seed	199,600	55,400	46,265	47,119	0	0	0	0
c.	Sunflower	6,700	159,600	133,283	135,743	0	0	0	0
Total Cropland Harvested		3,504,877	4,072,667	3,854,049	3,882,145	1,368	68,588	211,120	319,064
Cropland Not Harvested		723,832	505,445	420,451	417,955	946	12,712	8,367	12,721
Total Cropland		4,295,709	4,578,107	4,274,500	4,300,100	23,114	71,300	219,487	331,785

1/ Classification system is used for U.S. agricultural production. Missing crops are cotton (4), rice (7) and tobacco (12).

2/ Total cropland based on historical relationships. With irrigated cropland included, specified total cropland acreages are projected as follows:

	1980	1985
Potatoes	42,332	63,830
Dry beans	11,658	17,607
Vegetables	2,200	3,300
Cropland not harvested	380,104	349,353
Cropland harvested	3,894,396	3,950,747

For irrigated agriculture, the projected acreage distributions are acquired from the DISC Study. The projected acreages are based largely on personal knowledge of present practices in the utilization of irrigated cropland, given the commodity price relationships which existed in the year this study was initiated, namely, 1975.

⁸Michael Martin and Reynold Dahl, Grain Production Projections, by County and District, Minnesota, 1980 and 1985, Agricultural Experiment Station Bulletin 518, University of Minnesota, 1977.

Crop Production

Increases in both cropland acreages and yields per acre (non-irrigated) are incorporated in the projected crop expansion (table 7.3). The projected production increases are larger in the development option than the baseline option because of the large increases in cropland productivity under irrigated agriculture.

The baseline option incorporates the historical trends in crop productivity in the study region. Again, the previously cited sources are used in the derivation of the trend-based projections.

Table 7.3. Estimated and projected quantity produced of specified agriculture crops, by irrigation option, West Minnesota, 1970-1985

Crop No. ¹	Title	Unit	Estimated		Projected			
			1970	1975	Baseline Option		Development Option	
			(1,000 units)					
5.	Wheat	bu.	8,853	24,500	29,922	31,582	29,922	31,582
6.	Rye	bu.	1,064	568	556	566	556	566
8.	Corn							
a.	Grain	bu.	24,524	33,369	49,328	55,884	62,366	77,591
b.	Silage	ton	1,657	1,633	2,233	2,408	2,233	2,408
9.	Oats	bu.	50,092	24,270	27,200	29,256	27,200	29,256
10.	Barley	bu.	11,438	11,607	18,105	19,198	18,105	19,198
11.	Sorghum							
a.	Grain	bu.	29	39	38	38	38	38
b.	Silage	ton	23	17	14	14	14	14
13.	Fruit Trees	dol.	172	127	167	236	200	281
14.	Hay and Misc.							
a.	Potatoes	cwt.	1,852	1,172	1,210	1,350	14,397	21,859
b.	Sugar Beets	ton	390	717	590	623	634	701
c.	Dry Beans	cwt.	52	84	88	108	296	478
d.	Vegetables	dol.	447	393	436	554	972	1,630
e.	Hay	ton	1,382	1,418	1,190	1,251	1,270	1,423
(1)	Alfalfa	ton	1,152	1,199	1,009	1,067	1,089	1,187
(2)	Other	ton	230	219	181	184	181	184
f.	Seeds	cwt.	29,604	13,198	17,484	17,589	17,484	17,589
15.	Oil Bearing							
a.	Soybeans	bu.	5,430	5,961	6,081	6,106	6,081	6,106
b.	Flax Seed	bu.	2,271	658	560	575	560	575
c.	Sunflower	cwt.	578	1,504	1,308	1,386	1,308	1,386
16.	Other	dol.	649	1,127	1,366	1,486	1,366	1,486

¹Classification system is used for U.S. agricultural production. Missing crops are cotton (4), rice (7) and tobacco (12).

In the development option, yields per acre increase several-fold (over the baseline series) because of the availability of adequate water in the critical production period. Higher levels of fertilization and, hence, higher yields are feasible in this option than in the baseline option, especially on the higher, irrigated cropland.

For both baseline and development options, reported 1970 prices are used in the derivation of value of crop production. The constant prices are used to show changes in the quantity of production and, also, to convert dissimilar quantities into common monetary unity for economy-wide comparisons. The assumed price levels are consistent with the production practices associated with the projected levels of irrigation under the development option.

Crop production is shown for all cropland and, also, for irrigated cropland (table 7.4). The difference between total production under the baseline option and the development option is the result of the much higher productivity of cropland under irrigation. No interaction of the higher irrigated crop yields with dryland crop yields is assumed.

Livestock Production

Livestock production is concentrated in the transitional area. Meat animals which account for a major portion of total income in this sector in the study region, are less important than milk cows as an income source in the transitional area. Turkey production also is concentrated in the transitional area, accounting for more than 20 percent of the total number of turkeys sold in Minnesota in 1974.

Table 7.4. Estimated and projected value of production of specified agricultural crops, by irrigation option, West Minnesota, 1970-1985

Crop No. ¹	Title	Estimated		Projected			
		1970	1975	Baseline Option		Development Option	
		1980	1985	1980	1985	1980	1985
		(\$1,000)					
5.	Wheat	14,076	38,955	47,575	50,215	47,575	50,215
6.	Rye	1,043	557	545	555	545	555
8.	Corn						
a.	Grain	28,938	39,375	58,207	65,943	73,592	81,557
b.	Silage	12,709	12,525	17,127	18,469	17,127	18,469
9.	Oats	29,554	14,319	16,048	17,261	16,048	17,261
10.	Barley	10,637	10,795	16,838	17,854	16,838	17,854
11.	Sorghum						
a.	Grain	33	44	43	43	43	43
b.	Silage	122	90	74	74	74	74
13.	Fruit Trees	172	127	167	236	200	281
14.	Hay and Misc.						
a.	Potatoes	3,389	2,145	2,214	2,470	26,346	40,020
b.	Sugar beets	5,577	10,253	8,437	8,909	9,066	10,024
c.	Dry beans	333	538	533	691	1,899	3,059
d.	Vegetables	447	533	436	554	972	1,630
e.	Hay						
(1)	Alfalfa	27,187	28,296	23,812	25,181	25,698	28,021
(2)	Other	4,485	4,270	3,530	3,588	3,530	3,538
f.	Seeds	490	218	289	291	289	291
15.	Oil Bearing						
a.	Soybeans	15,150	16,631	16,966	17,036	16,966	17,036
b.	Flax seed	5,655	1,638	1,394	1,432	1,394	1,432
c.	Sunflower	2,865	6,933	6,030	6,389	6,030	6,389
16.	Other	649	1,127	1,366	1,486	1,366	1,486
	Total	163,344	189,369	221,661	238,677	265,598	309,235

¹Classification system is used for U.S. agricultural production. Missing crops are cotton (4), rice (7) and tobacco (12).

Estimated livestock on hand, January 1, 1974, shows further the underlying differences in livestock production patterns in the two areas of the study region. Dairy cows, for example, are nearly twice as numerous as beef cows in the transitional area, which is the opposite of the situation in the seven western counties. Because of the importance of dairying in the transitional area, other cattle and calves on hand are more numerous in this area, too. Cattle on feed, however, are more numerous in the western counties and, hence, the proportion of other cattle and calves in relation to the total number of dairy and beef cows is greater in the area of intensive cultivation.

Projections of future production of livestock and livestock products are derived in a series of steps anticipated in the preceding discussion. First, the numbers of livestock are determined for the projection period from historical relationships between livestock inventories and crop production. The livestock inventories noted earlier are estimated for 1970 and 1975—the two base years used in the derivation of the historical relationships. Livestock numbers are projected to increase under the irrigation development option because of the projected increase in corn and other feed grain production which is utilized in local livestock production.

Livestock yield data are used in converting livestock inventories into livestock and livestock products. The livestock data also show increasing yields per unit. Except for dairy production, both the inventory and yield series are increasing for the projection period. Again, 1970 production prices are used in converting the quantity of livestock and livestock products into corresponding value series.

The derived yield data, when multiplied by the projected levels of livestock, provide the estimates and projections of livestock outputs. Different production levels are shown under the two irrigation options because of projected differences in feed grain supplies. The increase in feed grain production from expanded irrigation agriculture is converted into a corresponding increase in livestock production.

The total value of production in the livestock sector of the agricultural economy in West Minnesota is shown in constant 1970 prices (table 7.5). Again, use of constant prices makes possible direct comparison of physical production levels over time and between irrigation development options.

Irrigated Agriculture

Expansion of sprinkler irrigation from the historical pre-1975 base of less than 100,000 acres to more than 300,000 acres by 1985 is based on the one critical assumption that the associated investment in irrigation facilities and know-how is perceived as being profitable. Meanwhile, the producer prices used in the several projection series are maintained at their 1970 levels so that the projected changes in agricultural production can be compared over the entire period from 1970 to 1985. Market-clearing prices are not projected. They are neither available nor appropriate for this analysis of the economic impacts of irrigation development.

Two obvious changes are indicated by the projected levels of agricultural production, namely, a large expansion in irrigated crop production and a less than equal reduction in dryland crop production due to conversion of dryland into irrigated cropland. Thus, total cropland output is projected to increase by \$49,072,000—from \$189,369,000 to \$238,441,000 (in 1970 dollars)—during the 1975-85 period (table 7.6). The added value of cropland output due to irrigation development is projected at \$65,811,000 (unadjusted).

Table 7.5. Estimated and projected value of production of livestock and livestock products (in constant 1970 prices), West Minnesota, 1970-1985

Livestock No. ¹	Title	Estimated		Projected			
		1970	1975	Baseline Option		Development Option	
		1980	1985	1980	1985	1980	1985
		(\$1,000)					
1	Dairy products						
a.	Value of product	73,205	72,165	70,127	74,823	70,127	74,823
b.	Milk production	73,205	72,165	70,127	74,823	70,127	74,823
2.	Poultry products						
a.	Value of product	29,177	35,378	33,367	36,172	36,574	40,917
b.	Egg production	6,147	5,238	5,884	6,410	7,138	7,914
c.	Broilers	413	440	410	425	497	525
d.	Turkeys	22,629	29,700	27,173	29,337	28,939	32,478
3.	Meat animals						
a.	Value of product	105,053	80,245	176,579	196,118	212,972	264,724
b.	Cattle of calves	74,162	53,949	140,103	165,418	177,132	220,371
c.	Hogs and pigs	29,193	25,086	27,861	30,170	35,225	43,823
d.	Sheep and lambs	1,698	1,210	615	530	615	530

Use of 1975 rather than 1970 prices would greatly increase the value of crop production. For estimation of irrigation development impacts, however, the use of constant prices, as noted earlier, is essential. Thus, the comparison of relative, rather than absolute, levels of output increases in constant dollars is the essential purpose of the analysis in this section of the report.

Livestock production increases are projected, also, for both baseline and the development options. The downward trend in livestock production from 1970 to 1975 is reversed in the 1975 to 1985 projections. This reversal in total value of production is due to three major considerations, namely, the upward movement of the livestock production cycles (which reached their low points in 1975), the downward pressure on crop prices (which, in 1975, were much higher than 1970) and the added local supplies of feed grains (which, in table 7.6, are assumed as being utilized locally). Again, comparison of the two production options in 1985 is the focus of the analysis.

The total value of the expanded livestock production over the 1975 to 1985 period is projected at \$99,678,000—from \$207,435,000 to \$307,113,000—in the baseline option. The added value of the livestock production due to irrigation is projected at \$76,326,000. Thus, a much larger relative increase is projected for livestock production than crop production because of the external conditions noted earlier. The added value of production due to irrigation, on the other hand, is approximately the same for both livestock production and crop production. These calculations are based, however, on the assumption that the additional feed grains from irrigated cropland will be utilized locally for livestock feeding.

Table 7.7. Estimated and projected value of gross output (1970 dollars) in specified industry group, by development option, West Minnesota, 1970-1985¹

Industry		Estimated 1970		Projected 1985			
		Unadjusted	Adjusted	Baseline		Development	
No.	Title			Unadjusted	Adjusted	Unadjusted	Adjusted
1.	Dairy farm prod. (1)	73,205	73,206	74,823	73,206	74,823	75,167
2.	Poultry and eggs (2)	29,177	29,077	36,172	34,972	43,892	43,291
3.	Meat animals (3)	105,053	105,033	196,118	192,028	264,724	260,949
4.	Wheat (5)	14,076	20,098	50,215	56,353	50,215	53,545
5.	Other food grains (6)	1,043	1,000	555	523	555	582
6.	Corn (8)	41,647	53,267	84,412	79,703	73,949	74,613
7.	Other feed grains (9, 10, 11)	40,346	54,133	35,232	37,975	35,232	48,199
8.	Oil-bearing crops (15)	23,470	20,497	24,857	26,871	24,857	25,214
9.	Specialty crops (14 a, b, c, d)	9,746	9,123	12,624	13,913	11,541	10,984
10.	Irrigated corn (8)	0 ²	0 ²	0 ²	0 ²	36,096	36,658
11.	Other irrigated (13, 14)	0 ³	0 ³	0 ³	0 ³	48,752	45,973
12.	Other crops (13, 14e, f, 16)	32,811	60,908	30,546	48,746	23,058	35,750
Total		370,779	426,462	545,554	564,390	687,691	710,925

¹Crop and livestock sectors (shown in parentheses) are regrouped into a standard industry classification system for use in the West Minnesota input-output model.

²Value of irrigated corn is included with Industry No. 8 (corn) in baseline option.

³Value of other irrigated crops is included with Industry No. 9 (specialty crops) in baseline option.

Related effects of a progressive agricultural economy are obvious, especially in terms of expanded average size of farm and reduced numbers of full-time farmers. Agricultural land values, for example, will increase, especially in the areas of rapid expansion of irrigated agriculture. These, and other impacts of irrigated agriculture, are discussed further in the economic forecast.

The projected 1985 (unadjusted) agricultural production levels in this chapter are used in an initial calibration of the computer program for the baseline and the development options in the economic forecast. They differ from the final (adjusted) series because of their lack of internal consistency. The computer simulation model provides for this consistency in its forecasting procedures.



