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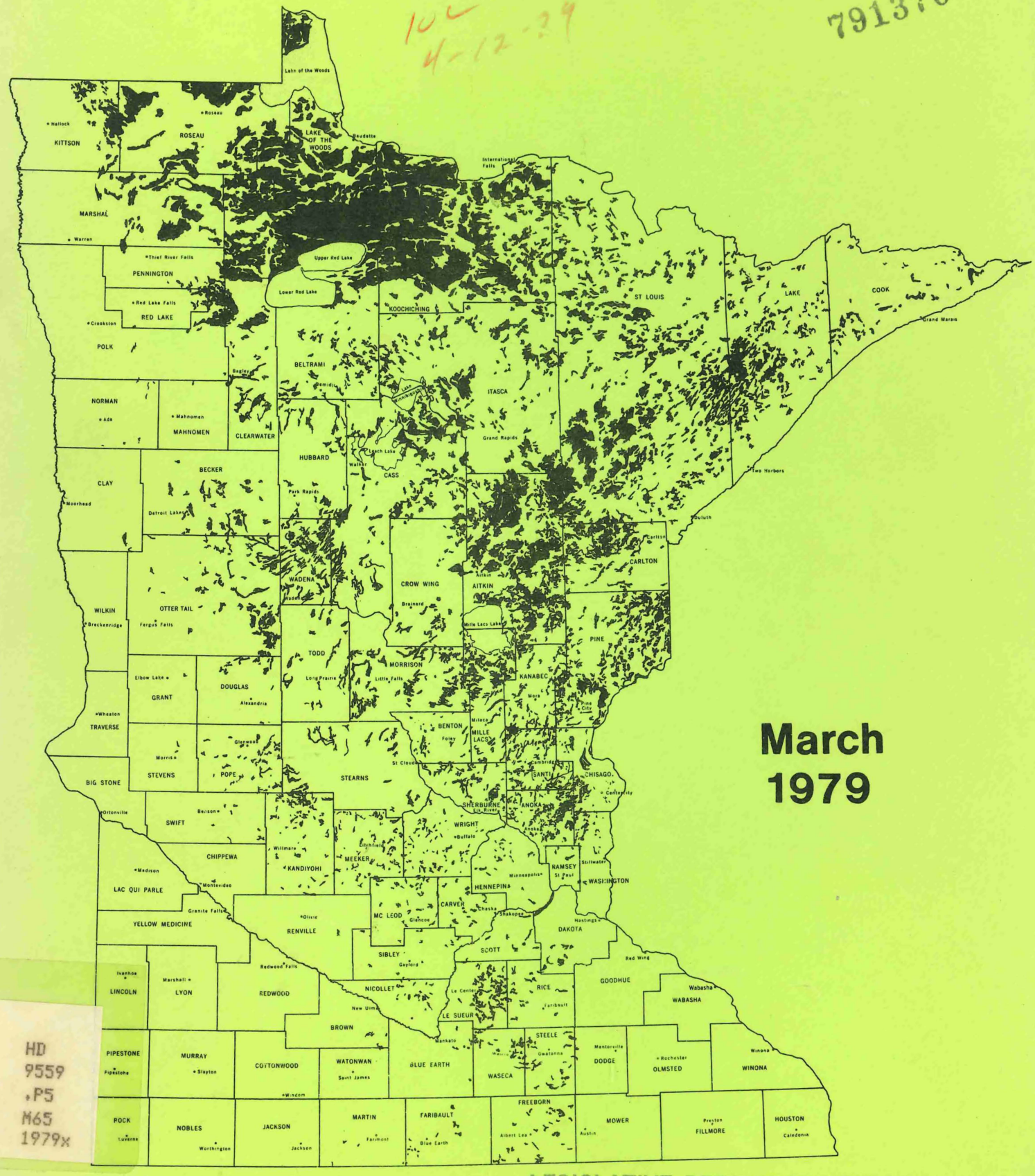

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SOCIO-ECONOMIC EFFECTS OF PEAT RESOURCE DEVELOPMENT IN NORTHERN MINNESOTA

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Report prepared for Phase II Peat Program,
Minnesota Department of Natural Resources

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ABSTRACT

Economic effects of peat land development in northern Minnesota and Douglas County, Wisconsin are identified and assessed in this report. An eight-county study region is delineated for the study of local population, employment and income changes which can be associated with a given pattern of commercial peat land utilization. Regional economic impact forecasts are presented for the Study Region which cover a three-year construction period and a 15-year operation period. Two peat development scenarios are identified and compared with a baseline forecast series without peat land development. Related demographic and economic data are presented, finally, for the 19 counties in three sub-state development regions in northern Minnesota where future peat land development is most likely to occur.

SUMMARY AND CONCLUSIONS

Peat land development effects are measured by changes in local population, and industry gross output, employment, value added, and earnings. This study was focused on peat land development for five peat related industries -- agriculture, synthetic gas (and chemical) production, synthetic gas distribution, peat coke production, and peat mining. One economically viable example of each was included in a composite development scenario assumed to begin in 1985. Potential impacts from this scenario are projected using the Minnesota Regional Development Simulation Laboratory -- SIMLAB.

Forecasts under the composite peat development scenario show a local population increase of about 18,700 persons in the early years of development. At the same time, gross output would increase by $529,400,000 (in 1970 dollars), employment would increase about 12,400 persons, and earnings from wages, salaries and proprietorial income would increase about $95,650,000. In addition, this scenario would also have a significant supportive or sustaining effect on the local economy should there be a downturn in this economy toward the end of the century.

In the second scenario, fuel gas from peat is substituted for natural gas. Under the very narrow and specific assumptions explained in this report, no decline in study area employment stemming from higher energy costs was forecast by SIMLAB. However, this conclusion must be viewed as tentative until more complete information on how study area gas users would adjust to higher prices becomes available.

In demonstrating these results, this study has exhausted available information. Yet, many information gaps remain. In particular, more complete information is needed on peat extraction and drying procedures and the labor force needed to do this. In addition, specific information is needed on the location of the proposed peat gasification plant. This is particularly important because some socio-economic impacts from gasification may spill outside the eight-county Study Region into Beltrami County, and to Bemidji, if the plant is located very near the western edge of Koochiching County, or in Beltrami County. If the plant is actually located in Beltrami County, the Study Region must be expanded to include the larger impact area. The geographic incidence of these impacts would change. Their magnitude, however, would be very nearly the same as those reported here.

More place-specific information is needed to evaluate impacts on the demand for roads, utilities, schools, and other public services. Available information does not make this possible. Increased demand for services would have important implications for local public finances that should be addressed in any further work.

In this report, a start in providing the additional place-specific information is made in the analysis of population, industry employment, personal income, agricultural production, and local government trends in the 19-counties in the three substate development regions of northern Minnesota. The supplementary information provides a factual basis for extending the detailed industry findings from SIMLAB to other potential peat land development areas in the extended 19-county region.

CONTENT

SOCIO-ECONOMIC EFFECTS OF PEAT RESOURCE DEVELOPMENT IN NORTHERN MINNESOTA

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Study of socio-economic effects of peat resource development is concerned with changes in employment, income and population resulting from peat-related development. Baseline and development projection series are used to show the scope and level of impact associated with this development. The development impact region extends over much of northern Minnesota.

Seven specific peat land areas are identified in the Phase II Peat Program (fig. 1.1). These seven areas are in five counties which lie in three planning regions. However, detailed analysis of peat resource development is confined to the eight-county Northeast Minnesota-Douglas County, Wisconsin Study Region. The Study Region contains significant quantities of peat with the most potential for development.

Northern Minnesota Economy

The northern Minnesota peat deposits occur in much of the area extending from the Red River Valley to Duluth, Minnesota and the North Shore of Lake Superior. In the east, timber, taconite and tourism constitute the economic base of the region. In the west, however, agriculture is

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1/ The authors gratefully acknowledge the assistance of Mason Chen in the computer programming and Mary Porto and Mike Scipioni in the data preparation.

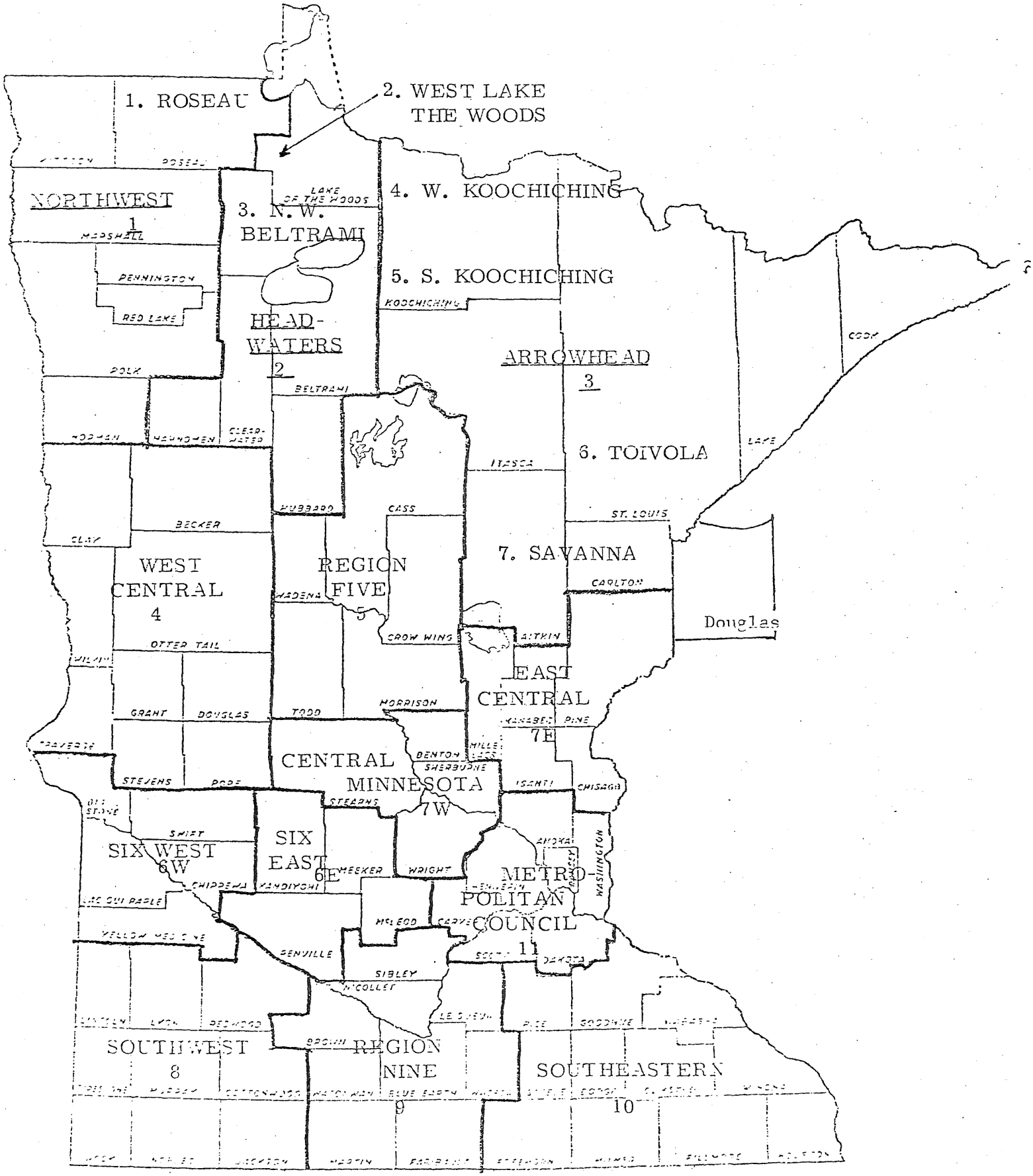

Fig. 1.1. Substate Planning and Development Districts, and Selected Peat Land Development Areas, Minnesota, 1978.

dominant. Much of the economy in the region is dependent, therefore, on primary resource development -- agriculture, mining and timber production.

The degree of urbanization in northern Minnesota varies widely, with the highest concentration of urban population associated with the mining and metropolitan development in St. Louis County (table 1.1). Detailed analysis in this report is confined to the eight-county Northeast Minnesota and Douglas County, Wisconsin Study Region, which is the most populated part of the extended region.

Population concentration is coupled with industry concentration, which, together, enhance a potential market for the products of peat land development. This development would have significant impacts on existing social and economic conditions near both the producing and the consuming sites.

Preliminary analysis indicates that most peat land development would occur within the eight-county Study Region. This Region includes extensive areas of peat land, especially in Koochiching and Aitkin counties. Businesses which sell equipment, parts, supplies, and services to the taconite industry already are located in Virginia, Hibbing, Ely, and other places in the Study Region. Should peat land development occur, it is very likely that the existing Study Region infrastructure, which is developed to serve one extractive industry, would be easily extended to serve the peat industry. The Study Region also includes the Duluth-Superior metropolitan area, which is a potential market for peat products and serves as a base for retailing, service, and other industries which may be affected

Table 1.1. Estimated total population in specified county and planning region, northern Minnesota and Douglas County, Wisconsin, 1970

	Urban				Rural				
					Nonfarm				
	2,500 to 9,999	10,000 to 24,999	25,000 and over	Total	Incorporated Places	Other	Farm	Total Rural	Total
					(number)				
orthwest Region:									
Kittson	-----	-----	-----	-----	3,789	752	2,312	6,853	6,853
Marshall	-----	-----	-----	-----	5,587	1,446	6,027	13,060	13,060
Norman	-----	-----	-----	-----	4,655	945	4,408	10,008	10,008
Pennington	8,444	-----	-----	8,444	481	1,238	3,103	4,822	13,266
Polk	15,951	-----	-----	15,951	5,344	4,041	9,099	18,484	34,435
Red Lake	-----	-----	-----	-----	2,724	98	2,566	5,388	5,388
Roseau	2,552	-----	-----	2,552	2,335	1,927	4,755	9,017	11,569
egional Total	26,947	0	0	26,947	24,915	10,447	32,270	67,632	94,579
leadwaters Region:									
Beltrami	-----	11,457	-----	11,457	1,306	8,495	5,115	14,916	26,373
Clearwater	-----	-----	-----	-----	2,495	2,382	3,136	8,013	8,013
Hubbard	2,772	-----	-----	2,772	622	4,803	2,386	7,881	10,583
Lake of the Woods	-----	-----	-----	-----	1,767	1,191	1,029	2,987	3,987
Mahnomen	-----	-----	-----	-----	1,815	869	2,954	5,038	5,638
egional Total	2,772	11,457	0	14,229	8,005	17,740	14,620	40,365	54,594
rrowhead Region:									
Aitkin	-----	-----	-----	-----	2,560	5,427	3,416	11,403	11,403
Carlton	8,827	-----	-----	8,827	4,590	11,037	3,618	19,245	28,072
Cook	-----	-----	-----	-----	1,301	1,401	721	3,423	3,423
Itasco	7,247	-----	-----	7,247	5,606	19,446	3,231	28,283	35,530
Koochiching	6,452	-----	-----	6,452	4,442	5,047	1,190	10,679	17,131
Lake	7,855	-----	-----	7,855	362	4,647	587	5,496	13,351
St. Louis	29,608	28,554	100,578	158,740	13,648	41,885	6,420	61,953	220,693
egional Total	59,989	28,554	100,578	189,121	32,509	88,890	19,083	140,482	329,603
OTAL, northern MN	89,708	40,011	100,578	230,297	65,429	117,077	65,973	248,479	478,776
Douglas County, WI	0	0	32,237	32,237	11,101		1,319	12,420	44,657

by peat land development. Finally, the taconite industry is a heavy energy user which may seek an alternative energy source, such as peat, in the event that natural gas supplies are curtailed.[2/]

About 3,350,000 acres of peat land are located in the Study Region with about 1,150,000 acres, or one-third, being located in Koochiching County. Of this total, about 20,000 acres are already developed, with 14,000 acres located in Aitkin County. Nearly all the developed acres are in agricultural production, with about 10,000 acres in hay, 2,500 in grain, and the rest in wild rice. Some acreage is also devoted to peat extraction for horticultural purposes, principally at one site near Cromwell in Carlton County.

Peat Land Development Potential

A search of available literature and expert consultation reveals that future peat land development options fall into only five different industry groups. The industry groups are agriculture, chemical production, including synthetic natural gas, synthetic gas distribution, peat coke production, and peat mining.

In the agricultural sector, peat land development refers to its use in crop production, potentially for cold season crops such as spinach, brocolli, carrots, celery, cabbage, and in production of forage grasses, and grain. This activity requires initial investment in land clearing and drainage and subsequent expenditures to sustain crop production. Aitkin

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2/ Tom Alexander, "New Fears Surround the Shift to Coal", Fortune, 93(10), November 20, 1978, 50-60.

County is the most likely location for agricultural development because of the large amount of peat land which is already served by a well-developed road network. It is assumed that mostly hay and, possibly, feed grains would be produced on the new peat land. These two activities already use about 12,500 acres of the 20,000 acres of peat land devoted to agriculture (with hay accounting for about 10,000 acres). Expanding production of these crops would make possible expansion of the local livestock industry.

Other possibilities for peat land agricultural production seem less likely than those already identified. Wild rice could be produced, but sustained access to mass markets remains uncertain. Peat land development may result in expansion for horticultural purposes, primarily soil improvement by the home gardener. This market is likely to be limited because of low per capita use, and because of high transportation costs of the bulky product. For these reasons, the existing and potential impacts due to wild rice production and horticulture are minimal and, hence, are not considered here.

In the industrial sector, peat development may take the form of industrial chemcial production, including "... activated carbon for waste water filtration, coke for metallurgical purposes, and chemicals such as furfural, humic ACIDS, and, phenols and alcohol", as reported in testimony presented before the Minnesota Legislature.[3/] No Minnesota peat land is

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3/ Minnesota Department of Natural Resources Peat Program: Testimony presented to the Senate Natural Resources and Agricultural Committee, October 12, 1977.

used currently for production of industrial chemicals. Production of coke for metallurgical purposes in one option inasmuch as it may become economically attractive should an anticipated shortage of metallurgical coal develop in the 1980's.[4/]

Other industrial uses appear less likely.[5/] Peat-sand filters are currently used in Minnesota for filtration of sewage effluent from campgrounds and wayside rest stops. Peat is also used as an oil absorbent medium for controlling oil spills. The potential peat land development for production of environmental products is unknown or, at best, small because of the availability of other products. For these reaons, environmental uses for peat products also are not given further consideration here.

Peat land development may occur as a result of the use of peat in energy production. Peat may be burned directly or it may be gasified into a fuel gas which is usually referred to as "synthetic natural gas", a terminology used in this report even though it is a contradiction in terms. Peat fired plants have been built in Finland to produce heat and electricity. Gasification of peat is less well-developed than direct burning. Although both types of energy-related peat resource development are technically feasible, this report focuses on peat gasification. This option is being actively considered in Minnesota in the face of possible natural gas

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4/ "A Smoldering Crisis in Coke", Business Week, Number 2561, November 20, 1978, 73-76.

5/ An excellent survey of existing and technically feasible uses for peat in chemical production is Charles H. Fuchsman, The Industrial Chemical Technology of Peat, Bemidji State University, Bemidji, Minnesota, submitted to the Minnesota Department of Natural Resources, February, 1978.

shortages.[6] Should peat gasification occur, utilities would distribute the gas to users within Minnesota and elsewhere. For this reason, the impacts of distribution and use of the synthetic gas are also considered in this report.

Finally, peat utilization for industrial chemicals and/or for gasification will necessarily involve peat mining. Although peat has been mined for centuries in Europe, foreign mining techniques are not likely to be used in Minnesota. These techniques require much labor and, hence, are extremely costly. At present, very little is certain about the best peat mining method to use in Minnesota. Hence, the peat mining cost and employment estimates presented in the next chapter of this report are tentative and subject to further revision.

In summary, prospects of peat land development for agricultural purposes are high in Aitkin County. Also peat coke and synthetic natural gas may be produced from peat. Some, or all, of the gas used by local industries and/or residents may eventually be derived from peat. Peat coke and gas production will necessarily require extraction or mining of peat. The vast tracts of peat land in Koochiching County are a particularly likely location for some or all of this mining activity. In the next chapter, scenarios concerning these potential uses of peat are presented as the next step toward estimation of peat land development impacts.

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[6] Private communication from Mr. A.M. Rader, Minnesota Gas Company, 1978.

Study Objectives

For the entire area of study in northern Minnesota, the primary study objective is to assess the socio-economic effects of peat land development. The capability for impact analysis is provided by a regional impact simulation and forecasting model called SIMLAB (an acronym for the Minnesota Regional Development Simulation Laboratory). Direct, indirect and induced effects of peat land development are derived with SIMLAB for one part of the larger study area.

Direct effects are changes in the volume of production, employment, and earnings experienced by local businesses which furnish supplies, materials, and services to peat-related industry. Other local business firms are indirectly affected if they furnish goods and services to those directly affected. Household spending of income received from the peat-related activity results in the induced effects on the local economy. Local population may increase through migration in response to job opportunities created by these direct, indirect, and induced effects.

The varied effects of development, or existing industry expansion and contraction, are traced quantitatively in SIMLAB. In this process, monetary calculations and projections are made in 1970 dollars. Real changes in income and output resulting from peat land development can then be compared.[7/]

7/ Further details on how SIMLAB works can be found in the Appendix.

A series of assumptions are delineated for this study. First the qualitative assumptions pertaining to the nature of peat land development are defined. Second, quantitative assumptions as to levels of potential peat land development in the Study Region are established. Third, baseline forecasts are prepared which show projected levels of population, employment, income and production without peat land development. Fourth, a series of peat land development forecasts are prepared to compare with the baseline forecasts. The impacts of peat land development are then measured as the difference between baseline and development projection of socio-economic indicators such as population, employment, and income. Finally, a series of chapters document the details of the procedures and data used in the socio-economic impact forecasting and simulation of peat development impacts.

The plan of the study report is to present, first, the economic forecast for the primary Study Region -- the eight-county Northeast Minnesota and Douglas County, Wisconsin Study Region. Next, the procedures and data used in the socio-economic impact forecasting and simulation are presented. The documentation includes a background discussion of population and labor force trends and projections for the extended Study Region -- the 19 counties in the three Minnesota planning regions. Industry employment and personal income trends are presented, also, along with basic data used in implementing the regional economic impact forecasting and simulation system. The agricultural economy, including production and income sources, is examined, next. Peat land development issues

are related to both the agricultural and nonagricultural industries in the 19-county Study Region. Finally, data showing local government income and expenditure trends and projections are included. These data provide a factual basis for relating the regional peat land development impacts to local government fiscal conditions within each substate development region.

ECONOMIC FORECAST

An economic forecast of the primary Study Region is presented at this time to show the total areawide effects of peat resource development in northern Minnesota. The focus here is on the total economic effects of the five development potentials. Economic effects are represented by the level and distribution of (1) gross product and income, (2) employment and unemployment, and (3) labor force and population. They are measured in terms of projected changes in the level of each of the principal economic indicators.

A key variable in measuring economic impact is the increase in industry output associated with the five peat development options cited earlier. Given these options, 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 eight-county Study Region. By confining the study of the economic effects of peat development to this Study Region, the data base for the recently completed copper-nickel study report can be utilized for the peat study, too. Thus, the combined total effects of both peat development and copper-nickel development can be assessed.[8/]

Data representing each of the topical areas identified in the preceding chapter are organized systematically for use in the computer model. This model is user-interactive. It is programmed to follow the instructions received from the user-operator. No special programming language is

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8/ In the presentation of study findings, however, the effects of copper-nickel development are omitted.

needed in performing the computer simulations of the Study Region economy under the two sets of assumptions.[9/]

Presented in this chapter is the unfolding of the economic implications of peat development in the eight-county Study Region. First, an overview of projected changes in the Study Region economy is presented by comparison of estimated 1970 and projected 2000 levels of selected economic indicators. Second, the historical and the projected base year levels of an expanded series of economic indicators are presented as reference levels for the determination of development impacts. Third, the transition of the Study Region economy from 1970 to 1985 and 1985 to 2000 levels of economic activity is presented, again, in terms of a few significant economic indicators. Finally, the projected regional economic effects of peat development are derived and their implications for regional well-being are discussed.

Overview of Peat Development

An overall, eight-county Study Region perspective on total development impact is presented, first, in a comparison of 1970 and 2000 data on output, input and employment (table 2.1). While the development increment is projected only for the 1985-2000 period, the baseline option is projected for the 30-year period, 1970 to 2000, for comparison with the historical base

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9/ A user manuel is available for a user-prepared computer simulation of alternative development options.

Table 2.1. Projected change in gross output and value added (in 1970 dollars) and total employment in specified industry, baseline change and development increment, Northern Minnesota and Douglas County, Wisconsin, 1970-2000.

No.	Title	Gross Output		Value Added		Total Employment	
		Baseline Change ($1,000)	Development Increment ($1,000)	Baseline Change ($1,000)	Development Increment ($1,000)	Baseline Change (no.)	Development Increment (no.)
1.	Livestock	30,137	4,150	8,944	1,232	-1,472	51
2.	Other ag.	14,464	1,564	7,145	764	-969	23
3.	Peatland a	0	9,015	0	5,091	0	102
4.	Ag. for fis	17,138	588	10,407	357	582	22
5.	Iron ore	454,480	208	254,327	117	-22	0
6.	Other meto	1,279	55	781	34	-46	1
7.	Copper ore	0	0	0	0	0	0
8.	Mnc pperop	0	0	0	0	0	0
9.	Mnc pperug	0	0	0	0	0	0
10.	Nonmetalni	4,630	194	2,643	111	-13	12
11.	Peat Minin	0	65,098	0	41,041	0	1,161
12.	Constructn	180,972	24,596	76,529	10,401	1,141	465
13.	Food kindrd	183,203	29,163	53,449	8,509	19	234
14.	Apparel	19,431	10,796	8,154	4,530	168	286
15.	Logging	54,678	90	24,524	40	-228	1
16.	Wood prod	43,812	64	19,255	28	293	1
17.	Paper prod	278,261	5,824	117,835	2,466	2,923	105
18.	Printing	25,506	7,016	12,739	3,054	378	254
19.	Chemicals	3,938	1,971	1,485	744	-55	23
20.	Peat chem	0	217,339	0	112,236	0	1,308
21.	Peat coke	0	3,719	0	1,647	0	31
22.	Petroleum	-8,997	2,608	-2,467	715	-198	14
23.	Rubber plas	2,355	413	1,125	198	-33	8
24.	Stone clay	13,257	-398	6,019	181	453	-19
25.	Iron metal	10,636	4,394	4,709	1,945	1,372	77
26.	Copper met	0	0	0	0	0	0
27.	Copper rol	0	0	0	0	0	0
28.	Other metal	2,835	2,369	1,070	895	-19	17
29.	Metal fab	27,302	1,540	12,136	684	645	50
30.	Machinery	12,744	5,086	33,192	2,927	281	74
31.	Elec mach	22,247	5,936	11,680	3,166	-23	42
32.	Mis manuf	33,923	5,447	15,419	2,476	151	56

year, 1970. Gross output is projected to increase by more than $2.6 billion -- from $2.9 billion to $5.6 billion in the baseline option. This option is used as a standard of comparison for the peat development option. Thus, the difference between the baseline option and the development option of $868,876,000 in gross output (see Col. 2, table 2.1) is the first measure of total peat development impact (without copper-nickel development).

An alternative measure of development impact is given in the increase in value added by primary inputs which are 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 Study Region. For the 1985 to 2000 period, this measure shows a peat development increment of $383,080,000 over the baseline increase of $1,385,833 (see, cols. 3 and 4, table 2.1).

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 peat 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, indirect, and induced) development impact on employment is given by the difference of 18,243 in the employment increases for the two options (see, col. 6, table 2.1).

Peat Lands in Transition

A computer simulation of the growth of the eight-county Study Region economy from 1970 to 2000 provides the next series of summary statements on the total development impact. Year-to-year changes in population, employment, gross output, personal consumption expenditures and per capita income are summarized for the Study Region. A composite development scenario is presented which starts with peat-related construction in 1982 and peat-related production in 1985.

Composite Development Scenario

In the composite development scenario, all industry activity -- peat land crop production, peat gasification and distribution, peat coke production, and peat mining -- starts simultaneously in 1985. The initial levels of industry gross output are below those attained in later years.

Projected growth in industry output occurs for different reasons in different industries. Peat land agricultural production is linked to the production of livestock products which, in turn, is linked to the level of personal consumption expenditures. As study area earnings and consumer expenditures rise, consumption of livestock products rises and, with it, peat land agricultural production. Similarly peat mining output is linked to output of synthetic gas and chemical by-products and to production of peat coke. As the production of these goods increases, so does peat mining output. Synthetic gas and chemical by-products output are allowed to increase at about 0.8 percent per year, a rate chosen to represent efficiency improvements in the gas and coke plants as old equipment wears out and new, improved, equipment replaces it. Peat mining output also

increases quite as fast because, presumably, peat utilization would become more efficient over time. The volume of synthetic gas delivered by the gas utility is allowed to increase slowly because of efficiency improvements. Similar assumptions concerning efficiency, which are derived from published sources[10/] are built into each of the 55 industries in the study area SIMLAB model. All these assumptions concern changes in the productive efficiency of labor. Employment is steady or slowly declining as production grows, except in the case of the peat coke industry. In this industry labor efficiency is allowed to decline with increasing industry output because of assumed effects of environmental and occupational safety and health problems. These could beset the synthetic gas plant as well but it is assumed that this very large operation will have the financial resources to overcome them and improve labor productivity at the same time, an option not always open to small industry.

Earnings are also projected to increase except in peat land agriculture where the employment declines. Worker productivity increases wipe out the effects of increasing earnings per worker. Projected increases in

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10/ U.S. Department of Commerce, Summary Input-Output Tables of the U.S. Economy, Op. Cit., and U.S. Department of Labor, The Structure of the U.S. Economy in 1980 and 1985, op. cit.

earnings per worker by industry used in SIMLAB are from published sources.[11/]

Peat Land Development Effects

In deriving the peat land development effects, a baseline option is prepared, starting with the 1970 base year and calibrated for the 1970-75 base period (table 2.2). This option is derived from the baseline projections presented in later chapters (and in the preceding section of this chapter.

Industry gross output is derived, next, given the interindustry structure and projected exports, personal consumption expenditures and other fianl demand components. In the baseline projection series, industry gross output nearly doubles, from $2.9 billion to $5.6 billion, in the period from 1970 to 2000. This accounts, in part, for the increasing levels of personal income and personal consumption expenditures. In turn, the output increases are due to increasing levels of employment and output per worker.

The development projection series follows the growth trends of the

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11/ Estimates of regional earnings per worker are their National counterparts calculated from earnings data in U.S. Water Resources Council, 1972 OBERS Projections, Regional Economic Activity in the U.S. Volume 1, Washington, D.C., April 1974. Employment data is from U.S. Department of Labor, Bureau of Labor Statistics, The Structure of the U.S. Economy in 1980 and 1985, op. cit. These estimates are then adjusted upward or downward to correspond to regional earnings data supplied by the U.S. Department of Commerce, Regional Economic Information Service.

Table 2.2. Selected baseline and development indicators, northeast Minnesota and Douglas County, Wisconsin, 1970-2000.

Year	Gross Output		Pers Cons. Exp.		Income per Person		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	2,923	2,923	629	629	2,288	2,288	135.0	135.0	375	375
1982*	3,988	4,119	856	856	3,520	3,464	164.8	168.2	360	366
1983*	4,106	4,296	888	903	3,619	3,672	169.2	175.0	364	374
1984*	4,225	4,455	930	995	3,710	3,788	173.7	181.9	369	384
1985	4,351	4,944	981	1,081	3,780	3,913	178.8	190.4	377	389
1986	4,485	5,114	1,035	1,140	3,894	3,950	181.0	193.1	379	398
1987	4,619	5,325	1,072	1,195	3,925	3,985	183.0	196.9	383	404
1988	4,722	5,454	1,091	1,235	3,973	4,053	183.4	198.5	384	406
1989	4,803	5,552	1,104	1,259	4,018	4,112	183.2	198.9	384	407
1990	4,889	5,659	1,116	1,284	4,072	4,167	182.1	198.5	382	407
1991	4,968	5,755	1,121	1,300	4,135	4,233	180.4	197.5	379	405
1992	5,044	5,845	1,119	1,307	4,199	4,301	178.4	195.9	375	402
1993	5,123	5,937	1,111	1,306	4,267	4,370	176.3	194.3	370	397
1994	5,205	6,028	1,099	1,300	4,341	4,447	174.5	192.6	364	393
1995	5,275	6,122	1,087	1,291	4,428	4,527	172.0	191.0	359	387
1996	5,337	6,194	1,074	1,281	4,510	4,042	169.1	188.2	352	381
1997	5,399	6,261	1,053	1,267	4,593	4,705	166.0	185.1	344	374
1998	5,453	6,320	1,027	1,243	4,688	4,795	162.5	181.5	336	366
1999	5,505	6,374	998	1,213	4,788	4,889	158.9	177.6	327	357
2000	5,552	6,421	965	1,177	4,895	4,988	155.1	173.4	317	348
Total Increase 1970-2000(pct.)	90	120	53	87	57	118	15	28	-15	-7

* Construction period.

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

Projected peat land development is associated with increasing levels of industry output and employment which sustain overall economic growth in the eight-county Study Region through the entire projection period, except for the employed work force. The employed work force in the development option is projected to reach its peak level in 1996. With peat land development, population and employment levels in the Study Region reach peak levels in 1988 while personal consumption expenditures are projected to peak in 1991. In the development option, the projected down-turn in economic activity is delayed 5 to 10 years and the rate of decline is slowed from the baseline option.

Future of Peat Land Development

The future of peat land development to the year 2000 has been projected in this study. In the extended computer simulations, the emphasis shifts from the short-term effects of investment in peat-related industry and the subsequent increases in industry output to the long-term effects of accumulated increases in output-increasing capital in agriculture, mining, manufacturing, utilities, and all other industries directly and indirectly affected by the increases in peat production.

Much of the projected expansion in the Study Region economy under the peat land development option for the 1985 - 2000 period is associated with expansion of related industrial chemicals and synthetic gas production in the Study Region. The projected increase in chemical and gas production assumes a potential increase in their exports to markets outside the eight-county Study Region. In the projection series the industrial and the agricultural uses of peat land are combined in a composite development projection series.

The local economic effects of two alternative composite scenarios of Study Region peat land development are considered here. Each alternative includes crop production, peat gasification, gas distribution, peat coke, and peat mining. Only composite scenarios are considered for a number of reasons. The impacts of crop production and peat coke production are not measured separately because these industries are too small to have measurable impacts relative to the present amount of economic activity in the Study Region. Peat mining is not considered separately because it is unclear why peat would be mined and shipped outside the Study Region without processing. Obviously, peat mining, peat gasification, and gas distribution are interrelated industries that must be considered simultaneously in impact analysis.

Under these circumstances, two principal scenarios involving peat-related industries emerge. In one scenario, the synthetic natural gas from peat is sold only outside the Study Region. In the other, some gas is substituted for natural gas consumed within the study area, a situation which

seems particularly cogent at the present time in view of possible natural gas curtailments. These scenarios could have considerably different impacts. In the first, the impacts are solely from peat industry purchases of supplies and services and from workers hired to produce the peat-derived products. In the second, there may be additional impacts stemming from the substitution of synthetic natural gas derived from peat for curtailed supplies of natural gas. These impacts may occur if the synthetic natural gas is significantly more expensive than the natural gas it replaces. Substitution of the more expensive fuel may raise study area energy costs to business and homeowners. This will obviously be a hardship for homeowners. The effect on business is also of potential concern since, for reasons explained below, higher energy costs may reduce the rate of study area economic growth and offset, to some extent, the increases in study area economic activity caused by peat industry development.

The two scenarios are examined separately. Because construction-related impacts precede production and consumption of peat-related products, the impacts of constructing the peat industry facilities are considered first. In impact analysis, construction impacts must be taken into account for their own sake. Furthermore, economic conditions at the beginning of the period of peat industry production may be significantly affected by carry-over effects of construction activity with implications for the nature of production period impacts. For example, Study Region population and labor force may be larger as a result of construction activity and this may affect the process of adjustment to the production

period conditions. Only one set of construction impacts must be considered here since the peat industry facilities involved in the two scenarios are identical.

Finally, the baseline option is presented as a total baseline forecast rather than the baseline change from the base-year level. Thus, the baseline projection series in this section are larger than the baseline change forecasts in table 2.1. The development increment forecasts in the two tabular series, however, are identical in concept.

Impacts From Construction of Peat Industry Facilities

Construction of peat industry facilities would have significant impacts on socio-economic conditions in the Study Region. Direct effects would be generated by the household spending of construction workers and construction industry spending for supplies, materials, and services furnished by Study Region firms. These would also have indirect and induced effects as defined earlier. The magnitude of these impacts would depend on the magnitude and timing of peat industry development. Under assumptions already explained, peatland crop production, peat gasification and distribution, peat coke production, and peat mining would commence simultaneously in 1985. Construction of peat industry facilities is assumed to occur in 1982, 1983, and 1984. The synthetic gas plant would be the principal part of this construction activity. Expenditures on gas plant buildings, excluding equipment, would amount to about $105 million (1970 dollars) annually for three years. A modest amount of construction activity, about $10 million per year, is assumed for the other peat industries during the 1982-1984 period.

Construction of the peat industry facilities will generate increases in business volume which, in turn, would lead to increases in employment and earnings. However, these effects will endure only as long as construction continues. Construction will also generate an influx of construction workers, their families, and other persons responding to employment opportunities associated with construction activities. These additional people may require additional public services, as well as housing. Decisions concerning these needs may be required of study area public officials. Hence, the potential population influx during the construction period is a matter of interest to government. SIMLAB forecasts of construction period population changes in the Study Region are presented in table 2.3.

In table 2.3, SIMLAB baseline population projections by age-sex category for 1977, 1982, and 1984 are presented. For 1982 and 1984, forecasts of the additional number of persons present in the Study Region in each age category under the assumption of peat industry construction are shown in the columns following the 1982 and 1984 baseline projections. Total population in each age category during construction is the sum of corresponding elements in baseline and impact columns.

Table 2.3 shows that during the first year of construction in 1982, the population increase is projected to be 1.6 percent or about 6,000 persons. Study Region employment would increase about 3,350 persons of which 2,700 persons would be employed constructing the peat industry facilities. Thus, in the first year of construction, most of the impacts would not be diffused through the Study Region economy. The population impacts

Table 2.3. Estimated and Projected Total Population in Specified Age Groups, Peat Study Region, 1977-1984: Construction Phase. 1/

Age Group	1977 Baseline	1982 Baseline	1982 Construction Increment	1984 Baseline	1984 Construction Increment
			(number)		
1-5	32,761	35,463	0	37,821	499
6-13	44,703	41,969	1,128	43,397	2,459
14-17	31,376	20,712	509	19,862	1,170
18-24	47,298	46,468	1,284	43,616	2,573
25-34	45,178	57,216	1,453	65,998	3,960
35-54	78,682	78,240	1,169	78,445	3,184
55-64	39,912	36,976	315	36,150	770
65+	42,644	43,453	103	43,819	201
Column Total	362,554	360,497	5,961	369,108	14,816
Grand Total	362,554	366,458		383,924	

1/ The baseline projection represents study area socio-economic events as they would unfold in the absence of peat industry development. The impact forecast represents the deviation from the baseline caused by peat industry development. Thus, total forecast population in the event of development is the sum of baseline and impact forecasts.

would consist primarily of construction workers and their families.

By the third year of construction, in 1984, the Study Region economy will have had time to expand to produce the additional goods and services needed to meet the requirements of the construction industry and the households of construction workers. This expansion will create additional job opportunities so that in 1984, employment is projected to increase by about 8,200 persons over its 1984 baseline level, with 2,700 people employed in peat industry construction. Table 2.3 shows that the projected population change is 14,800 persons or 4 percent above the 1984 baseline level of 369,108.

First Scenario: Impacts From Peat Industry Operation Only

With construction completed in 1984, the peat industries would commence operations in 1985. For the study area economy, the year 1985 will be a year of transition from the earlier impacts of construction to the later impacts of day-to-day operation. Impacts from operation will begin to emerge clearly after a period of adjustment so, the tables which follow show SIMLAB forecasts of peat industry operation impacts beginning in 1986.

Population. Table 2.4 shows the projected impacts of peat industry operation on Study Region population. In table 2.4, the projected impacts increase with time as can be seen by comparison between 1986, 1995 and 2000. This phenomenon is not caused primarily by growth in the peat industries. It is the result of a downward trend in the Study Region population which can be seen in the baseline projection. During the

Table 2.4. Estimated and Projected Total Population in Specified Age Group, Peat Study Region, 1977-2000: Development Phase. 1/

Age Group	1977 Baseline	1986		1995		2000	
		Baseline	Development Increment	Baseline	Development Increment	Baseline	Development Increment
1-5	32,761	40,025	1,219	35,098	3,612	24,877	3,672
6-13	44,703	44,517	2,802	49,814	2,925	44,608	4,314
14-17	31,376	21,633	1,500	20,529	1,042	21,118	1,273
18-24	47,298	38,776	1,963	25,866	3,560	21,937	1,727
25-34	45,178	73,885	5,405	50,590	5,653	24,864	6,121
35-54	78,682	80,805	4,923	104,074	9,881	111,543	10,632
55-64	39,912	35,375	983	31,395	1,450	30,970	1,873
65+	42,644	43,988	-77	41,153	749	37,504	926
Column Total	362,554	379,004	18,718	358,519	28,872	317,421	30,538
Grand Total	362,554	397,722		387,391		347,959	

1/ The baseline projection represents study area socio-economic events as they would unfold in the absence of peat industry development. The impact forecast represents the deviation from the baseline caused by peat industry development.

computer analysis, this trend was traced to downward trends in employment in taconite mining and manufacturing after the mid-1980's (shown later in table 2.5). Employment in these two economic base industries is projected to decline because of anticipated increases in worker productivity resulting from modernization and mechanization of plants and equipment. The peat industries appearance in the Study Region at the onset of declining employment in mining and manufacturing has a sustaining effect on the Study Region economy. People who would otherwise leave the Study Region when they become unemployed because of trends in mining and manufacturing are able to stay because of opportunities generated by the peat industry development. The sustaining effect is not strong enough to reverse the downward trend in Study Region population. This can be seen in table 2.4 by noting that in the year 2000 the population is projected to be 347,959 with peat industry development as compared to 387,391 five years earlier in 1995. Study Region population with peat industry development in the year 2000 is also projected to be less than the baseline population in 1995.

Gross Output. Gross output, the value of production in producer's prices, is a measure of study area business volume. Peat industry operations will affect Study Region business volume primarily through purchases of supplies, materials, and services from other area firms, and through spending of peat industry payrolls. Secondary effects will occur when firms serving the peat industry or the households of peat industry employees respend part of their revenues for materials and payrolls.

Table 2.5 shows projected baseline levels of gross output by study area industries for 1977, 1986, 1995, and 2000. Forecasts of increases in gross

Table 2.5. Estimated and Projected Value of Gross Output (in 1970 Dollars) in Specified Industry for Baseline and Development Options, Peat Study Region, 1977-2000. 1/

Industry No.	Industry Title	1977 Baseline	1986 Baseline	1986 Development Increment	1995 Baseline	1995 Development Increment	2000 Baseline	2000 Development Increment
		(1,000's of 1970 Dollars)						
1.	Agriculture & Agr. Services	92,174	123,098	4,199	140,215	5,704	144,652	6,284
2.	Peatland Agriculture	-	-	6,103	-	8,947	-	9,015
3.	Iron Ores	585,403	694,487	0	887,772	0	1,017,504	0
4.	Peat Mining	-	-	59,199	-	63,952		65,098
5.	Construction	264,434	333,298	24,596	333,298	24,596	333,298	24,596
6.	Manufacturing	982,075	1,265,671	46,579	1,478,311	80,139	1,590,747	82,319
7.	Peat Coke	-	-	3,023	-	3,806	-	3,719
8.	Peat Chemicals & Synthetic Gas	-	-	198,122	-	213,324	-	217,339
9.	Transportation	190,347	235,537	3,789	276,387	11,651	298,491	11,943
10.	Communication	37,266	52,645	2,724	68,550	5,317	76,230	5,596
11.	Utilities	129,768	182,502	7,560	254,180	21,937	300,028	22,768
12.	Synthetic Gas Distribution	-	-	177,981	-	193,232	-	195,686
13.	Trade	469,289	629,916	33,827	751,759	73,117	764,702	75,233
14.	Finance,Insurance,Real Est.	217,237	279,034	14,557	341,030	51,880	330,086	55,384
15.	Services	296,229	392,328	25,093	436,139	53,186	412,982	55,321
16.	Other Industry	26,103	27,717	366	29,492	288	30,710	250
17.	Government	209,735	268,285	16,716	277,610	35,985	252,274	38,117
	Column Total	3,500,060	4,484,518	624,434	5,274,743	847,061	5,551,964	868,668
	Grand Total	3,500,060	5,108,912		6,121,804		6,420,632	

1/ The baseline projection represents study area socio-economic events as they would unfold in the absence of peat industry development. The impact forecast represents the deviation from the baseline caused by peat industry development.

output because of peat industry operation are shown for 1986, 1995 and 2000. All data in table 2.5 are in hundreds of 1970 dollars. Thus, changes over time represent differences in the quantity of goods produced and/or sold. In 1986, the projected gross output from the peat industries, sectors 2, 4, 7, 8, and 12, is the sum of the peat industry data in the third column in table 2.5, or $444,428,000. The projected impact on other Study Region industries is the sum of the other data in the same column, or $185,006,000. The total impact is $624,434,000.

Of the $180,006,000 impact, 26 percent is in manufacturing, 19 percent in trade, 14 percent in services, and 14 percent in construction. Thus, 73 percent of the increase in business volume caused by peat industry operation is found in only four Study Region industries. Examination of the detailed computer output from which table 2.5 was prepared revealed that about one-helf of the increase in manufacturing output was in consumer items like food and kindred products. The other half was in industrial products like machinery. Increases in gross output in trade and services are primarily caused by increases in consumer spending. Construction is for facilities used by business firms and for homes. Thus, increases in Study Region business volumn caused by peat industry operation seem about equally attributable to increases in purchases by industry and consumers.

Earnings. Industry income payments to households in the wage and salary payments and proprietorial income are a major component of value added. In the economic forecast, baseline projections of earnings from wages and salaries in Study Region industries and forecasts of impacts from peat industry operations are presented in table 2.6. In 1986, peat industry

Table 2.6. Estimated and Projected Total Earnings of Employed Work Force in Specified Industry for Baseline and Development Option, Peat Study Region, 1977-2000. 1/

Industry No.	Industry Title	1977 Baseline	1986 Baseline	1986 Development Increment	1995 Baseline	1995 Development Increment	2000 Baseline	2000 Development Increment
					(1,000's of 1970 Dollars)			
1.	Agriculture & Agr. Services	25,148	26,513	439	23,365	864	20,929	725
2.	Peatland Agriculture	-	-	1,174	-	1,104	-	854
3.	Iron Ores	155,797	208,973	0	195,413	0	188,285	0
4.	Peat Mining	-	-	14,446	-	17,353	-	18,503
5.	Construction	102,405	143,456	7,420	136,272	10,076	135,739	10,037
6.	Manufacturing	149,985	215,677	8,102	255,076	13,625	271,802	13,290
7.	Peat Coke	-	-	350	-	494	-	506
8.	Peat Chemicals & Synthetic Gas	-	-	16,308	-	19,524	-	20,837
9.	Transportation	53,503	73,108	2,519	84,552	4,037	86,663	3,889
10.	Communication	14,661	21,865	1,033	27,176	2,119	28,193	2,122
11.	Utilities	13,355	16,450	447	17,019	1,776	17,310	1,714
12.	Synthetic Gas Distribution	-	-	2,150	-	2,506	-	2,596
13.	Trade	162,903	213,291	13,607	239,456	23,569	232,374	24,487
14.	Finance,Insurance,Real Est.	42,078	57,790	1,156	69,368	3,382	69,180	12,222
15.	Services	139,535	223,745	9,717	255,647	29,668	244,227	31,798
16.	Other Industry	13,214	14,893	70	14,890	68	14,908	55
17.	Government	197,864	260,139	16,717	269,463	35,986	244,127	38,117
	Column Total	1,070,448	1,475,900	95,655	1,587,697	166,151	1,553,737	181,752
	Grand Total	1,070,448	1,571,555		1,753,848		1,735,489	

1/ The baseline projection represents study area socio-economic events as they would unfold in the absence of peat industry development. The impact forecast represents the deviation from the baseline caused by peat industry development.

earnings are projected at $34,428,000 (1970 dollars) and the earnings increase in other industries is $61,227,000.

Earnings data in table 2.6 includes only earnings from wages and salaries and proprietorial income. Income from other sources, such as rents, interest, dividends, and social security, is not included. Income from these sources, in relation to personal income, is not likely to change significantly because of peat industry development and operation.

Employment. Table 2.7 shows projected baseline levels of employment in Study Region industries and forecasts of employment increases caused by peat industry operations. Examination of the projected employment increases reveals that the principal impacts will be in the peat industries themselves and in trade (sector 13), services (sector 15), and government (sector 17). In 1986, it is projected that 2,887 persons would be employed in peat industries and an additional 9,537 persons in other industries. Of the 9,537 persons, 2,834 would be in trade, 2,316 in services, and 1,972 in government. The markets for these industries are primarily Study Region households, suggesting that the principal employment impacts from peat industry operations stem from stimulation of local consumer spending.

This conclusion is somewhat different than the one concerning gross output. It was concluded that the largest gross output increases seemed equally attributable to industrial and consumer spending. An important reason for the difference is that worker productivity is less in trade and services than in the manufacturing industries which produce goods used by other industries. Thus, an increase of, say, $100,000 in business volume

Table 2.7. Estimated and Projected Total Employed Work Force in specified Industry for Baseline and Development Options, Peat Study Region, 1977-2000. 1/

	1977 Baseline	1986 Baseline	1986 Development Increment	1995 Baseline	1995 Development Increment	2000 Baseline	2000 Development Increment
			(number)				
1. Agriculture & Agri. Services	3,680	3,716	118	3,088	108	2,732	96
2. Peatland Agriculture	-	-	147	-	133	-	102
3. Iron Ores	13,933	15,831	0	13,036	0	11,579	0
4. Peat Mining	-	-	1,165	-	1,181	-	1,161
5. Construction	7,233	8,305	614	6,950	513	6,285	465
6. Manufacturing	22,608	26,438	974	25,333	1,381	24,068	1,225
7. Peat Coke	-	-	28	-	33	-	31
8. Peat Chemicals & Synthetic Gas	-	-	1,315	-	1,329	-	1,308
9. Transportation	5,069	5,345	113	4,805	213	4,474	186
10. Communication	1,241	1,275	67	1,061	82	919	68
11. Utilities	1,427	1,533	82	1,467	157	1,406	141
12. Synthetic Gas Distribution	-	-	232	-	232	-	225
13. Trade	35,219	42,567	2,834	41,363	4,313	37,152	4,011
14. Finance,Insurance,Real Estate	5,669	6,771	435	7,512	1,189	6,634	1,195
15. Services	25,878	36,939	2,316	39,748	4,734	37,059	4,832
16. Other Industry	1,866	2,063	12	2,029	5	2,014	14
17. Government	24,921	30,174	1,972	25,576	3,396	20,806	3,180
Column Total	148,744	180,957	12,424	171,968	18,999	155,128	18,240
Grand Total	148,774	193,381		190,967		173,368	

1/ The baseline projection represents study area socio-economic events as they would unfold in the absence of peat industry development. The impact forecast represents the deviation from the baseline caused by peat industry development.

in trade and services requires the hiring of more workers than a similar business volume increase in manufacturing.

Second Scenario: Impacts From Consumption of Synthetic Natural Gas Within the Study Region

Synthetic natural gas from peat may be used within the Study Region as a substitute for curtailed supplies of natural gas. It is also possible that synthetic gas will be much more expensive than natural gas. If so, energy costs to gas users will rise, especially if they cannot substitute a lower cost fuel.

If energy costs rise, economic growth in the Study Region may slow down for at least two reasons. Higher energy costs may force households to spend less on other items. This may reduce the rate of growth in the Study Region retailing and service industries. In addition, higher energy costs to business and industry may reduce profits. Reduced profits may then result in reduced investment in new plants and equipment. Ultimately, reduced investment may result in fewer new job openings and lower levels of employment in the Study Region. The alternative to higher energy costs -- sharp curtailment of energy use -- would inhibit economic growth even more than the high energy costs.

At present the SIMLAB model does not forecast the effects of higher energy costs on household consumption expenditures. A statistical study of how household spending patterns are altered by increases in energy costs relative to the cost of other goods would provide the information needed to modify the SIMLAB model for this capability. The model already has the capability to forecast the effects of higher energy costs on the rate of new

investment. Accordingly, a computer simulation run was made in an attempt to determine if higher cost gas supplies would ultimately result in lower levels of investment and hence employment in the study area.

The computer run was made under the assumptions that Study Region gas supplies would be five times more expensive than natural gas and that one-half the extra cost would be passed on to consumers and one-half would be abosrved in lower business profits. The computer results showed study area employment was not adversely affected over the fifteen-year period 1985-2000, which suggests that the impacts of peat industry development would be the same in both scenarios considered here.

However, this conclusion must be considered a tentative one. As already mentioned, the SIMLAB model does not take possible adverse effects on household expenditures into account. In addition, a fifteen-year period may not be long enough for significant effects on investment and, hence,employment to appear. Finally, increased energy costs may be shared differently than was assumed.

Further analysis of other possibilities seems fruitless at this time. More specific information on the cost of synthetic gas to users is needed and the SIMLAB model should be modified. Modification and adequate testing would be time consuming and expensive and should only be undertaken when it is clear that more specific gas cost information will be available. This information should include the expected price of natural gas and the cost of synthetic gas at the time the synthetic gas is substituted for natural gas. In addition, information on which natural gas users will switch to another fuel should be available.

IMPACT MEASUREMENT

Population, employment and income are the principal indicators of regional industry performance used in this study. The socio-economic impacts of peat resource development are measured and reported as changes in total population, total employment, and total income. Industry output and investment, and related data, are used, also, to show the specific industry impacts of each new resource development activity in the Study Region.

Measurement of socio-economic impacts of resource development is difficult, especially if the development is on a small scale and gradual in its attainment of full-scale activity. Peat land development fits this scenario, in part. It also fits the opposite scenario, the large-scale facility construction and operation which typically triggers a local boom-and-bust cycle with rapid expansion of the local labor force to full-scale development (as in the case of synthetic gas plant construction).

In this study, the peat land development option is assessed in terms of its direct, indirect and induced effects. Direct economic consequences of peat land development are the easiest to identify, measure and forecast. Given the projected peat land development, direct economic effects can be identified as (1) the added capital expenditures for peat-related development and (2) the added peat-related production derived from these expenditures. For example, an increase in peat land utilization involves investment in the peat-related activity which incurs certain capital and operating costs.

The indirect effects are the secondary consequences of the peat land development. Using the farm example, again, farm equipment dealers and farm marketing and processing businesses which serve the farm enterprise will 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 peat land farm enterprise. Because of other inter-business 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 peat land agriculture. They account for the long-term effects of farm income expansion through farm household and investment expenditures and, ultimately, through expenditure increases in the entire regional economy.

Measurement of the total effects -- direct, indirect and induced -- of peat land development 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 following chapters. The forecasting models are available on a standby basis for simulating alternative peat land development options, starting with the five development options identified earlier.

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 industry-to-industry linkages, 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 Study Region, especially those which are part of the regional economic base. For this study, a standard industry classification system was prepared for a total of 55 market-based interacting sectors (see, table 3.1). Because an all-inclusive classification system is used, several of the interacting sectors are not located in Study Region, although they are located elsewhere in the Nation.

A total of eight final demand and three primary input and import sectors are involved in the input-output system.[12/] The final demand sectors show the purchases for end uses of industry output in the Study Region and, also, in the

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12/ Demand (column) sectors are listed as follows:

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
63 Gross Output

Intermediate and primary input (row) sectors are listed as follows:

56 Total Intermediate Purchases
57 Total Earnings
58 Total Imports
59 Other Value Added
60 Total Outlays

Table 3.1. Standard industrial classification for peat resource development, Minnesota, 1978.

Industry No.	Industry Title	1967 U.S. Input-Output	Standard Industrial Classification Code (1972 Edition)
1.	Livestock & Livestock Prod.	1	0132, 0133, 0134, 0135, 0136, 0139, pt. 014, 0193, pt. 0729
2.	Other Agri. Products	2	pt. 0112, pt. 0113, pt. 014, pt. 0119, 0122, 0123, 0192
3.	Peat Land Agr. Products	pt. 2.05, pt. 2.02	pt 0112, pt. 0113, pt. 0119, pt. 014
4.	Forestry & Fishery Prod; Ag., For., & Fish Serv.	3, 4	071, 0723, 073, 074, pt. 0729, 081, 082, 084, 085, 086, 091, 098
5.	Iron & Ferro Alloy Ores	5	1011, 016
6.	Other Metal Ores, exc. Cu.	6.02	013, 014, 015, 018, 109
7.	Copper Ore Mining, exc. MN	pt. 6.01	pt. 102
8.	Copper Ore Mining, MN, Open Pit	pt. 6.01	pt. 102
9.	Copper Ore Mining, MN, Deep Shaft	pt. 6.01	pt. 102
10.	Nonmetal Mining	7, 8, 9, 10	141, 142, 144, 145, 148, 149
11.	Ag. Chemicals, Incl. Peat Mining	pt. 10	pt. 147
12.	Construction	11, 12	15, 16, 17, 138, pt. 6561
13.	Food and Kindred Products	14	20
14.	Apparel & Misc. Fabric Text.	15-19	22, 23
15.	Logging Camps, Sawmills	20.1-.04	2411, 2432, 2433, 244, 25, 2401, 2499
16.	Other Lumber & Wood Prod.	20.05-.09 21-23	2431, 2432, 2433, 244, 25, 2491, 2499
17.	Paper & Allied Products	24-25	26
18.	Printing & Publishing	26	27
19.	Chemical, exc. Peat	pt. 27.01, 27.02-.03, pt. 27.04, 28-30	28, pt. 281, pt. 2861, pt. 289
20.	Industrial Chemicals, Peat	pt. 27, 01	pt. 281
21.	Misc. Chem., Peat	pt. 27.04	pt. 2861, pt. 289
22.	Petroleum Refining & Relat.	31	29
23.	Rubber & Leather Prod.	32-34	30, 32
24.	Stone & Clay Products	35, 36	324-329
25.	Primary Iron and Steel	37	331, 332. 3391, 3399
26.	Primary Copper	38.01	3331
27.	Copper Rolling & Drawing	38.07	3351
28.	Other Pr. Metals, Roll., Dwg.	pt. 38	pt. 2819, 3334, 3352, 3356, 3357, 3332, 3333, 3339, 3341, 3361, 3362, 3369, 3392

Table 3.1 (continued). Standard industrial classification for peat resource development, Minnesota, 1978.

Industry No.	Industry Title	1967 U.S. Input-Output	Standard Industrial Classification Code (1972 Edition)
29.	Fabricated Metal Products	15, 39-42	342, 343, 344, 347, 348, 349(exc. 3491)
30.	Machinery exc. Elec.	43-52	342, 343, 344, 347, 348, 349(exc. 3491)
31.	Electrical Machinery	53-58	361, 362, 365, 366
32.	Misc. Manufacturing	13, 59-64	19, 371, 373, 374, 375, 379, 38, 39
33.	Transportation, exc.	65.04, .07	44, 46, 47(exc. 473 and 474)
34.	Railroad Trans.	65.01	30, 373
35.	Highway Pass. Trans.	65.02	41
36.	Truck Trans. & Warehsg.	65.03	43, 473
37.	Air Trans.	65.06	45
38.	Communication	66, 67	48
39.	Electric Service	68.01	491, pt. 493
40.	Gas Service, exc. Peat	pt. 68.02	pt. 492, pt. 493
41.	Syntheses Gas from Peat	pt. 68.02	pt. 492, pt. 493
42.	Water & Sanitary Serv.	68.03	494-497, pt. 493
43.	Wholesale Trade	69.01	50 (exc. manufactures sales offices)
44.	Retail Trade	69.02	52-59, 7369, pt. 8099
45.	Finance & Insurance	70	60-64, 67
46.	Real Estate & Rental	71	65 (exc. pt. 6561), 66
47.	Hotels, Personal & Repair	72	70, 72, 76(exc. 7692, 7694, & pt. 7699)
48.	Business Services	73	73, (exc. 7396), 7692, 7694, pt. 7699, 81 89(exc. 8921)
49.	Auto Repair & Service	75	75
50.	Amusements	76	78, 79
51.	Medical, Ed. & Nonprofit Org.	77	80 (exc. pt. 8099), 0722, 82, 84, 86, 8921
52.	Federal Gov't. Ent.	78	1/
53.	State & Local Gov't. Ent.	79	1/
54.	Other	80	
55.	Government, Other	2/	2/

1/ Not included in 1972 Edition, but included in 1967 U.S. Input-Output and 1970 Minnesota and Northeast Minnesota Input-Output.

2/ All other government employment and private household employment.

rest of Nation. In the Study Region, the largest end use sector is the household. Personal consumption expenditures account for 72.3 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, and 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 and proprietoral income are 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 payments 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 iron ore and taconite pellets exports of $526,918,700 compares with iron mining industry gross outputs of $563,024,000 in the

Table 3.2. Selected export market indicators for specified industry, Northeast Minnesota and Douglas County, Wisconsin 197..

NO.	INDUSTRY TITLE	GROSS OUTPUT: UNITED STATES	GROSS OUTPUT: TOTAL REGION	ACTUAL MARKET SHARE: REGIONAL EXPORTS	ACTUAL MARKET SHARE: PERCENT OF U.S. GROSS OUTPUT	ACTUAL MARKET SHARE: ANNUAL CHANGE	POTENTIAL MARKET SHARE: EXPORTS	POTENTIAL MARKET SHARE: PERCENT OF U.S. GROSS OUTPUT
		(mil. dol.)	(hund. dol.)	(hund. dol.)	(pct.)	(pct.)	(hund. dol.)	(pct.)
1	LIVESTOCK	37514.	448249.	0	0	0	0	0
2	OTHER AG.	37195.	212983.	0	0	0	0	0
3	PEATLAND A 1/	0	0	0	0	0	0	0
4	AG. FORFIS	5295.	16789.	133722.	.2525	0	133699.	.2525
5	IRON ORE	1931.	5636240.	5269187.	27.3015	0	5269189.	27.3015
6	OTHER METO	1634.	16199.	0	0	0	0	0
7	COPPER ORE	1475.	0	0	0	0	0	0
8	NNC PREPOP	0	0	0	0	0	0	0
9	NNC PREPNG	0	0	0	0	0	0	0
10	NONMETALMI	2735.	27144.	0	0	0	0	0
11	PEAT MININ 1/	172.	0	0	0	0	0	0
12	CONSTRUCTN	127718.	1523268.	879837.	.0689	0	879977.	.0689
13	FOODKINDRD	105645.	26929.6.	1235234.	.1176	0	1235329.	.1176
14	APPAREL	37279.	322461.	0	0	0	0	0
15	LOGGING	8648.	372259.	67509.	.0781	0	67541.	.0781
16	WOODPROD	13162.	318078.	186748.	.1419	0	186769.	.1419
17	PAPERPROD	26820.	1773952.	1183477.	.4413	0	1183567.	.4413
18	PRINTING	24002.	226643.	22315.	.0085	0	22362.	.0085
19	CHEMICALS	45552.	43884.	0	0	0	0	0
20	PEATCHEM 1/	0	0	0	0	0	0	0
21	PEAT COKE 1/	0	0	0	0	0	0	0
22	PETROLEUM	31765.	546995.	147223.	.0463	0	147072.	.0463
23	RUBBERPLAS	17213.	21994.	0	0	0	0	0
24	STONECLAY	12734.	63254.	0	0	0	0	0
25	IRONMETAL	34966.	1016976.	572648.	.1638	0	572743.	.1638
26	COPPERMET	2814.	0	0	0	0	0	0
27	COPPERROLL	2933.	0	0	0	0	0	0
28	OTHERMETAL	9930.	36771.	1649.	.0017	0	1686.	.0017
29	METAL FAB	28925.	155615.	0	0	0	0	0
30	MACHINERY	36282.	391193.	0	0	0	0	0
31	ELECMACH	33916.	150451.	0	0	0	0	0
32	MISCMANUF	69132.	163448.	0	0	0	0	0
33	TRANSEXC	14486.	826239.	243420.	.1680	0	243365.	.1680
34	RAIL TRAN	14938.	592515.	338023.	.2263	0	338047.	.2263
35	LOCAL TRAN	5666.	44319.	0	0	0	0	0
36	TRUCKTRAN	22214.	151435.	2183.	.0011	0	2224.	.0011
37	AIR TRAN	10436.	7351.	26.	.0000	0	0	0
38	COMMUNICAT	29568.	293812.	66118.	.0224	0	66232.	.0224
39	ELECTRICAL	31546.	824383.	228182.	.0723	0	228078.	.0723
40	GAS SERVIC	11741.	136963.	0	0	0	0	0
41	PEAT GAS 1/	0	0	0	0	0	0	0
42	WATER	4584.	77678.	10862.	.0237	0	10864.	.0237
43	WHOLE SALE	81594.	1470936.	431564.	.0530	0	431971.	.0530
44	RETAIL	125605.	2316935.	584453.	.0465	0	584063.	.0465
45	F. I.	65495.	630038.	46.	.0000	0	0	0
46	REAL EST.	143163.	1273281.	10870.	.0008	0	11453.	.0008
47	HOTELS	23597.	390930.	100728.	.0427	0	100759.	.0427
48	MISS SERVI	68991.	185896.	0	0	0	0	0
49	CAR REPAIR	18443.	123526.	0	0	0	0	0
50	AMUSEMENT	11675.	43594.	0	0	0	0	0
51	MEDICAL ED	68615.	1667350.	712016.	.1038	0	712224.	.1038
52	FED GOVT	9869.	136792.	0	0	0	0	0
53	ST. LOC. G	11866.	148184.	0	0	0	0	0
54	OTHER	2370.	194941.	5346.	.0226	0	5356.	.0226
55	OTHER GOVT	18915.	1584210.	0	0	0	0	0
	TOTAL	1534745.	20231169.	12433376.	.0810	0	12434571.	.0810

Study Region and $1,929,200,000 in the Nation. The regional market share for the iron mining sector is equivalent to 29.2 percent of industry gross output including imports, in the Nation. This compares with a 0.036 percent market share for the iron and steel manufacturing sector in 1970. Outshipments are made to buyers outside the region only for the mining sector. Iron ore shipments are sold for processing and direct utilization outside the Region, while manufactured iron and steel products are purchased from sectors outside the Region.

Sales of local industry outputs to local final demand sectors are summarized, next, for each industry in the Study Region (see, table 3.3). No iron mining output, for example, was purchased directly for personal consumption, while intermediate were small in 1970. Iron and steel was produced in the Study Region in 1970, but this activity was closed down in the early 1970's and, hence, the intermediate and local final demands are not shown. Thus, an even larger portion of total employment in the iron mining industry is now engaged in producing for export markets than in 1970. This industry remains an important part of the economic base of the Study Region.

Local personal consumption expenditures for all industry outputs in the Study Region totaled $573,439,790 in 1970. The total personal consumption expenditure is equal to the total personal income of households, less total personal income taxes and total personal savings and total personal consumption expenditures outside the region, including imports.

Table A.3. Estimated intermediate and final purchases of specified industry output, by demand sector, Northeast Minnesota and Douglas County, Wisconsin, 1970.

INDUSTRY NO.	TITLE	INTERMEDIATE PURCHASES	FINAL LOCAL DEMAND: PERSONAL CONSUMPTION EXPENDITURES	GROSS PRIVATE CAPITAL FORMATION	INVENTORY CHANGE	GOVERNMENT: STATE AND LOCAL	GOVERNMENT: FEDERAL	GOVERNMENT: TOTAL
		(hundred dollars)						
1	LIVESTOCK	423537.	24541.	0	76.	5.	91.	24712.
2	OTHER AG.	184035.	29328.	0	8.	-693.	336.	28978.
3	PEATLAND A 1/	0	0	0	0	0	0	0
4	AG. FORETS	29644.	4398.	0	0.	-24.	240.	4524.
5	IRON ORE	361120.	0	0	5.	-72.	0	-67.
6	OTHER METO	16150.	0	0	2.	37.	0	40.
7	COPPER ORE	0	0	0	0	0	0	0
8	NNC PREPOP	0	0	0	0	0	0	0
9	NNC.PREPNG	0	0	0	0	0	0	0
10	NONMETALMI	27881.	45.	0	-30.	-1.	-747.	-738.
11	PEAT MINTN 1/	0	0	0	0	0	0	0
12	CONSTRUCTN	68831.	0	436041.	0.	4416.	134136.	574593.
13	FOODKINDPD	821361.	832314.	0	82.	530.	3384.	836311.
14	APPAREL	71637.	250284.	0	36.	167.	337.	250823.
15	LOGGING	302840.	732.	1129.	14.	45.	0	1910.
16	WOODPROD	138739.	6161.	16166.	9.	40.	207.	22583.
17	PAPERPROD	561497.	28129.	0	29.	184.	1634.	29977.
18	PRINTING	132859.	65723.	0	15.	268.	5473.	71479.
19	CHEMICALS	293117.	13826.	0	5.	155.	591.	14577.
20	PEATCHEM 1/	0	0	0	0	0	0	0
21	PEAT COKE 1/	0	0	0	0	0	0	0
22	PETROLEUM	222976.	173111.	0	51.	1268.	2426.	176796.
23	RUBBERPLAS	17548.	4247.	269.	-242.	36.	137.	4446.
24	STONECLAY	61431.	1762.	0	8.	12.	40.	1822.
25	IRONMETAL	443863.	62.	0	92.	300.	12.	466.
26	COPPERMET	0	0	0	0	0	0	0
27	COPPERROLL	0	0	0	0	0	0	0
28	OTHERMETAL	34651.	230.	220.	19.	0	2.	471.
29	METAL FAB	139385.	10614.	17264.	-12055.	231.	191.	16235.
30	MACHINERY	121116.	1251.	186129.	-8316.	336.	1683.	181082.
31	ELECMACH	21619.	55038.	89877.	-23685.	6722.	879.	128832.
32	MISCMANUF	48959.	78489.	136958.	-103629.	1428.	1244.	114489.
33	TRANSEXC	563312.	18474.	0	6.	968.	188.	19666.
34	RAIL TRAN	215559.	37999.	0	21.	427.	487.	38933.
35	LOCAL TRAN	13134.	29862.	8399.	-8399.	20.	2183.	31166.
36	TRUCKTRAN	121123.	27516.	0	8.	653.	952.	29129.
37	AIR TRAN	4241.	2914.	0	0.	72.	98.	3084.
38	COMMUNICAT	115716.	101578.	7055.	1.	578.	2774.	111977.
39	ELECTRICAL	448773.	136689.	0	3.	424.	10311.	147428.
40	GAS SERVIC	98921.	36651.	0	2.	36.	1354.	38042.
41	PEAT GAS 1/	0	0	0	0	0	0	0
42	WATER	33722.	32824.	0	0.	61.	208.	33094.
43	WHOLE SALE	546771.	484032.	0	75.	1412.	7052.	492571.
44	RETAIL	178595.	1499881.	57270.	1.	-21.	-3245.	1553886.
45	F. I.	287488.	310137.	44.	1.	59.	2280.	312512.
46	REAL EST.	578313.	686733.	188.	3.	227.	2956.	690107.
47	HOTELS	61833.	226693.	0	-1.	775.	902.	228371.
48	BUSS SERVI	166886.	16338.	0	1.	575.	2304.	19211.
49	CAR REPAIR	41941.	61124.	0	0.	29.	531.	61685.
50	AMUSEMENT	10761.	30412.	0	-2.	59.	-637.	29833.
51	MEDICAL ED	47461.	817594.	0	0.	2690.	27588.	847873.
52	FED. GOVT	107286.	21259.	0	0.	278.	1970.	23506.
53	ST. LOC. G	135155.	12934.	0	0.	19.	115.	13069.
54	OTHER	187155.	0	0	1.	210.	2229.	2440.
55	OTHER GOVT	0	120734.	0	0	1217625.	241851.	1580210.
	TOTAL	9011799.	6245539.	957009.	-155783.	1242495.	930745.	8785774.

1/ Peat related industry was non-existent in 1970, except for peat land in agriculture.

A series of industry demand forecasts is available for 1985 and 2000 from the Minnesota two-region input-output system.[13] Projection series from the Minnesota Regional Development Simulation Laboratory, SIMLAB, are derived for the Study Region, given the projected final demand. 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 and 2000 Study Region final demand forecasts, the projected baseline option is used. This option, because it provides essentially for projected levels of mineral industry development without copper-nickel and peat mining, is the "low" forecast for the Study Region. The peat development option (exclusive of copper-nickel development) is the "high" forecast.

Preparation of the forecast series is based on a consistent series of final demand requirements for the two regions -- the Study Region and the Rest-of-Nation. These series are keyed to the projected levels of total personal income and related business and government expenditures.

Projected levels of Study Region mineral industry production, and related non-mineral activity, are derived from the data presented earlier. The projected production levels are converted into equivalent

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13/ See: Henry Hwang 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.

levels of industry gross output (in constant 1970 prices). Industry output in excess of final requirements is shown as net exports. Projected expansion in mineral production which exceeds the projected growth in total personal income is likely to show as a projected increase in exports from the Study Region while a deficit supply (due to capital restrictions, resource depletion and related reasons is shown as a projected increase in imports (a negative export).

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

	Personal inc. per person (dol.)		Eight-County Study Region			
			Personal Income		Pers. cons. expend.	
Year	United States	Minnesota	Per person (dol.)	Total (mil. dol.)	Per person (dol.)	Total (mil. dol.)
1970	3,966	3,859	2,925	1,100	1,524	573
1971	4,022	3,872	2,941	1,118	1,508	573
1972	4,213	4,018	2 842	1,063	1,572	588
1973	4,413	4,469	2,903	1,185	1,419	579
1974	4,320	4,306	3,319	1,391	1,539	645
1975	4,259	4,197	3,566	1,544	1,889	818
1980	5,499	5,466	4,115	2,000	2,599	1,263
1985	6,280	6,280	4,666	2,277	3,135	1,530

All data are in constant 1970 dollars. Thus, the recent decline in U.S. and Minnesota personal income per person is due, in part, to price inflation. In the Study Region, however, real income increased in the 1973-75 period.

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 baseline forecasts from the Minnesota Regional Development Simulation Laboratory (SIMLAB).

The second demand forecast series corresponds with the peat development option. In this option, the projected expansion of peat-related industry output is converted into corresponding increases in total industry outputs and final demands. Increases in peat production trigger corresponding increases in the production and, ultimately, the consumption of all goods and services in the Study Region.

Under the peat development option, export market purchases of locally-produced goods and services expand, initially, to completely exhaust any increases in mineral industry output. In some industries, the production increases are utilized within the Study Region. For these industries, the projected increase in exports is less than the projected increase in gross output. For others, the production increases, as in the taconite industry, are dependent totally on increases in export demand.

The production and utilization forecasts in the development option are derived for each industry from SIMLAB. Initially, the population and income forecasts of the baseline option are used. Starting in 1985, however, the projected increases in peat-related industry outputs under the development option are intended. These increases ultimately lead to projected increases in employment, population and regional income. Thus, the projected 1985 and 2000 levels of final demand invariably 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 the Study Region shows the purchases and sales of each industry in this 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 interindustry transactions tables (see, Appendix B).

A base-year interindustry sales and purchases are shown simply as a point of departure for study of the economic implications of projected peat land development. In 1970, the livestock agriculture industry, for example, purchased inputs from most of the producing industries in the Study Region. Purchases of feed inputs, including hay, are among the direct requirements of livestock production. Expansion of peat land agriculture provides for an expansion of hay production, which, in turn, makes possible an expansion of livestock production. The increase in gross output may be utilized in the Study Region, thus reducing imports of livestock products, or it may be entirely exported. The second round expansion effects are due to the derived increases in demand for the intermediate inputs of the livestock industry.

The input profile of each industry is shown with reference to the 55 producing industries in the Study Region for 1970 and, also, 1985, which is the secondary base year. This profile depicts the extent of inter-industry and primary resource (i. e., internal) interdependence of the regional economy. This interdependence is measured by the "backward" linkages of a given industry to the input-supplying industries and the "forward" linkages of this industry to input-purchasing industries. The "backward" linkages of livestock agriculture, for example, were more numerous than its "forward" linkages in 1970.

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 industry structure depicted by the interindustry transactions table determines the intensity and duration of the regional economic impact of industry development in the eight-county in the two options. The proportion of total industry outlays accounted for by imports is directly related to the size of the industry output multiplier. The larger the imports, the smaller the output multiplier. The total regional economic impact of peat resource development thus depends on the relative importance of imports in each of the peat-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 (i.e., outlay) coefficients derived from the Study Region 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. These coefficients are derived from the interindustry transactions data. The derived data represent the value of the input purchases per $1,000 total outlay of each industry (see, col. 1, tables 3.4, 3.5 and 3.6). The total value of imports (see col. 3) for each purchasing industry is deducted from the industry's total input requirements (col. 4) to obtain the requirements acquired locally (cols. 1 and 2). 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

Table 3.4. Estimated changes in industry gross output, value added, earnings and employment associated with a 1-unit change in specified final demand, baseline series, Northeast Minnesota and Douglas County, Wisconsin, 1970.

	PER DOLLAR TOTAL OUTLAY (DIRECT CHANGES)				PER DOLLAR FINAL DEMAND (DIRECT AND INDIRECT CHANGES)				TYPE ONE MULTIPLIERS (DIRECT + INDIRECT / DIRECT)			
INDUSTRY	INTER-MEDIATE	VALUE ADDED	IMPORTS	TOTAL	GROSS OUTPUT	VALUE ADDED	EARNINGS	EMPLOY-MENT 1/	GROSS OUTPUT	VALUE ADDED	EARNINGS	EMPLOY-MENT
1. LIVESTOCK	.45061	.29451	.25488	1.00000	1.69079	.59876	.47080	.08886	1.69079	2.03307	1.63466	1.66735
2. OTHER AG.	.29218	.49109	.21673	1.00000	1.39934	.69907	.38618	.08858	1.39934	1.42351	1.37632	1.26283
3. PEATLAND A	0	0	0	0	1.00000	0	0	0	1.00000	0	0	0
4. AG. FORFIS	.23450	.60633	.15917	1.00000	1.35222	.76853	.39159	.05978	1.35222	1.26752	1.29926	1.41433
5. IRON ORE	.26780	.56133	.17087	1.00000	1.37957	.76538	.29883	.03197	1.37957	1.36351	1.37585	1.55147
6. OTHER METO	.21430	.61152	.17418	1.00000	1.30944	.77129	.64432	.06466	1.30944	1.26127	1.15012	1.21732
7. COPPER ORE	0	0	0	0	1.00000	0	0	0	1.00000	0	0	0
8. MNC.PPEROP	0	0	0	0	1.00000	0	0	0	1.00000	0	0	0
9. MNC.PPERUG	0	0	0	0	1.00000	0	0	0	1.00000	0	0	0
10. NONMETALNI	.24891	.55841	.19268	1.00000	1.35057	.72644	.32681	.06826	1.35057	1.30089	1.32402	1.25180
11. PEAT MININ	0	0	0	0	1.00000	0	0	0	1.00000	0	0	0
12. CONSTRUCTN	.30562	.42462	.26976	1.00000	1.43464	.65225	.52328	.05615	1.43464	1.53607	1.29129	1.66285
13. FOODKINDRD	.51728	.27075	.21196	1.00000	1.85440	.61152	.26811	.04780	1.85440	2.25856	3.49363	3.47210
14. APPAREL	.28918	.39872	.31210	1.00000	1.40407	.58186	.28227	.06659	1.40407	1.45933	1.48049	1.39890
15. LOGGING	.36728	.44841	.18431	1.00000	1.56303	.71403	.29412	.05952	1.56303	1.59236	1.65912	1.56566
16. WOODPROD	.45981	.43852	.10167	1.00000	1.70204	.78099	.28482	.05557	1.70204	1.78096	2.13582	1.94297
17. PAPERPROD	.41968	.42321	.15711	1.00000	1.64512	.72972	.33935	.05319	1.64512	1.72426	1.76800	1.80001
18. PRINTING	.38599	.48564	.12837	1.00000	1.59211	.77396	.53713	.08772	1.59211	1.59367	1.43744	1.41842
19. CHEMICALS	.24748	.37425	.37827	1.00000	1.35426	.53883	.37671	.05101	1.35426	1.43976	1.30685	1.39034
20. PEATCHEM	0	0	0	0	1.00000	0	0	0	1.00000	0	0	0
21. PEAT COKE	0	0	0	0	1.00000	0	0	0	1.00000	0	0	0
22. PETROLEUM	.20024	.25288	.54688	1.00000	1.28091	.37977	.14369	.01580	1.28091	1.50176	1.58803	1.93703
23. RUBBERPLAS	.15695	.46851	.37454	1.00000	1.22582	.58348	.25287	.06578	1.22582	1.24540	1.32574	1.18395
24. STONECLAY	.31787	.47076	.21137	1.00000	1.44535	.70197	.36177	.09144	1.44535	1.49114	1.48305	1.28829
25. IRONMETAL	.38544	.44335	.17120	1.00000	1.56695	.72640	.34517	.05263	1.56695	1.63843	1.65418	1.60495
26. COPPERMET	0	0	0	0	1.00000	0	0	0	1.00000	0	0	0
27. COPPERROLL	0	0	0	0	1.00000	0	0	0	1.00000	0	0	0
28. OTHERMETAL	.33117	.37713	.29170	1.00000	1.47174	.60658	.22175	.03348	1.47174	1.60842	1.96845	1.89296
29. METAL FAB	.35825	.50407	.13768	1.00000	1.54000	.76269	.35135	.05334	1.54000	1.51307	1.57655	1.60016
30. MACHINERY	.30285	.46449	.23266	1.00000	1.44687	.68252	.41397	.05944	1.44687	1.46939	1.37216	1.41340
31. ELECMACH	.17980	.51884	.30136	1.00000	1.24290	.64455	.18150	.02825	1.24290	1.24228	1.47443	1.49654
32. MISCMANUF	.29430	.44146	.26424	1.00000	1.43454	.65443	.17755	.03895	1.43454	1.48243	2.33286	1.75875
33. TRANSEXC	.41076	.49042	.09881	1.00000	1.63437	.80640	.27068	.03586	1.63437	1.64430	1.90769	2.02680
34. RAIL TRAN	.18036	.66897	.15066	1.00000	1.24399	.79475	.47884	.05028	1.24399	1.18803	1.14535	1.19750
35. LOCAL TRAN	.27760	.60620	.11620	1.00000	1.36817	.79643	.53061	.07061	1.36817	1.31381	1.28646	1.37245
36. TRUCKTRAN	.22255	.67021	.10724	1.00000	1.29258	.82431	.57984	.07591	1.29258	1.22993	1.18117	1.24002
37. AIR TRAN	.25169	.58447	.16384	1.00000	1.35693	.74688	.35087	.04611	1.35693	1.27788	1.29382	1.36022
38. COMMUNICAT	.13989	.72659	.13352	1.00000	1.19129	.82616	.46741	.05653	1.19129	1.13703	1.15775	1.26477
39. ELECTRICAL	.41788	.39967	.18245	1.00000	1.59520	.69080	.27139	.03340	1.59520	1.72840	2.08564	2.28781
40. GAS SERVIC	.06089	.66188	.27723	1.00000	1.08184	.70409	.13621	.01786	1.08184	1.06376	1.25121	1.30839
41. PEAT GAS	0	0	0	0	1.00000	0	0	0	1.00000	0	0	0
42. WATER	.54017	.20417	.25566	1.00000	1.72356	.57069	.32059	.04854	1.72356	2.79518	3.79776	4.31228
43. WHOLE SALE	.18890	.67612	.13498	1.00000	1.27144	.80866	.39125	.06281	1.27144	1.19603	1.27375	1.29603
44. RETAIL	.14555	.76034	.09411	1.00000	1.19662	.86989	.52804	.13614	1.19662	1.14408	1.11955	1.06883
45. F. I.	.27463	.58418	.14119	1.00000	1.38524	.79228	.56967	.08912	1.38524	1.35624	1.34683	1.35281
46. REAL EST.	.13254	.72430	.14316	1.00000	1.18065	.82206	.13321	.01846	1.18065	1.13497	1.74760	2.06485
47. HOTELS	.25995	.54566	.19439	1.00000	1.35929	.73287	.45159	.12687	1.35929	1.34309	1.28163	1.16127
48. BUSS SERVI	.34398	.52831	.12771	1.00000	1.49549	.79009	.61787	.13917	1.49549	1.49550	1.38068	1.23957
49. CAR REPAIR	.21963	.56004	.22033	1.00000	1.28885	.72615	.45584	.09655	1.28885	1.29661	1.23926	1.19419
50. AMUSEMENT	.20373	.57136	.22491	1.00000	1.27764	.71849	.51033	.15163	1.27764	1.25751	1.21431	1.13983
51. MEDICAL ED	.17206	.71953	.10842	1.00000	1.24541	.84319	.48586	.09472	1.24541	1.17187	1.16726	1.13615
52. FED. GOVT	.16014	.71248	.12738	1.00000	1.21590	.83491	.66427	.07181	1.21590	1.17184	1.11673	1.14686
53. ST. LOC. G	.21551	.52245	.26204	1.00000	1.31512	.67200	.45941	.07376	1.31512	1.28625	1.20768	1.17283
54. OTHER	.53684	.02729	.43588	1.00000	1.84143	.40995	.75776	.11653	1.84143	15.02451	1.39699	1.53182
55. OTHER GOVT	0	1.00000	0	1.00000	1.00000	1.00000	.99994	.13531	1.00000	1.00000	1.00000	.99995

1/ Employment change per $1,000 change in final demand; all others per $1 change in final demand.

Table 3.5. Estimated changes in industry gross output, value added, earnings and employment associated with a 1-unit change in specified final demand, development series, Northeast Minnesota and Douglas County, Wisconsin, 1970.

INDUSTRY	PER DOLLAR TOTAL OUTLAY (DIRECT CHANGES)				PER DOLLAR FINAL DEMAND (DIRECT AND INDIRECT CHANGES)				TYPE ONE MULTIPLIERS (DIRECT + INDIRECT / DIRECT)			
	INTER-MEDIATE	VALUE ADDED	IMPORTS	TOTAL	GROSS OUTPUT	VALUE ADDED	EARNINGS	EMPLOY-MENT 1/	GROSS OUTPUT	VALUE ADDED	EARNINGS	EMPLOY-MENT
1. LIVESTOCK	.44812	.29252	.25936	1.00000	1.68071	.58864	.47001	.08835	1.68071	2.01231	1.62743	1.65709
2. OTHER AG.	.28987	.48626	.22387	1.00000	1.38979	.68829	.38667	.08812	1.38979	1.41549	1.36566	1.25666
3. PEATLAND A	.24514	.55545	.19941	1.00000	1.33090	.72692	.36570	.08556	1.33090	1.30871	1.30376	1.22010
4. AG. FORFIS	.23206	.60637	.16156	1.00000	1.34664	.76425	.39083	.05952	1.34664	1.26036	1.29674	1.40802
5. IRON ORE	.26098	.56918	.16985	1.00000	1.37567	.77103	.29295	.03177	1.37567	1.35464	1.37823	1.54102
6. OTHER METO	.21320	.60955	.17725	1.00000	1.30558	.76672	.64253	.06435	1.30558	1.25784	1.14708	1.21143
7. COPPER ORE	0	0	0	0	1.00000	0	0	0	1.00000	0	0	0
8. MNC.PPEROP	0	0	0	0	1.00000	0	0	0	1.00000	0	0	0
9. MNC.PPERUG	0	0	0	0	1.00000	0	0	0	1.00000	0	0	0
10. NONMETALNI	.24498	.55788	.19714	1.00000	1.34227	.72025	.32524	.06783	1.34227	1.29105	1.31740	1.24332
11. PEAT MININ	.20398	.67395	.12207	1.00000	1.28059	.82584	.31746	.06628	1.28059	1.22536	1.28612	1.21661
12. CONSTRUCTN	.30224	.42462	.27314	1.00000	1.42695	.64281	.52365	.05574	1.42695	1.51384	1.29222	1.65071
13. FOODKINDRD	.52553	.25381	.22066	1.00000	1.84353	.58339	.26821	.04725	1.84353	2.29851	3.41555	3.43172
14. APPAREL	.29752	.36641	.33607	1.00000	1.39040	.53508	.29230	.06590	1.39040	1.46030	1.45401	1.38552
15. LOGGING	.36321	.45224	.18455	1.00000	1.54848	.71490	.29206	.05930	1.54848	1.58079	1.65905	1.55975
16. WOODPROD	.45732	.43849	.10419	1.00000	1.69525	.77539	.28405	.05524	1.69525	1.76830	2.13004	1.93174
17. PAPERPROD	.41805	.42282	.15913	1.00000	1.63948	.72508	.33834	.05290	1.63948	1.71489	1.76274	1.79014
18. PRINTING	.38096	.48559	.13345	1.00000	1.58168	.76736	.53453	.08720	1.58168	1.58026	1.43045	1.40934
19. CHEMICALS	.25141	.35752	.39108	1.00000	1.34914	.51952	.38144	.05061	1.34914	1.45315	1.29381	1.37783
20. PEATCHEM	.27900	.40067	.32034	1.00000	1.37410	.56132	.36302	.04695	1.37410	1.40098	1.25768	1.27825
21. PEAT COKE	.24530	.61040	.14430	1.00000	1.33681	.79214	.19236	.02643	1.33681	1.29775	1.69457	1.83139
22. PETROLEUM	.19705	.25288	.55007	1.00000	1.27477	.37584	.14237	.01552	1.27477	1.48621	1.57345	1.90206
23. RUBBERPLAS	.15436	.46841	.37723	1.00000	1.22041	.57890	.25208	.06549	1.22041	1.23586	1.32189	1.17889
24. STONECLAY	.31391	.46801	.21809	1.00000	1.43584	.69301	.36002	.09084	1.43584	1.48077	1.47324	1.27986
25. IRONMETAL	.38016	.44301	.17683	1.00000	1.55435	.71863	.34322	.05220	1.55435	1.62216	1.64482	1.59171
26. COPPERMET	0	0	0	0	1.00000	0	0	0	1.00000	0	0	0
27. COPPERROLL	0	0	0	0	1.00000	0	0	0	1.00000	0	0	0
28. OTHERMETAL	.29918	.37707	.32375	1.00000	1.41660	.58142	.21311	.03207	1.41660	1.54196	1.89207	1.81409
29. METAL FAB	.44095	.37994	.17910	1.00000	1.52469	.62733	.40706	.05282	1.52469	1.65111	1.45481	1.58458
30. MACHINERY	.29887	.46450	.23663	1.00000	1.43745	.67593	.41275	.05909	1.43745	1.45518	1.36817	1.40490
31. ELECMACH	.18202	.50501	.31297	1.00000	1.23665	.62550	.18422	.02795	1.23665	1.23860	1.45504	1.48269
32. MISCMANUF	.29818	.42331	.27852	1.00000	1.42274	.62698	.17902	.03850	1.42274	1.48114	2.27806	1.73961
33. TRANSEXC	.40606	.49043	.10352	1.00000	1.62350	.79815	.26843	.03530	1.62350	1.62746	1.89182	1.99403
34. RAIL TRAN	.17661	.66896	.15443	1.00000	1.23707	.78995	.47739	.05000	1.23707	1.18087	1.14189	1.19084
35. LOCAL TRAN	.26609	.58883	.14508	1.00000	1.33398	.76011	.53923	.06868	1.33398	1.29087	1.24842	1.33505
36. TRUCKTRAN	.22155	.66577	.11268	1.00000	1.28528	.81476	.58476	.07548	1.28528	1.22378	1.17559	1.23327
37. AIR TRAN	.24740	.58457	.16803	1.00000	1.34862	.74168	.34864	.04568	1.34862	1.26877	1.28599	1.34746
38. COMMUNICAT	.13597	.72657	.13746	1.00000	1.18423	.82145	.46585	.05609	1.18423	1.13059	1.15387	1.25404
39. ELECTRICAL	.40162	.39968	.19870	1.00000	1.56737	.67419	.26373	.03212	1.56737	1.68681	2.02674	2.19988
40. GAS SERVIC	.05739	.65413	.28848	1.00000	1.07505	.69248	.13684	.01755	1.07505	1.05863	1.22739	1.28265
41. PEAT GAS	.05013	.65094	.29893	1.00000	1.06663	.68511	.12486	.01626	1.06663	1.05250	1.22057	1.26772
42. WATER	.47932	.20420	.31648	1.00000	1.63749	.52425	.29263	.04386	1.63749	2.56736	3.46662	3.89679
43. WHOLE SALE	.18430	.67613	.13958	1.00000	1.26268	.80310	.38906	.06233	1.26268	1.18780	1.26661	1.28509
44. RETAIL	.14107	.76034	.09859	1.00000	1.18913	.86493	.52622	.13577	1.18913	1.13756	1.11568	1.06500
45. F. I.	.27455	.56948	.15597	1.00000	1.36788	.76539	.58129	.08810	1.36788	1.34402	1.32571	1.33604
46. REAL EST.	.12812	.72427	.14761	1.00000	1.17315	.81715	.13139	.01808	1.17315	1.12824	1.72364	2.02100
47. HOTELS	.25262	.54564	.20174	1.00000	1.34598	.72396	.44871	.12618	1.34598	1.32682	1.27345	1.15404
48. BUSS SERVI	.33979	.52580	.13441	1.00000	1.48341	.78021	.61708	.13854	1.48341	1.48385	1.37139	1.23301
49. CAR REPAIR	.22579	.54039	.23382	1.00000	1.28174	.70114	.47100	.09614	1.28174	1.29745	1.22566	1.18908
50. AMUSEMENT	.20962	.54648	.24389	1.00000	1.26730	.68632	.53352	.15090	1.26730	1.25588	1.19890	1.13593
51. MEDICAL ED	.16791	.71953	.11256	1.00000	1.23730	.83824	.48379	.09433	1.23730	1.16498	1.16230	1.13146
52. FED. GOVT	.15952	.70875	.13173	1.00000	1.21061	.82770	.67071	.07154	1.21061	1.16782	1.11321	1.14245
53. ST. LOC. G	.21114	.51932	.26954	1.00000	1.30366	.66211	.45876	.07329	1.30366	1.27495	1.19807	1.16428
54. OTHER	.53031	.02729	.44240	1.00000	1.82390	.39599	.75525	.11575	1.82390	14.51012	1.39236	1.52156
55. OTHER GOVT	0	0	0	0	1.00000	0*	.15E+06	.13531	1.00000	0	1.00000	.99905

1/ Employment change per $1,000 change in final demand; all others, per $1 change in final demand.

Table 3.2. Projected changes in gross output, value added, earnings and employment associated with a 1-unit change in specified final demand, development series, Northeast Minnesota and Douglas County, Wisconsin, 1985.

INDUSTRY	PER DOLLAR TOTAL OUTLAY (DIRECT CHANGES) INTER-MEDIATE	VALUE ADDED	IMPORTS	TOTAL	PER DOLLAR FINAL DEMAND (DIRECT AND INDIRECT CHANGES) GROSS OUTPUT	VALUE ADDED	EARNINGS	EMPLOY-MENT 1/	TYPE ONE MULTIPLIERS (DIRECT + INDIRECT / DIRECT) GROSS OUTPUT	VALUE ADDED	EARNINGS	EMPLOY-MENT
1. LIVESTOCK	.44619	.29662	.25718	1.00000	1.67156	.59601	.46707	.04655	1.67156	2.00933	1.62493	1.82625
2. OTHER AG.	.28482	.49366	.22153	1.00000	1.38200	.69524	.37155	.04575	1.38200	1.40934	1.39861	1.49751
3. PEATLAND A	.24512	.75488	0	1.00000	1.32863	.92791	.35689	.06505	1.32863	1.22921	1.32163	2.00177
4. AG. FORFIS	.23205	.60834	.15961	1.00000	1.34382	.76771	.40388	.05136	1.34382	1.26198	1.28260	1.25483
5. IRON ORE	.26699	.56023	.17279	1.00000	1.37267	.76407	.38928	.03235	1.37267	1.36386	1.29337	1.40892
6. OTHER METO	.21349	.61163	.17488	1.00000	1.30072	.77169	.45628	.03711	1.30072	1.26169	1.20044	1.24253
7. COPPER ORE	0	0	0	0	1.00000	0	0	0	1.00000	0	0	0
8. MNC.PPEROF	0	0	0	0	1.00000	0	0	0	1.00000	0	0	0
9. MNC.PPERUG	0	0	0	0	1.00000	0	0	0	1.00000	0	0	0
10. NONMETALNI	.24589	.57323	.18088	1.00000	1.33938	.73776	.28259	.04371	1.33938	1.28703	1.41716	1.33445
11. PEAT MININ	.20397	.79603	0	1.00000	1.27787	.95545	.24085	.03789	1.27787	1.20028	1.39544	1.38109
12. CONSTRUCTN	.30326	.42431	.27242	1.00000	1.42446	.64632	.55596	.04294	1.42446	1.52321	1.28419	1.71907
13. FOODKINDRD	.50045	.28681	.21274	1.00000	1.80942	.61508	.27560	.03303	1.80942	2.14459	3.17246	2.86346
14. APPAREL	.26330	.39808	.33862	1.00000	1.35466	.55966	.29335	.05343	1.35466	1.40589	1.42184	1.39487
15. LOGGING	.36624	.44918	.18458	1.00000	1.54680	.71267	.28157	.03959	1.54680	1.58662	1.70723	1.63253
16. WOODPROD	.45762	.44842	.10196	1.00000	1.69173	.77878	.31153	.04355	1.69173	1.76825	1.96323	1.84311
17. PAPERPROD	.41813	.42394	.15796	1.00000	1.63611	.72837	.37898	.04369	1.63611	1.71919	1.69312	1.73453
18. PPINTING	.37238	.49856	.12907	1.00000	1.56202	.77499	.60330	.07029	1.56202	1.55447	1.41612	1.41976
19. CHEMICALS	.23948	.36606	.39446	1.00000	1.33674	.52756	.30295	.03407	1.33674	1.44120	1.33721	1.56453
20. PEATCHEM	.27900	.72100	0	1.00000	1.37144	.88394	.35505	.02790	1.37144	1.22599	1.29533	1.23040
21. PEAT COKE	.24527	.75473	0	1.00000	1.33360	.94681	.18780	.01852	1.33360	1.25451	1.73633	2.07906
22. PETROLEUM	.19168	.25900	.54932	1.00000	1.26471	.37958	.19049	.01336	1.26471	1.46553	1.45284	1.88282
23. RUBBERPLAS	.15205	.47257	.37538	1.00000	1.21491	.59311	.23623	.04358	1.21491	1.23391	1.36737	1.27144
24. STONECLAY	.31392	.45553	.23055	1.00000	1.43206	.68362	.42331	.07862	1.43206	1.50871	1.39503	1.24941
25. IRONMETAL	.38218	.44511	.17271	1.00000	1.55183	.72371	.33407	.04608	1.55183	1.62599	1.59374	1.62907
26. COPPERMET	0	0	0	0	1.00000	0	0	0	1.00000	0	0	0
27. COPPERROLL	0	0	0	0	1.00000	0	0	0	1.00000	0	0	0
28. OTHERMETAL	.30885	.38981	.30133	1.00000	1.41347	.59794	.19059	.02253	1.41347	1.53391	1.95093	1.91872
29. METAL FAB	.35144	.44635	.20221	1.00000	1.51859	.69642	.46806	.05737	1.51859	1.56026	1.37262	1.37492
30. MACHINERY	.23763	.52894	.23343	1.00000	1.34161	.69928	.28296	.03250	1.34161	1.32204	1.41979	1.46423
31. ELECMACH	.17106	.51605	.31289	1.00000	1.22627	.63416	.18306	.01929	1.22627	1.22883	1.46383	1.59461
32. MISCMANUF	.27787	.44475	.27818	1.00000	1.40078	.64250	.17453	.02800	1.40078	1.44464	2.33192	1.42306
33. TRANSEXC	.40711	.49362	.09927	1.00000	1.61956	.80401	.33433	.03184	1.61956	1.62880	1.84867	1.89241
34. RAIL TRAN	.17618	.67265	.15117	1.00000	1.23401	.79436	.42109	.02705	1.23401	1.18095	1.17690	1.31142
35. LOCAL TRAN	.24378	.62967	.12654	1.00000	1.31152	.79239	.79413	.07254	1.31152	1.25841	1.21243	1.39634
36. TRUCKTRAN	.21571	.67475	.10955	1.00000	1.27788	.82298	.71519	.06721	1.27788	1.21963	1.15356	1.21750
37. AIR TRAN	.23925	.59647	.16428	1.00000	1.33279	.74972	.26081	.02513	1.33279	1.25693	1.49201	1.66791
38. COMMUNICAT	.13211	.73388	.13401	1.00000	1.17660	.82704	.48213	.03494	1.17660	1.12644	1.18667	1.19693
39. ELECTRICAL	.40173	.41286	.18541	1.00000	1.55469	.69721	.23519	.02277	1.55469	1.66493	2.90346	3.13717
40. GAS SERVIC	.05515	.65928	.28556	1.00000	1.07293	.69725	.16792	.01837	1.07293	1.05759	1.23022	1.26329
41. PEAT GAS	.05913	.94087	0	1.00000	1.06625	.98443	.15917	.01780	1.06625	1.03631	1.23816	1.35564
42. WATER	.43874	.23969	.27156	1.00000	1.60878	.55036	.45767	.05148	1.60878	2.29611	2.77413	2.57480
43. WHOLE SALE	.17930	.68507	.13563	1.00000	1.25193	.80993	.35672	.04804	1.25193	1.18226	1.32903	1.33246
44. RETAIL	.13209	.77299	.09453	1.00000	1.17593	.87185	.44573	.09611	1.17593	1.12848	1.10404	1.94104
45. F. I.	.25462	.59573	.14968	1.00000	1.34621	.78586	.65732	.08325	1.34621	1.31916	1.32264	1.71844
46. REAL EST.	.12232	.73389	.14380	1.00000	1.16305	.82345	.14257	.01461	1.16305	1.12234	1.58999	1.98219
47. HOTELS	.24059	.56363	.19578	1.00000	1.32381	.73487	.42761	.10760	1.32381	1.31383	1.30416	1.15169
48. BUSS SERVI	.33728	.53317	.12954	1.00000	1.47418	.78842	.80320	.14197	1.47418	1.47873	1.30381	1.17795
49. CAR REPAIR	.20473	.56134	.23392	1.00000	1.26214	.71549	.59876	.10045	1.26214	1.27460	1.13057	1.16617
50. AMUSEMENT	.18497	.57198	.24305	1.00000	1.24598	.71399	.72272	.14347	1.24598	1.23080	1.15963	1.11754
51. MEDICAL ED	.16037	.73077	.10886	1.00000	1.22348	.84534	.69371	.09961	1.22348	1.15673	1.11999	1.10627
52. FED. GOVT	.15552	.71482	.12966	1.00000	1.20616	.83315	1.14892	.08652	1.20616	1.16554	1.08573	1.08797
53. ST. LOC. G	.20952	.52464	.26584	1.00000	1.29068	.66070	.71113	.08160	1.29068	1.27458	1.12704	1.11702
54. OTHER	.53380	.02744	.43876	1.00000	1.81184	.40573	.87020	.12093	1.81184	14.78624	1.37248	1.50803
55. OTHER GOVT	0	1.00000	0	1.00000	1.00000	1.00000	1.00000	.11865	1.00000	1.00000	1.00000	.99098

1/ Employment change per $1,000 change in final demand, all others per $1 change in final demand.

imports per $1 gross outlay (col. 3). 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 supply-deficit industries).

The two-region input-output computer program generates an import table for the Study 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.

Final Demand Multipliers

The total final demand multiplier, which includes both the direct and indirect effects of a $1 change in final demand on the total regional economy, is derived for each industry in the Study Region (see, col. 5). Both the direct effect and the individual industry sources of the indirect effect (which are not shown in tables 3.5, 3.6 and 3.7) are derived in the two-region computer program.

The output multiplier is represented in terms of industry gross output, value added (i.e., income), and employment in two ways: first, as a change in the specified indicator per $1 change (or $1,000 change) in specified final demand and, second, as the total change in the specified indicator per 1-unit change in its final demand equivalent. Because of differing relationships between the two series of indicators, the final demand multiplier will differ in its interpretation for each industry. Labor-intensive industry generally has high income and employment multipliers. Capital intensive

industry has 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 final demand multipliers, whether based on gross output, value added, earnings 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 yields 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 or 1985. They differ for each development system and each of the two base years in this study.

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, four economic impact indicators were cited, namely, gross output, value added, earnings, and employment. The four 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 mineral industry output).

First, the base year 1970 levels of employment, income and gross output are specified for the Study Region economy. To illustrate: Sector 5

-- iron ore mining -- accounts for a total production-related employment which is equivalent to an employed work force of 11,601. Income payments of this sector for primary inputs, i.e., labor earnings and capital earnings, total $218,489,000. Gross output (which is equal to gross outlay in the input-output) totals $563,024,000.

Each of the four economic indicators is shown, next, in terms of its direct relationship to final demand (see, col. 1, 2, 3 and 4, tables 3.5, 3.6 and 3.7). The direct effect of a $1 increase in final demand is a $1 increase in total outlay, of which 26.78 cents is used for intermediate purchases, 56.133 cents is used for primary inputs and 17.087 cents for imports.

The Leontief inverse is computed from the technical coefficients, which is the third step in the preparation of the estimates and projections of the total effects, given a change in final demand. (see, columns 5, 6, 7 and 8). The results of this operation show the total effect on gross output, value added, earnings and employment of a $1 change in final demand. Thus, for each $1-increase in final demand for iron ore, an increase of $1,691 in gross output is required. This increase in gross output is associated with a $0.599 increase in value added, a $0.471 increase in total earnings, and a small fractional increase in employed work force (which is shown as a 0.088886-person increase per $1,000 increase in final demand) in the baseline series.

The corresponding final demand multipliers are derived by dividing the direct effect in specified units into the total effect (in constant dollars).

Thus, they show a different set of inter-industry differences in the total effect of a 1-unit change in a given final demand (see, columns 9, 10, 11 and 12 and compare with columns 5, 6, 7 and 8, respectively). The value added multiplier, for example, shows the total value effect (across all industries) of a $1-increase in value added(associated with a given increase in final demand) in a given industry, while the employment multiplier shows the total employment effect (across all industries) of a 1-person increase in total employed work force (associated with a given increase in final demand) in a given industry.

The four sets of multipliers vary greatly among industries because of differences in the corresponding input-output relationships. While the employment multiplier, for example, is small for the iron mining sector, it is large for the food and products manufacturing sector. Employment requirements per $1,000 of gross output differ greatly in the two production systems. The value added and earnings differ, also, because of differences in employment and capital 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.

The two ways of presenting the total effects are confined to year-to-year changes in final demand. Hence, the change in each of the four indicators which is associated with a $1 change in final demand, or a 1-unit change in the demand for the given input or output represented by this indicator, is a

short term change. It is re-computed each year as the accumulative effects change local final demands. In this way, the induced effects enter the computational process in the measurement of accumulative, long term economic impacts.

DEMOGRAPHIC TRENDS AND PROJECTIONS

The demographic consequences of resource development in northern Minnesota are represented by changes in population, including sources of population change encompassed in the two fundamental demographic variables -- natural increase and migration. The natural increase in regional population is linked to social and economic conditions which are of national scope. Migration, however, is a function of local conditions, especially employment opportunities. Significant peat land development ultimately affects in some way the level of migration into and out of the extended Study Region.

In this and the next five chapters, the estimates and projections pertain to the 19 counties in northern Minnesota within the three planning regions -- Northwest, Headwaters and Arrowhead. The seven Northeast Minnesota counties identified in this listing are included, also, in the eight-county Study Region.

Population

Total population in northern Minnesota increased slightly from 1950 to 1970, but declined from 1972 to 1975. It is projected to increase, again, in the 25-year period from 1975 to 2000 (table 4.1).[14/] In this projection series, neither peat land development nor copper-nickel

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14/ Difference between estimated and projected 1975 population is due primarily to a larger-than projected increase in population in the Headwaters Region which is attributed to net in-migration of people.

Table 1.1. Estimated and projected population in specified area and county, northern Minnesota, 1950-2000.

Area and County	Estimated [1]								Projected [5]					
	1950	1960	1970	1971 [2]	1972 [2]	1973 [3]	1974 [4]	1975 [3]	1975	1980	1985	1990	1995	2000
	(number)													
Northwest Region:														
Kittson	9,644	8,343	6,853	7,000	7,000	6,998	6,900	6,958	7,000	6,800	6,800	6,700	6,500	6,200
Marshall	16,125	14,262	13,060	13,300	13,400	13,363	13,000	13,371	13,200	13,000	13,100	13,100	13,100	12,800
Norman	12,909	11,253	10,008	10,000	9,900	9,641	9,500	9,523	9,700	9,500	9,500	9,400	9,200	9,000
Pennington	12,965	12,468	13,266	14,000	14,200	14,459	14,300	14,544	14,400	15,100	16,100	16,900	17,600	18,200
Polk	35,900	36,182	34,436	34,700	35,000	35,129	35,100	35,285	34,900	34,800	35,100	35,000	34,600	33,700
Red Lake	6,806	5,830	5,388	5,500	5,400	5,375	5,300	5,304	5,300	5,200	5,200	5,200	5,200	5,100
Roseau	14,505	12,154	11,569	11,800	12,000	12,225	12,300	12,322	12,100	12,100	12,500	12,700	12,900	12,800
Total	108,859	100,492	94,579	96,200	96,900	97,190	96,400	97,307	96,600	96,500	98,200	99,000	99,200	97,800
Headwaters Region:														
Beltrami	24,962	23,425	26,373	27,400	28,400	28,587	29,400	29,501	28,300	30,200	32,400	34,300	36,200	37,900
Clearwater	10,204	8,864	8,013	8,200	8,600	8,576	8,500	8,753	8,500	8,300	8,500	8,400	8,400	8,300
Hubbard	11,085	9,962	10,583	11,100	11,500	11,862	12,100	12,119	11,800	12,400	13,300	14,200	15,400	16,900
Lake of the Woods	4,955	4,304	3,987	4,200	4,300	4,075	4,200	4,239	4,200	4,200	4,300	4,300	4,300	4,200
Mahnomen	7,059	6,341	5,638	5,600	5,700	5,714	5,700	5,805	5,700	5,600	5,700	5,600	5,600	5,400
Total	58,265	52,896	54,594	56,500	58,500	58,814	59,900	60,417	58,500	60,800	64,200	66,900	70,100	72,800
Arrowhead Region:														
Aitkin	14,327	12,162	11,403	11,700	12,100	12,201	12,400	12,552	12,400	12,300	12,600	12,600	12,600	12,800
Carlton	24,584	27,932	28,072	28,600	28,900	28,629	28,400	28,689	28,900	29,300	30,300	30,900	31,100	30,800
Cook	2,900	3,377	3,423	3,500	3,700	3,716	3,500	3,688	3,500	3,500	3,500	3,500	3,600	3,700
Itasca	33,321	28,006	35,530	36,500	37,000	37,139	37,300	38,504	36,500	36,600	37,700	37,700	37,500	36,400
Koochiching	16,910	18,190	17,131	17,300	17,600	17,407	17,300	17,664	17,600	17,800	18,200	18,400	18,300	17,800
Lake	7,781	13,702	13,351	13,600	13,300	13,351	13,100	13,780	13,500	13,700	14,000	14,200	14,200	13,900
St. Louis	206,062	231,588	220,693	222,000	221,000	218,288	216,100	216,220	218,700	217,100	216,400	215,000	212,900	210,000
Total	305,885	344,957	329,603	333,800	333,700	330,731	328,100	331,097	331,100	330,300	332,600	332,400	330,200	325,400
All Counties	473,009	498,345	478,776	486,500	489,100	486,735	484,400	488,821	486,200	487,600	495,000	498,300	499,500	496,000

1/ U.S. Bureau of the Census, 1970 Census of Population, U.S. Government Printing Office, Washington, D.C., 1972.

2/ Population Estimates for Minnesota Counties 1974, Office of the State Demographer, Development Planning Division, State Planning Agency, July, 1975.

3/ U.S. Bureau of the Census, Current Population Reports, Series P-25, No. 671, May 1977.. 1973 (revised) and 1975 Population Estimate and 1972 (revised) and 1974 Per Capita Income Estimates for Counties, Incorporated Places, and Selected Minor Civil Divisions in Minnesota.

4/ Current Population Reports, Population Estimates and Projections, Series P-25, No. 709,. September 1977. Estimates of the Populatiorof Counties and Metropolitan Areas: July 1, 1971 and 1975.

5/ Minnesota Population Projections 1970-2000, Office of the State Demographer, State Planning Agency, Division of Development Planning, 101 Capital Square Building, St. Paul, MN, 55101.

development are incorporated directly into the underlying assumptions. Hence, the baseline projections correspond with the baseline series cited earlier.

The baseline projections show an internal shift in total population. The Headwaters Region, for example, is projected to experience a sharp reversal from a declining to an increasing total population. Total population in the Arrowhead Region would decline slightly during the projection period.

Much of the county-to-county shift in resident population is associated with differences in migration levels (table 4.2). The natural increases component, while changing dramatically from decade to decade, follows a similar pattern for each county. The migration component, however, shifts sharply from net out-migration to net in-migration in several counties.

The age distribution of population in each of the three planning regions is shown, also, because of its importance in public facility planning, particularly schools and hospitals (table 4.3). For example, total persons born in the 1965-69 period was less than in any previous five-year period. The small number of births was the result of a low birth rate and a small female population in the child-bearing age classes. Subsequent increases in total births were due, not to higher birth rate (which continue to decline), but to a larger female population in the child-bearing

Table 4.2. Estimated population change in specified area and county, by population change component, Minnesota, 1950-75. [1/]

Area & County	Natural Increases				Migration				Total
	1950-60	1960-70	1970-75	Total	1950-60	1960-70	1970-75	Total	
				(number)					
Northwest Region:									
Kittson	1,153	339	105	1,597	-2,459	-1,829		-4,288	-2,691
Marshall	2,157	1,171	211	3,539	-4,020	-2,373	100	-6,293	-2,754
Norman	1,231	400	-85	1,546	-2,887	-1,645	-400	-4,932	-3,386
Pennington	1,935	931	478	3,344	-2,432	-133	800	-1,765	1,579
Polk	5,578	3,357	650	9,585	-5,296	-5,104	200	-10,200	-615
Red Lake	1,039	516	316	1,871	-2,015	-958	-400	-3,373	-1,502
Roseau	2,456	1,154	453	4,063	-4,807	-1,739	300	-6,246	-2,183
Total	15,549	7,868	2,128	25,545	-23,916	-13,781	600	-37,097	-11,552
Headwaters Region:									
Beltrami	3,979	2,630	528	7,137	-5,516	318	2,600	-2,598	4,539
Clearwater	1,130	397	240	1,767	-2,470	-1,248	500	-3,218	-1,451
Hubbard	1,230	518	536	2,284	-2,353	103	1,000	-1,250	1,034
Lake of the Woods	748	556	52	1,356	-1,399	-873	200	-2,072	-716
Mahnomen	1,287	788	267	2,342	-2,005	-1,491	-100	-3,596	-1,254
Total	8,374	4,889	1,623	14,886	-13,743	-3,191	4,200	-12,734	2,152
Arrowhead Region:									
Aitkin	1,270	233	-251	1,252	-3,435	-992	1,400	-3,027	-1,775
Carlton	4,371	3,032	917	8,320	-1,023	-2,892	-300	-4,215	4,105
Cook	568	334	65	967	-91	-288	200	-179	788
Itasca	6,963	3,059	1,874	1,896	-2,278	-5,535	1,100	-6,713	5,183
Koochiching	2,968	1,506	733	5,207	-1,688	-2,565	-200	-4,453	754
Lake	2,413	2,006	129	4,548	3,508	-2,357	300	1,451	5,999
St. Louis	30,223	16,830	4,327	51,380	-4,697	-27,725	-8,800	-41,222	10,158
Total	48,776	27,000	7,794	83,570	-9,704	-42,354	-6,300	-58,358	25,212
All Counties	72,699	39,757	11,545	124,001	-47,363	-59,326	-1,500	-108,189	15,812

1/ U.S.D.A., ERS, et. al., Net Migration of the Population, 1960-70, by Age, Sex and Color, Part 2. North Central States. Athens, Georgia, University of Georgia Printing Dept., 1975.

U.S.D.A., ERS, Net Migration of the Population, 1950-60, by Age, Sex and Color, Part 2. North Central States. Athens, Georgia, University of Georgia Printing Dept.

U.S. Department of Commerce, Bureau of the Census. Estimates of the Population of Counties and Metropolitan Areas: 1971 & 1975. Current Population Reports, Population Estimates & Project. Series P-25, No. 709, [illegible]

Table 4.3. Estimated and projected population in specified age class, by planning region, northern Minnesota, 1970, 1985 and 2000.[1/]

Age Class	Northwest			Headwaters			Arrowhead		
	Estimated	Projected		Estimated	Projected		Estimated	Projected	
	1970	1985	2000	1970	1985	2000	1970	1985	2000
	(number)								
0-4	7,405	5,732	7,723	4,204	5,108	4,165	25,155	25,861	18,411
5-9	9,776	6,634	6,936	5,686	4,702	4,470	33,132	23,788	20,691
10-14	10,608	7,613	5,657	6,008	3,962	5,154	37,329	19,846	23,800
15-19	9,290	7,288	7,408	6,059	4,911	5,743	33,826	23,721	23,714
20-24	4,826	5,883	8,754	4,326	6,262	5,161	20,713	28,384	19,947
25-29	4,958	4,474	9,142	2,662	5,744	3,823	17,178	30,739	15,470
30-34	4,332	6,633	8,757	2,435	5,843	4,522	15,796	29,383	20,608
35-39	4,443	8,737	5,275	2,390	4,459	6,173	16,210	19,185	26,757
40-44	4,907	9,444	4,946	2,479	3,247	6,269	18,087	17,041	31,006
45-49	5,219	8,355	4,459	2,707	2,774	6,633	19,049	15,754	28,098
50-54	5,460	4,685	4,408	2,842	2,505	5,243	19,703	15,666	17,870
55-59	5,262	4,268	4,730	2,916	2,501	4,187	19,411	16,761	15,615
60-64	4,883	3,948	4,805	2,792	2,680	2,669	15,764	16,707	13,964
65-69	4,171	3,651	4,590	2,358	2,829	2,264	12,299	16,163	13,114
70-74	3,627	3,551	3,944	1,891	2,596	2,047	9,910	14,227	12,636
75-79	3,971	3,045	3,678	1,419	2,056	1,858	7,919	9,819	10,638
80-84	1,831	2,300	2,129	879	1,265	1,443	5,126	5,950	7,917
85+	1,120	1,556	1,494	541	739	961	2,996	3,559	5,153
Total	94,579	97,797	98,235	54,594	64,183	72,785	329,603	332,554	325,409

1/ Minnesota Population Projections: 1970-2000, Office of the State Demographer, State Planning Agency, 101 Capital Square Building, St. Paul, Minnesota, 55101, November, 1975.

Table 4.4. Estimated and projected labor force 16 years and older in specified sex and age class, by planning region, northern Minnesota, 1970, 1985, and 2000. [1/]

Sex and Age Class	Northwest			Headwaters			Arrowhead		
	Estimated	Projected		Estimated	Projected		Estimated	Projected	
	1970	1985	2000 [2/]	1970	1985	2000 [2/]	1970	1985	2000 [2/]
	(number)								
Male:									
16-24	3,538	4,816	3,890	2,342	3,136	3,180	14,193	15,923	17,134
25-34	4,103	8,728	5,350	2,283	5,415	4,137	15,379	29,087	17,235
35-44	4,334	4,719	8,861	2,235	3,700	6,206	16,393	16,026	27,758
45-64	8,859	7,079	8,115	4,669	4,055	8,780	31,615	25,240	28,043
65+	1,715	1,112	828	877	696	525	2,555	2,386	2,239
Total	22,549	26,454	27,044	12,386	17,002	22,828	80,135	88,662	92,409
Female:									
16-24	2,618	4,295	3,668	1,872	2,730	2,803	10,364	18,662	12,102
25-34	1,803	4,943	3,299	949	3,035	2,236	6,175	15,732	10,350
35-44	2,158	2,909	5,283	1,167	2,135	3,530	7,695	10,724	16,989
45-64	4,695	4,400	5,472	2,389	2,343	3,694	16,009	14,469	23,664
65+	721	667	606	286	346	320	1,706	1,958	1,992
Total	11,995	7,214	18,328	6,663	10,589	12,583	41,949	57,045	65,097
All Classes	34,544	43,668	45,372	19,049	27,591	35,411	122,084	145,707	157,506

1/ Minnesota Labor Force Projections, Development Planning Division, State Planning Agency, 101 Capitol Square Building, St. Paul, Minnesota, 55101, July, 1976.

2/ Based on projected trends in labor force participation rates and projected populations.

age classes. When this population declines, total births decline, also (as indicated by the projections for the year 200 compared with the year 1985).

Regional requirements for public school facilities in the 1970-85 period will decline insofar as these requirements are based on the school-age populations. In the 1985-2000 period, however, these requirements will increase. Requirements for health care facilities, on the other hand, will increase first, then decline slightly in the second 15-year period. An influx of population associated with peat development will modify the projected age distribution of population and, thus, its public facility and service requirements.

Labor Force

Total labor force is a derivative of total population. All persons 16 years and older who are employed or seeking employment are in the labor force (table 4.4). Employed persons include persons employed in both civilian and military positions. Self employed and unpaid family workers (largely in farming and retail trade) are included, also, in the employed labor force. Persons seeking work who remain unemployed are part of the unemployed labor force. The proportion of the total labor force which is unemployed is set at four percent in the baseline and development projections.

The total labor force in each of the three planning regions is projected to increase in the 30-year period, 1970-2000. The largest relative increase is projected for the Headwaters Region. The smallest increases are projected for the Northwest Region.

The age distribution of the labor force in each region shifts dramatically over the 30-year period. In 1970, the 45-to-64-year age group accounted for the largest number of persons in the total labor force, both male and female. By 1985, the 25-to-34-year age group is projected to become the largest of the five groups. In the next 15 years the projection series show a gradual shift, again, to an older labor force. Thus, during the first years of the projected copper-nickel and peat development, a relatively large labor force would be available as potential workers in the development-related activities.

The increase in labor force relative to population in the 1970's and later years is due to increases in (1) total population 16 years and older and (2) female labor force participation (table 4.5). While the rates of increase in persons 16 to 18 years of age are down, the rates of increase in female labor force participation in older age groups are up. The high female labor force participation rates and the increases in total female population combine to produce large increases in total labor force.

Age-specific rates of male and female labor force participation reveal the increasing importance of women in the future labor force and, also, the continuing effects of higher education and early retirement programs. If participation in higher education and/or early retirement programs were to decline, male labor force participation rates would increase. However, neither one of the two possibilities is incorporated into the baseline labor force projection series.

Table 4.5. Estimated and projected labor force participation rates in specified sex and age class, by planning region, northern Minnesota, 1970, 1985 and 2000. [1/]

Sex and Age Class	Northwest			Headwaters			Arrowhead		
	Estimated	Projected		Estimated	Projected		Estimated	Projected	
	1970	1985	2000 [2/]	1970	1985	2000 [2/]	1970	1985	2000 [2/]
	(percent)								
Male:									
16-24	58.2	64.2	65.4	49.6	57.8	51.0	61.1	66.4	66.8
25-34	94.3	93.7	93.3	89.9	90.6	91.2	95.5	94.5	93.9
35-44	92.4	92.7	93.5	92.2	92.6	93.4	96.4	95.5	95.5
45-64	82.7	78.8	81.0	82.4	78.6	81.0	86.5	81.2	82.8
65+	25.6	16.2	14.0	23.9	15.4	13.6	14.7	11.3	11.1
Average	69.3	70.1	72.9	65.2	67.8	73.4	72.7	71.7	72.8
Female:									
16-24	44.8	59.6	63.6	41.7	56.9	61.7	43.4	58.4	62.8
25-34	40.7	57.6	61.4	37.1	54.1	58.7	36.6	53.6	58.4
35-44	46.3	56.7	60.7	47.3	57.5	60.9	44.5	55.2	59.2
45-64	46.4	46.7	48.7	42.7	44.2	46.8	42.8	44.3	56.9
65+	10.3	8.0	7.4	8.4	7.0	6.8	8.5	6.8	6.8
Average	37.4	44.5	46.7	36.0	43.4	47.0	36.1	42.4	47.7
All Classes	53.5	57.1	59.4	50.8	55.8	61.2	53.9	56.4	59.7

1/ Minnesota Labor Force Projections, Development Planning Division, State Planning Agency, 101 Capitol Square Building, St. Paul, Minnesota, 55101, July, 1976.

2/ Based on projected trends in labor force participation rates and projected populations.

Employment Status

Employment status refers to the levels and rates of employment and unemployment of the resident labor force. Civilian employment covers farm and nonfarm, including private industry and government, employment. Two different definitions of employment -- the employed labor force and the employed work force -- are used. The employed labor force is a count of employed persons who reside in the region. An employed person is assigned to the job which brings the most remuneration in case of a multiple job holder. The employed work force is a count of jobs held by employed persons. Since one employed person may have more than one job, the count of employed work force is higher than the count of employed labor force. Two exceptions occur to this rule, namely, when the resident labor force differs from the resident work force and when under-reporting of jobs occurs (because of the incomplete coverage of the Unemployment Insurance Program from which the statistics are obtained).

The two concepts of employment are compared for the 1970 calendar year (table 4.6). The employed labor force is reported for the first week in April 1970. The employed work force is an estimated annual average of total employment. A common industry breakdown is used to facilitate the industry by industry comparisons.

The employed work force is larger than the employed labor force in most counties. In two of the 19 counties (i.e., Beltrami and Lake), however, the April 1970 employed labor force was larger than the average 1970 employed work force. In these counties, the differences are accounted for

ole 4.6. Estimated labor force in specified county and planning region, by labor force status, northern Minnesota, 1970.

nning Region County	Labor Force									Employed Worked Force
	Male				Female				Total	
	Employed		Unemployed	Total	Employed		Unemployed	Total		
	Civilian	Military			Civilian	Military				
	(number)									
rthwest Region;										
Kittson	1,512	0	94	1,606	815	0	49	864	2,470	2,971
Marshall	2,746	5	348	3,099	1,173	0	196	1,373	4,472	5,148
Norman	2,248	10	143	2,401	916	0	54	970	3,371	3,630
Pennington	3,125	0	257	3,382	1,891	0	196	2,087	5,469	6,877
Polk	7,505	114	482	8,101	4,379	0	252	4,631	12,732	13,694
Red Lake	1,084	3	105	1,192	510	0	58	568	1,760	2,068
Roseau	2,428	0	275	2,703	1,205	0	205	1,470	4,173	5,589
Total	20,648	132	1,704	22,484	10,953	0	1,010	11,963	34,447	39,977
adwaters Region:										
Beltrami	5,285	6	468	5,759	3,442	0	180	3,622	9,381	7,527
Clearwater	1,739	11	204	1,954	869	0	52	921	2,875	2,951
Hubbard	2,061	5	171	2,237	1,040	0	133	1,173	3,410	3,242
Lake of the Woods	712	254	84	1,050	395	0	26	421	1,471	1,361
Mahnomen	1,233	0	78	1,311	549	0	14	563	1,874	2,330
Total	11,030	276	1,005	12,311	6,295	0	405	6,700	19,011	17,411
rowhead Region:										
Aitkin	2,246	0	286	2,532	1,129	0	165	1,294	3,826	3,763
Carlton	6,271	25	393	6,689	3,126	0	207	3,333	10,022	9,690
Cook	805	13	40	858	491	0	37	528	1,386	1,200
Itasca	7,073	0	1,076	8,149	3,326	0	391	3,717	11,866	11,254
Koochiching	3,899	23	254	4,170	1,783	10	251	2,044	6,214	5,956
Lake	3,099	143	198	3,440	1,224	0	192	1,416	4,856	4,276
St. Louis	48,704	1,991	3,494	54,189	27,226	44	2,189	29,459	83,648	86,050
Total	72,091	2,195	5,741	80,027	38,305	54	3,432	44,791	121,818	122,189
nnesota Counties	103,769	2,603	8,450	114,822	55,553	54	4,847	60,454	175,276	179,577

largely by net out-commuting of the resident labor force to places of work outside the county of residence. In another five counties (i. e., Hubbard, Lake of the Woods, Aitkin, Carlton and Koochiching), high unemployment is coupled with net-out-commuting to account for the positive differentials between total labor force and total employed work force.

The occupational distribution of the labor force in each planning region is shown for both the male and the female population, 16 years and older (table 4.7). In the demographic analyses reported later, employed and unemployed persons in the labor force are identified by sex and occupational class. Only the total employed labor force is identified by occupational class and industry group.

Large differences occur in the occupational mix and employment status of the male and female labor force in each planning region. The male employed labor force, for example, is dominantly "blue collar". The female employed labor force is dominantly "white collar". The unemployed labor force is dominantly "blue collar" for both male and female.

In the peat development options, the expansion of employment in manufacturing and related service industries will be associated with shifts in the occupational distribution of the employed work force. These shifts are discussed in the next chapter.

In summary, studies show that even if no peat-related industry were to be started within the 19 county area during the years 1975-2000, the total population would increase. Yet, inter-county migration will occur, shifting the population of individual counties more or less than the 19 county average.

Table 4.7. Estimated number of persons in labor force in specified occupational class, by employment status, northern Minnesota, 1970. [1/]

Occupational Class	Northwest			Headwaters			Arrowhead		
	Male	Female	Total	Male	Female	Total	Male	Female	Tota
				(number)					
Employed:									
Professional, technical & kindred workers	1,632	1,744	3,376	1,454	1,009	2,463	8,739	6,671	15,40
Managers and administrators, exc. farm	2,410	417	2,827	1,272	282	1,554	7,452	1,615	9,06
Sales workers	873	869	1,742	516	462	978	3,558	2,994	6,55
Clerical & kindred workers	878	2,499	3,377	406	1,771	2,177	3,840	11,450	15,29
Craftsmen, foremen and kindred	3,508	145	3,653	1,903	91	1,994	18,831	560	19,45
Operatives	3,172	976	4,148	1,502	378	1,880	16,065	3,286	19,35
Laborers, exc. farm	1,095	93	1,188	778	56	834	6,012	413	6,42
Service workers	1,078	3,315	4,393	895	1,796	2,691	5,864	9,633	15,49
Farmers/managers/laborers	5,996	369	6,365	2,298	206	2,504	1,634	291	1,92
Private household	6	526	532	6	244	250	30	1,392	1,42
Total employed	20,648	10,953	31,601	11,030	6,295	17,325	72,091	38,305	100,39
Unemployed:									
Professional, technical, managers	46	60	106	55	18	73	28	227	35
Sales workers	21	14	35	17	5	22	128	210	33
Clerical and kindred workers	42	104	146	34	110	144	120	679	79
Craftsmen, foremen and kindred	470	0	470	266	0	266	1,491	0	1,49
Operatives	631	500	1,131	201	81	282	1,577	599	2,17
Laborers, exc. farm	280	104	384	243	9	252	1,234	142	1,37
Service workers	31	153	184	64	108	172	473	886	1,35
Farm workers	166	23	189	94	5	99	40	12	5
Private household	2/	12	2/	2/	37	2/	2/	75	2
Total unemployed	1,687	970	2,657	974	373	1,347	5,491	2,830	8,32
Total labor force	22,335	11,923	34,258	12.004	6,668	18,672	50,940	41,135	102,07

1/ U.S. Bureau of the Census, Census of Population: 1970, General Social and Economic Characteristics, Final Report PC (1)-C25, Minnesota, U.S. Government Printing Office, Washington, D.C., 1972.

2/ Male private household workers are included with service workers.

INDUSTRY EMPLOYMENT

Industry employment is derived from the two statistical sources used in the preceding chapter, namely, the U.S. Census of Population and the U.S. Unemployment Insurance Program. The U.S. Census of Population provides data on the sex, occupational, and industry distribution of the total labor force. The Unemployment Insurance Program is used in periodic reporting to the U.S. Department of Commerce, which prepared the annual employment and income estimates published by the Regional Economic Information System and the first-quarter covered employment and payroll estimates published annually in County Business Patterns. Both industry employment series are used in deriving the employment series used in measuring the industry effects of peat resource development in northern Minnesota.

Industry Classification

A first step in compiling industry employment statistics is a consistent classification by industry. In this chapter, a 36-industry breakdown of employed labor force and a 39-industry breakdown of employed work force are used. Both industry groupings follow the industry classification scheme published in the official U.S. Office of Management and Budget (OMB) Standard Industry Classification Manuel.

Employed labor force

In the 36-industry breakdown of employment for Northern Minnesota, primary (agriculture, forestry and fisheries, and mining), secondary (contract construction and manufacturing) and tertiary (all non-commodity-producing) industries are listed for comparison with corresponding

U.S. industry employment series (table 5.1). Sufficient industry detail is not available in this series, however, for listing individually the peat-related (i.e., agriculture, mining, chemicals and allied products, and utilities) and copper-nickel-related (i.e., mining, primary metals and fabricated metals) industries in the Study Region. Rather, historical trends in all segments of the Study Region economy are presented as introductory background information for assessing the validity of the economic forecasts presented earlier.

The employed labor force in each planning region is listed for the historical base year of this study, namely, 1970 (table 5.2). Comparisons of the industry mix reveal differences in the economic structure of each region, namely, the dependence on agriculture, mining, timber production and other export-producing industry. In addition, industry-mix differences occur in the tertiary sector because of differences in the level of local demand for services, which, in turn, are due to differences in levels of per capita income and urbanization.

Employed work force

The industry classification scheme for the employed work force in northern Minnesota is derived from related work dealing with the measurement of industry output, income payments and product sales to other industries, households and government. An 85-industry breakdown of U.S. industry output and employment is the basis for a corresponding breakdown of industry employment for northern Minnesota. The 85-industry breakdown is regrouped into a 39-industry breakdown for this study (table 5.3).

Table 5.1. Industry classification of employed labor force, U.S. and Minnesota, 1940-2000.

Industry No.	Industry Title	U.S. Dept. of Commerce 28-sector series	U.S. Dept. of Commerce 85-industry series	Related SIC Codes (1967 edition)
1.	Agriculture & Agr. Serv.	1	1, 2, 4	01, 02, 07 (exc. 071
2.	For. & Fisheries	2	3	08, 09
3.	Mining	3	5-10	10-14
4.	Construction	4	11, 12	15-17
5.	Food & Kindred Prod.	5	14	0713, 20
6.	Textile Mill Prod.	6	16, 17	22
7.	Apparel & Other Fab. Prod.	7	18, 19	23
8.	Lumber, Wood Prod., Furn.	8		24, 25
9.	Printing, Pub. & Allied Prod.	9	26	27
10.	Chemicals & Allied Prod.	10	27-30	28
11.	Machinery, exc. Elec.	11 (pt)	43-52	35
12.	Electrical Mach.	11 (pt)	53-58	36
13.	Motor Vehicles & Equip.	12	59	371
14.	Trans., exc. Mot. Veh.	13	60, 61	37 (exc. 371)
15.	Pulp & Paper Prod.	14 (pt)	24, 25	26
16.	Petroleum Ref. & Kel. Ind.	14 (pt)	31.1, 31.2	29
17.	Primary Metals	14 (pt)	37, 38	33
18.	Fabricated Metals	14 (pt)	39-42	34
19.	Misc. Manuf.	14 (pt)	13, 15, 32-36, 62-64	19, 21, 30, 31, 32, 3
20.	Railroads & Rail. Exp.	15	65.2 (pt)	40
21.	Trucking & Warehousing	16	65.4 (pt)	42
22.	Other Transportation	17	65.1, 65.2 (pt) 65.4 (pt)65.3, 6.5	41, 44-47
23.	Communication	18	66, 67	48
24.	Elec., Gas, & San., Util.	19	68	49
25.	Wholesale Trade	20 (pt)	69.1	50
26.	Food & Dairy Prod. Stores	20 (pt)	69.2 (pt)	54
27.	Eating & Drinking Pl.	20 (pt)	69.2 (pt)	58
28.	Other Retail Trade	20 (pt)	69.2 (pt)	52, 53, 55-57, 59
29.	F.I.R.E.	21	70, 71	60, 67
30.	Lodging & Personal Serv.	22	72 (pt)	70, 72
31.	Business & Repair Serv.	23	72 (pt), 73 (pt), 75 (pt)	73, 75, 76
32.	Entertain. & Rec. Serv.	24	76	78, 79
33.	Private Households	25	--	88
34.	Prof. Services	26	73 (pt), 77	80, 81, 83, 84, 86, 89
35.	Public Admin.	27	78 (pt), 79 (pt)	91 (exc. 9190) 92, 9
36.	Military	28	--	9190 (pt)

Table 5.2. Estimated employed labor force in specified industry, by planning region, northern Minnesota, 1970.

Industry No.	Industry Title	Northwest Total (no.)	Northwest Proportion of Total (pct.)	Headwaters Total (no.)	Headwaters Proportion of Total (pct.)	Arrowhead Total (no.)	Arrowhead Proportion of Total (pct.)
1.	Agriculture	6,722	20.8	2,610	14.8	2,285	2.0
2.	For. and Fish.	18	.1	150	.8	496	.4
3.	Mining	27	.1	40	.2	12,249	10.9
4.	Construction	1,614	5.0	1,155	6.5	6,109	5.4
5.	Food Prod.	1,447	4.5	212	1.2	1,860	1.7
6.	Textile Prod.	13	2/	37	.2	220	.2
7.	Apparel	70	.2	126	.7	1,291	1.2
8.	Lumber, Furn.	320	1.0	807	4.6	2,329	2.1
9.	Printing & Pub.	260	.8	168	1.0	1,950	1.7
10.	Chemicals	60	.2	69	.4	338	.3
11.	Machinery, exc. Elec.	617	1.9	41	.2	1,022	.9
12.	Electrical Mach.	20	.1	36	.2	314	.3
13.	Motor Vehicles	85	.3	0	0	42	2/
14.	Trans.exc. Mot. Veh.	1,162	3.6	51	.3	165	.2
15.	Paper Prod.	18	.1	23	.1	5,141	4.6
16.	Petroleum Refining	0	0	12	.1	119	.1
17.	Primary Metals	6	2/	0	0	2,518	2.2
18.	Fabricated Metals	29	.1	30	.2	1,167	1.0
19.	Misc. Manuf.	177	.6	78	.4	1,108	1.0
20.	Railroads	513	1.6	97	.6	2,938	2.6
21.	Trucking	630	2.0	349	2.0	957	.8
22.	Other Transp.	174	.5	161	.9	1,447	1.3
23.	Communications	349	1.1	128	.7	1,309	1.2
24.	Elec.,gas, Sani.	400	1.2	254	1.4	1,988	1.8
25.	Wholesale Trade	1,178	3.5	258	1.5	3,704	3.3
26.	Food Stores	777	2.4	420	2.4	3,199	2.8
27.	Eating & Drinking	1,437	4.4	833	5.3	4,277	3.8
28.	Other Retail	3,666	11.4	2,095	11.9	11,562	10.3
29.	F. I. R. E.	713	2.2	382	2.2	3,422	3.0
30.	Lodging, Personal	631	2.0	575	2.9	3,424	3.0
31.	Business & Repair	655	2.0	463	2.6	2,160	1.9
32.	Entertain. & Rec.	132	.4	60	.3	734	.6
33.	Private Households	764	2.4	344	2.0	1,922	1.7
34.	Prof. Services	6,298	19.5	4,641	26.3	23,054	20.6
35.	Public Admin.	1,285	4.0	919	5.2	5,264	4.7
36.	Military						
	Total	32,267	100.0	17,664	100.0	112,095	100.0

Table 5.3. Industry classification for employed work force, U.S. and Minnesota, 1970-1985.

Industry No.	Industry Title	U.S. Dept. of Commerce 36-industry series	U.S. Dept. of Commerce 85-industry series	Related SIC Codes (1967 edition)
1.	Livestock & live. prod.	pt. 1	1	0132, pt. 014, 0193, pt. 0729, 0139
2.	Other agric. products	pt. 1	2	0112, pt. 014, 0192
3.	Agri. services, for., fish.	pt. 1, 2	3, 4	07-09, (exc. 0729, 0722)
4.	Iron & ferro alloy ores	pt. 3	5	101, 105
5.	Nonferrous metal ores	pt. 3	6	102-105, 108, 109
6.	Other mining, quarrying	pt. 3	7-10	11, 12, 131, 132, 14
7.	Construction	4	11, 12	15-17, pt. 138, 6511
8.	Food & kindred products	5	14	201-265
9.	Lumber, wood prod. & furn.	8	20-23	241-249, 251-259
10.	Pulp & paper prod.	15	24, 25	261-265
11.	Printing, pub. & allied	9	26	271-279
12.	Chemicals & allied prod.	10	27-30	28
13.	Petroleum ref. & rel. ind.	16	31	29
14.	Stone, clay & glass	pt. 19	35, 36	32
15.	Primary metals	17	37, 38	33
16.	Fabricated metals	18	39-42	34
17.	Machinery, exc. elec.	11	43-52	35
18.	Electrical machinery	12	53-58	36
19.	Other manufacturing	6, 7, 13, 14, pt. 19	13, 15-19, 32-34, 59-64	19, 21, 22, 23, 30, 31, 37-39
20.	Railroad transportation	20	pt. 65	40, 474
21.	Trucking & warehousing	21	pt. 65	42, 473
22.	Other transportation	22	pt. 65	41, 44-47
23.	Communication	23	66, 67	48
24.	Electric utilities	pt. 24	pt. 68	491, pt. 493
25.	Gas utilities	pt. 24	pt. 68	492, pt. 493
26.	Other utilities	pt. 24	pt. 68	494-497, pt. 493
27.	Wholesale trade	25	pt. 69	50
28.	Retail trade	26, 27, 28	pt. 69	52-59, 7396, pt. 8099
29.	F. I. R. E.	29	70, 71	60-67
30.	Lodging & pers., & rep. serv.	30, pt. 31	72	70, 72, 76
31.	Business services	pt. 31, pt. 34	73	73 (exc. pt. 7396) 81, 89
32.	Medical, educational	pt. 34, pt. 1	77	80 (exc. pt. 8092) 82, 84, 86, 0722
33.	Other services	pt. 31, 32	74-76	75, 78, 79
34.	Federal govt. ent.	pt. 35	78	*
35.	State & local govt. ent.	pt. 35	79	*
36.	Private households	33	*	88
37.	Other federal govt.	pt. 34, pt. 35	*	*
38.	Other state & local govt.	pt. 34, pt. 35	*	*
39.	Military	36	*	*

Key differences in the two industry classification schemes are due to the handling of government workers in the employment accounts and the use of a job-oriented, rather a person-oriented, enumeration procedure. These differences are revealed by comparison of the 36-industry employed labor force and the 39-industry employed work force estimates.

Inter-regional differences in industry employment levels occur, also, in the employed work force series (table 5.4). These differences correspond with those shown earlier, except for government employment. Federal, state and local government enterprises are listed seperately because of their similarity with private industry. All industries are engaged in producing at a price which covers costs of production. Other federal and state and local investments are engaged in producing public goods which depend on taxes for their financing.

Export-Producing and Residentiary Employment

The economic significance of year-to-year changes in industry employment is difficult to assess without a rudimentary concept of cause and effect in total employment changes. A simple cause-and-effect sequence is triggered by a change in primary employment, e.g., mining, which results in change in the total purpose of the primary industry. This change in payroll leads to a corresponding change in household purchases from local stores and shops. If this change in household purchases is sustained, then the regional activity reaches a new level with corresponding changes occurring in jobs and employment. Implicit in this explanation of employment change is the concept of "basic" and "service" industry. This concept underlies the differentiation of industry employment into export-producing and residentiary categories.

Table 5.4. Estimated employed work force in specified industry, by planning region, northern Minnesota, 1970.

Industry No.	Industry Title	Northwest Total	Northwest Proportion of Total	Headwaters Total	Headwaters Proportion of Total	Arrowhead Total	Arrowhead Proportion of Total
		(no.)	(pct.)	(no.)	(pct.)	(no.)	(pct.)
1.	Livestock & live. prod.	1,831	4.9	1,620	9.6	2,113	1.7
2.	Other agric. products	9,605	2.6	1,608	9.5	1,345	1.1
3.	Agri. services, for.,fish.	43	2/	354	2.1	1,171	.9
4.	Iron & ferro alloy ores	0	0	0	0	13,124	10.3
5.	Nonferrous metal ores	0	0	0	0	175	.1
6.	Other mining, quarrying	14	2/	14	.1	151	.1
7.	Construction	1,495	4.0	947	5.6	6,164	4.8
8.	Food & kindred products	1,346	3.6	122	.7	3,341	2.6
9.	Lumber, wood prod. & furn.	312	.8	486	2.9	2,084	1.6
10.	Pulp & paper prod.	8	2/	7	2/	5,223	4.1
11.	Printing, pub. & allied	152	.4	61	.4	1,237	1.0
12.	Chemicals & allied prod.	34	.1	24	.1	68	.1
13.	Petroleum ref. & rel. ind.	0	0	0	0	299	.2
14.	Stone, clay & glass	139	.1	23	.1	347	.3
15.	Primary metals	0	0	0	0	3,316	2.6
16.	Fabricated metals	26	2/	16	.1	699	.5
17.	Machinery, exc. elec.	488	1.3	20	.1	866	.7
18.	Electrical machinery	21	2/	24	.1	283	.2
19.	Other manufacturing	1,360	3.7	163	1.0	2,173	1.7
20.	Railroad transportation	310	.8	64	.4	2,624	2.1
21.	Trucking & warehousing	180	.5	108	.6	1,160	.9
22.	Other transportation	129	.3	130	.8	1,672	1.3
23.	Communication	222	.6	89	.5	1,495	1.2
24.	Electric utilities	86	.2	59	.3	1,195	.9
25.	Gas utilities	29	.1	20	.1	188	.1
26.	Other utilities	101	.3	69	.4	650	.5
27.	Wholesale trade	1,029	2.8	233	1.4	4,799	3.8
28.	Retail trade	4,547	12.2	2,716	16.0	17,071	13.4
29.	F. I. R. E.	518	1.4	265	1.6	3,253	2.6
30.	Lodging & pers. & rep. serv.	1,178	3.2	581	3.4	4,437	3.5
31.	Business services	530	1.4	226	1.3	2,286	1.8
32.	Medical, educational	3,446	9.3	1,533	9.1	12,239	10.4
33.	Other services	248	.7	68	.4	1,448	1.1
34.	Federal govt. ent.	451	1.2	260	1.5	1,570	1.2
35.	State & local govt. ent.	264	.7	152	.9	918	.7
36.	Private households	764	2.1	344	2.0	1,922	1.5
37.	Other state & local govt.	579	1.6	502	3.0	2,846	2.2
38.	Other federal govt.	5,606	15.1	4,024	23.8	20,301	16.0
	Total	37,091	100.0	16,932	100.0	127,253	100.0

Export-producing employment is engaged in the production of industry output for purchase by economic units located outside a given region. Much of agricultural production, for example, moves from farms to processing plants and, thence, to retail outlets for purchase, finally, by individual households. If the first step in this sequence of activity is from farms to buyers located outside the region, then the workers engaged in farm production are in an export-producing activity.

Some farm employment is not export-producing but residentiary in its role in the regional economy. If all of the steps from farm production to final purchase occurred in the region, then the farm production is entirely residentiary. Most industry is at least partly residentiary. A highly specialized industry, like iron mining, is entirely export-producing when the region is small and lacks ore processing and smelting facilities.

A method of "excess" employment estimation is used to provide an initial approximation of export-producing employment in a region. This method starts with the percentage distribution of industry employment in the United States. Corresponding regional distributions of employment are provided, next, for industry-by-industry comparisons with the U.S. norm. At this point, the method shows the importance of employment in a given industry with reference to total employment in the region. In the three northern Minnesota planning regions, for example, the west-to-east shift from agriculture to mining is indicated in the regional comparisons (see, tables 5.2 and 5.4).

The critical step in deriving "excess" industry employment is the comparison of regional with U.S. employment percentages. In this comparison, the percentage for the U.S. industry is subtracted from the corresponding percentage for the region. A positive difference denotes the occurrence of export-producing employment. This difference is multiplied by total employment in the region to yield an estimate of "excess" employment in the given industry (table 5.5). The west-to-east shift from agriculture to mining is now confirmed as a shift in a region's export-producing industry.

The contribution of each industry to total export-producing employment is given by the industry distribution of export-producing employment (table 5.6). Agriculture in Northwest Minnesota, for example, accounts for 63.3 percent of total export-producing employment, which means that 63.3 percent of total employment in this region is dependent on agriculture. In the Arrowhead Region, mining accounts for 8.3 percent of total export producing and hence, 8.3 percent of total employment in the region is dependent on mining. This region has the most diversified economic base as measured by the distribution of "excess" employment.

The excess-employment method of employment estimation makes use, also, of the concept of an employment "multiplier". In the regional case, export-producing employment is the variable which links the local area to the national economy. The entirely local variable is the residentiary employment which determines total employment change associated with a 1-unit

Table 5.5. Estimated excess employment in specified industry, by planning region, northern Minnesota, 1970. 1/

Industry No.	Industry Title	Northwest Region	Headwaters Region	Arrowhead Region	Study Region
			(number)		
1.	Agriculture	4,254	1,259	0	5,513
2.	For. & Fish.	0	136	405	541
3.	Mining	0	0	1,193	1,193
4.	Construction	0	170	0	170
5.	Food Prod.	415	0	0	415
6.	Textile Prod.	0	6	26	32
7.	Apparel	0	28	666	694
8.	Lumber, Furn.	77	674	1,485	2,236
9.	Printing & Pub.	0	0	0	0
10.	Chemicals	0	0	0	0
11.	Machinery, exc. Elec.	0	0	0	0
12.	Electrical Mach.	0	0	0	0
13.	Motor Vehicles	0	0	0	0
14.	Trans. exc. Mot. Veh.	987	0	0	987
15.	Paper Prod.	0	0	3,303	3,303
16.	Petroleum Refining	0	0	0	0
17.	Primary Metals	0	0	1,915	1,915
18.	Fabricated Metals	0	0	0	0
19.	Misc. Manuf.	0	0	0	0
20.	Railroads	90	0	1,468	1,558
21.	Trucking	125	73	0	198
22.	Other Transp.	0	0	0	0
23.	Communications	0	0	15	15
24.	Elec., gas, Sani.	33	53	722	808
25.	Wholesale Trade	0	0	0	0
26.	Food Stores	0	0	235	235
27.	Eating & Drinking	213	263	26	502
28.	Other Retail	135	162	0	297
29.	F. I. R. E.	0	0	0	0
30.	Lodging, Personal	0	53	491	544
31.	Business & Repair	0	0	0	0
32.	Entertain. & Rec.	0	0	0	0
33.	Private Households	315	98	361	774
34.	Prof. Services	0	1,159	956	2,115
35.	Public Admin.	80	259	1,078	1,417
	Total	6,724	4,392	14,345	25,462

1/ Regional Economic Information System (REIS), U. S. Department of Commerce.

Table 5.6. Estimated proportion of total excess employment in specified industry, by planning region, northern Minnesota, 1970. 1/

Industry No.	Industry Title	Northwest Region	Headwaters Region	Arrowhead Region	Study Region
			(percent)		
1.	Agriculture	63.3	28.7	0	21.7
2.	For. & Fish.	0	3.1	2.8	2.1
3.	Mining	0	0	8.3	4.7
4.	Construction	0	3.9	0	.7
5.	Food Prod.	6.2	0	0	1.6
6.	Textile Prod.	0	.1	.2	.1
7.	Apparel	0	.6	4.6	2.7
8.	Lumber, Furn.	1.1	15.3	10.4	8.8
9.	Printing & Pub.	0	0	0	0
10.	Chemicals	0	0	0	0
11.	Machinery, exc. Elec.	0	0	0	0
12.	Electrical Mach.	0	0	0	0
13.	Motor Vehicles	0	0	0	0
14.	Trans. exc. Mot. Veh.	14.7	0	0	3.9
15.	Paper Prod.	0	0	23.0	13.0
16.	Petroleum Refining	0	0	0	0
17.	Primary Metals	0	0	13.3	7.5
18.	Fabricated Metals	0	0	0	0
19.	Misc. Manuf.	0	0	0	0
20.	Railroads	1.3	0	10.2	6.1
21.	Trucking	1.9	1.7	0	.8
22.	Other Transp.	0	0	0	0
23.	Communications	0	0	.1	.1
24.	Elec., gas, Sani.	.5	1.2	5.0	3.2
25.	Wholesale Trade	0	0	0	0
26.	Food Stores	0	0	1.6	.9
27.	Eating & Drinking	3.2	6.0	.2	2.0
28.	Other Retail	2.0	3.7	0	1.2
29.	F. I. R. E.	0	0	0	0
30.	Lodging, Personal	0	1.2	3.4	2.1
31.	Business & Repair	0	0	0	0
32.	Entertain. & Rec.	0	0	0	0
33.	Private Households	4.7	2.2	2.5	3.0
34.	Prof. Services	0	26.4	6.7	8.3
35.	Public Admin.	1.2	5.9	7.5	5.6
	Total	100.0	100.0	100.0	100.0

1/ Regional Economic Information System (REIS), U. S. Department of Commerce

change in export-producing employment.[15/] The employment multiplier is projected to increase over the 1970 to 2000 period in each region. As long as the percentage increase in the regional multiplier exceeds the percentage decrease in export-producing employment, total employment will increase, also. Because the increase is gradual and systematic, the employment multiplier is useful in predicting total employment change from a given change in export-producing employment.

The "excess" employment approach to regional impact analysis is based simply on the linkage of the regional to the national economy. This linkage is established by the market relationships which a region's export-producing industries have with the rest of the Nation. Without these linkages, an "open" regional economy cannot survive. In northern Minnesota, these linkages are provided by the primary and related secondary industries.

Sources of Employment Change

Another method of measuring regional economic change is derived from the study of the sources of industry employment change. Three sources of employment change are identified -- a national-growth effect, an industry-mix effect, and a regional-share effect. The national-growth effect is the proportional change in industrial employment due to change in

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15/ This relationship is given by the form,

$$TOT = \frac{1}{1 - \frac{RES}{TOT}} \cdot EXP,$$

where TOT = total employment;
EXP = export producing employment; and
RES = residentiary employment.

total U.S. employment. The industry-mix effect is the differential change in industry employment due to above-average or below-average employment growth in a given industry.

Two of the three effects -- the national-growth effect and the industry-mix effect -- are derived from U.S. data sources. Only the regional-share effect is derived from region-specific data. Hence, when forecasting regional employment change, the two sources of employment change are predetermined (being available from national industry forecasts), thus leaving only the regional-share effects to be forecast from regional data sources.

The 36-industry breakdown of total regional employed is used to partition individual industry employment change into the three sources of change (table 5.7). The long-term historical perspective is introduced to show the effects of changing industry mix on total employment change in the northern Minnesota. The industry employment change is the relative change to industry-mix and regional-share effects. The sum of the two effects accounts for any difference between the actual change in industry employment and the derived change based solely on the national growth effect. 16/

The heavy dependence on below-average growth industries in northern Minnesota was a dominant factor in its lagging rates of growth in the 30-

16/ The national-growth coefficient in the two periods from 1940 to 1970 and 1970 to 2000 is 0.71529 and 0.50467, respectively. This coefficient, when multiplied by the base-year inudstry employment, yields the industry employment change due to the national growth effect.

Table 5.7. Projected change in total employment in specified industry, by source of employment change, northern Minnesota, 1970-2000.

	INDUSTRY SECTOR	1970 EMPL.	REGIONAL CHANGE DUE TO NAT. GROWTH	IND. MIX	REG. SHARE	TOTAL CHANGE	2000 EMPL.
1	AGRICULTURE	11617.	5863.	-10376.	-2273.	-6787.	4830.
2	FOR. AND FISH	664.	335.	-166.	-485.	-315.	349.
3	MINING	12316.	6215.	-8767.	681.	-1871.	10445.
4	CONSTRUCTION	8878.	4480.	-612.	-3512.	357.	9235.
5	FOOD PROD.	3519.	1776.	-1358.	-4.	413.	3932.
6	TEXTILE PROD.	270.	136.	-185.	79.	30.	300.
7	APPAREL	1487.	750.	-664.	524.	610.	2097.
8	LUMBER, FURN.	3456.	1744.	139.	-113.	1770.	5226.
9	PRINTING AND PUB.	2378.	1200.	-1910.	1218.	508.	2886.
10	CHEMICALS	467.	236.	68.	-222.	81.	548.
11	MACHINERY,EXC.ELEC.	1681.	848.	-625.	2465.	2688.	4369.
12	ELECTRICAL MACH.	370.	187.	42.	138.	367.	737.
13	MOTOR VEHECLES	127.	64.	-59.	49.	54.	181.
14	TRANS.EXC.MOT.VEH.	1378.	695.	-838.	2115.	1972.	3350.
15	PAPER PROD.	5182.	2615.	-908.	4912.	6619.	11801.
16	PETROLEUM REFINING	131.	66.	-47.	-79.	-60.	71.
17	PRIMARY METALS	2524.	1274.	-1949.	545.	-130.	2394.
18	FABRICATED METALS	1226.	619.	-123.	-633.	-138.	1088.
19	MISC.MANUF.	1363.	688.	-18.	-1031.	-361.	1002.
20	RAILROADS	3548.	1791.	-3918.	-175.	-2302.	1246.
21	TRUCKING	1936.	977.	-146.	-276.	555.	2491.
22	OTHER TRANS.	1782.	899.	-312.	-208.	379.	2161.
23	COMMUNICATIONS	1786.	901.	613.	-1267.	247.	2033.
24	ELEC.,GAS,SANI.	2652.	1338.	587.	-1433.	492.	3144.
25	WHOLESALE TRADE	5140.	2594.	-531.	-2399.	-336.	4804.
26	FOOD STORES	4396.	2219.	-57.	-1728.	433.	4829.
27	EATING AND DRINKING	6647.	3355.	-687.	-1394.	1274.	7921.
28	OTHER RETAIL	17323.	8742.	-769.	-2164.	5809.	23132.
29	F.I.R.E.	4517.	2280.	1653.	-2487.	1445.	5962.
30	LODGING, PERSONAL	4570.	2306.	-2154.	-1185.	-1032.	3538.
31	BUSINESS AND REPAIR	3278.	1654.	3638.	-1132.	4160.	7438.
32	ENTERTAIN. AND REC.	926.	467.	-98.	-347.	23.	949.
33	PRIVATE HOUSEHOLDS	3030.	1529.	-2884.	-180.	-1535.	1495.
34	PROF. SERVICES	33993.	17155.	20281.	-8072.	29365.	63358.
35	PUBLIC ADMIN.	7468.	3769.	1557.	-3137.	2189.	9657.
	TOTALS	162026.	81769.	-11584.	-23212.	46974.	209000.

year period from 1940 to 1970. This depressive effect of having a disproportionately large share of below-average growth industries is tempered by the declining importance of these industries in the period from 1970 to 2000. In the future, therefore, industry diversification, especially in export producing industries, will lead to both greater employment stability and greater sharing in overall national economic growth.

Peat resource development enhances industry diversification. It is not a stabilizing factor in industry employment, however, unless the peat-related industry is totally residentiary. Additional analysis is needed at this point to establish both the short-term and long-term employments effects of peat-related industry expansion.

In summary, certain industries produce products which are sold to buyers outside the Study Region. These are termed export industries. These support the service industry with the "first" dollar which comes from the sale of their product to buyers residing outside the region. The diversity of a regional economic base depends on the number and size of its export-producing industries.

PERSONAL INCOME

Personal income refers to the income received by persons, in the form of wages and salaries, proprietorial income (of self employed), property income (rent, interest, dividends), and transfer payments (social insurance).

Personal income payments are reported annually by the U.S. Department of Commerce, Bureau of Economic Analysis in its county-level statistical series (i.e., Regional Economic Information System). Total earnings, which include wage and salary payments, propertorial income and other labor income, correlate with total employment (i.e., employed work force) in each industry.

Total Earnings of Employed Work Force

Total earnings of the employed labor force more than doubled in the 10-year perion from 1965 to 1975 (table 6.1). The Northwest Region experienced the largest increase -- 167.2 percent, with the Arrowhead Region having the smallest -- 108.8 percent. Despite price inflation, the increases in nonfarm earnings were smaller in the 1970-75 period than in the 1965-70 period. For the Northwest Region, however, the increase in farm earnings was much larger in the second than in the first five-year period. In this region, net farm income tripled from 1972 to 1973. In the Headwaters Region, total earnings of government employees nearly doubled in the 10-year period, while in the Northwest Region and the Arrowhead Region these earnings increased by approximately 50 percent. Thus, the higher rate of growth in total earnings in the two regions -- Northwest and Headwaters -- is explained, in part, by sharp increases in earnings from farming and government.

Table 6.1. Estimated total farm and nonfarm earnings of employed work force in specified planning region, northern Minnesota, 1965-1975. [1/]

Planning Region	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
					(mil. dol.)						
Northwest:											
Farm	51.6	36.5	52.7	29.5	35.4	67.6	67.5	79.1	239.7	233.3	140.6
Nonfarm private	62.6	67.8	73.2	81.1	94.8	107.4	114.7	131.1	146.4	155.7	170.1
Total private	114.2	104.3	125.9	110.6	130.2	175.0	182.2	210.2	386.1	389.0	310.7
Federal govt.	3.8	4.3	4.2	4.7	4.8	5.4	5.8	6.0	6.9	7.4	8.0
State & local govt.	17.0	18.4	19.9	22.1	23.9	26.4	29.8	33.1	36.1	38.3	43.1
Total govt.	20.8	22.7	24.1	26.8	28.7	31.8	35.6	39.1	43.0	45.7	51.1
Total earnings	136.0	128.2	151.1	138.5	160.3	208.3	219.3	250.8	430.8	436.4	363.5
Total personal income [2/]	183.3	178.5	205.4	199.1	226.1	284.7	306.0	341.4	528.5	559.3	500.9
Headwaters:											
Farm	6.4	5.1	5.8	4.4	5.9	8.5	8.4	9.8	27.8	18.2	10.0
Nonfarm private	29.6	32.3	33.6	39.7	40.3	43.7	45.8	51.0	58.7	64.9	70.9
Total private	36.0	37.4	39.4	44.1	46.2	52.2	54.2	60.8	86.5	83.1	80.9
Federal govt.	2.4	3.1	3.7	3.8	3.9	4.6	5.0	5.6	6.7	7.5	8.5
State & local govt.	11.7	12.9	14.3	16.2	18.1	20.3	22.7	25.6	28.0	29.6	33.4
Total govt.	14.1	16.0	18.0	20.0	22.0	24.9	27.7	31.2	34.7	37.1	41.9
Total earnings	51.4	54.7	58.8	65.5	69.8	78.7	83.4	93.6	123.0	122.0	124.7
Total personal income [2/]	72.8	77.6	84.1	94.0	100.9	93.1	100.7	112.3	143.5	147.1	153.7
Arrowhead:											
Farm	3.9	3.1	3.0	2.5	3.9	4.3	3.1	5.1	13.9	8.2	3.9
Nonfarm private	511.1	547.5	568.1	601.5	634.2	671.1	697.6	743.7	813.3	884.3	1,041.5
Total private	515.0	550.6	571.1	604.1	638.1	675.4	700.7	748.8	827.2	892.5	1,045.4
Federal govt.	13.8	15.9	18.7	19.8	22.4	25.4	28.3	30.1	33.2	36.3	39.4
State and local govt.	76.1	81.7	88.1	96.9	106.0	117.3	131.5	145.9	160.7	119.6	186.4
Total govt.	89.9	97.6	106.8	116.7	128.4	142.7	159.8	176.0	193.9	155.9	225.8
Total earnings	621.2	665.9	697.5	742.3	787.6	848.1	887.3	950.2	1,046.9	1,126.7	1,297.3
Total personal income [2/]	778.6	825.6	872.1	922.5	991.2	1,079.2	1,149.0	1,327.8	1,353.1	1,413.0	1,700.4

[1/] Regional Economic Information System (REIS), U.S. Department of Commerce.

[2/] By place of residence of income recipients.

Growth in total personal income parallels the growth in total earnings in the three planning regions. Total personal income, which is reported by place of residence of income recipient rather than place of work, increased in the three planning regions from $1,033.9 million in 1965 to $2,440.1 million in 1975. This compares with an increase in total earnings from $808.6 million to $1,785.5 million (a 120.8 percent increase as compared with a 136 percent increase in total personal income).

Property Income Transfer Payments and Residence Adjustments

While total earnings are reported by place of work, property income and transfer payments are reported by the residence of income recipient (table 6.2). A residence adjustment is derived for each county which accounts for the net income payments made to in-commuters by local indsutry, or received by out-commuters by industry located outside the county. The residence adjustment thus converts total earnings by place of work to total earnings by place of residence.

Personal contributions to social insurance programs are deducted from total earnings to obtain net earnings. A compensating adjustment is mode for transfer payments, including income received from social insurance programs. Property income, including rent, interest, and dividends are added, also, to net total earnings in the derivation of total personal income.

In this study, the personal contributions to social insurance programs, the residence adjustment, and property income are directly related to total earnings. Transfer payments are related to total unemployment, total population 65 years and older, and total earnings. These relationships are used in projecting total personal income in the Study Region.

Table 6.2. Estimated total earnings of employed work force in specified industry and total personal income, by planning region, northern Minnesota, 1970 and 1975.

Industry and Income Source	Northwest		Headwaters		Arrowhead	
	1970	1975	1970	1975	1970	1975
	(thou. dol.)					
Farm	128,879	261,490	16,326	17,743	7,921	6,197
Mining	5,152	7,598	1,195	580	131,696	197,299
Construction	7,990	10,436	6,095	8,677	54,614	120,597
Manufacturing	29,751	39,080	5,585	7,169	154,066	189,797
Trans., Comm., Util.	8,783	15,462	4,741	8,449	68,296	118,987
Trade	28,840	55,167	14,027	25,398	124,897	197,130
Fin., Ins., Real Est.	3,413	6,965	2,872	3,615	23,051	40,320
Services	23,452	35,320	9,214	17,057	114,416	177,341
Federal Gov't	6,814	9,813	6,160	10,365	55,429	65,465
State & Local Gov't	26,445	43,085	20,290	33,380	117,275	186,431
Total Earnings by Place of Work	208,283	363,538	78,708	124,671	848,079	1,297,314
Less: Personal Contr.	6,888	13,539	3,468	7,003	37,522	78,455
Net Earnings by Place of Work	201,395	349,999	75,240	117,688	810,557	1,218,859
Plus: Resid. Adj.	10,547	16,839	1,418	1,546	-12,378	-25,185
Net Earnings by Place of Residence	211,942	366,838	76,328	119,214	798,179	1,193,674
Plus: Property Income	35,920	62,143	15,299	27,587	137,434	215,143
Plus: Transfer Payments	36,858	71,884	23,399	50,216	143,579	291,602
Total Personal Income	284,720	500,865	115,026	197,017	1,079,192	1,700,419

Earnings and Income Per Person

The statistical series on total earnings of the employed work force shows the importance of each major industry in contributing to the economic well being of residents in northern Minnesota. The key statistic is total earnings per employed worker (table 6.3). High earnings per worker in export-producing industries typically transform into high earnings per worker in residentiary industries.

Inter-industry differences in earnings per worker trends occur because of differences in the trends in (1) the productivity of the average employed worker and (2) the degree of unionization in each industry. In northern Minnesota, workers in manufacturing generally are in a superior position to capture at least part of the above-average increases in labor productivity in the form of above-average earnings per worker.

Depending on the type of resource development the earnings per worker impacts will vary by industry with lower earnings associated with agriculture and mining (i.e., horticultural uses of peat land) and higher earnings associated with industrial chemicals manufacturing and energy production. Above-average earnings in the developing industries are transformed into higher earnings in the local industries which cater to the local work force and its dependent population.

Total Income Payments

Total income payments are derived in constant 1970 dollars to show the composite effect of changes in (1) total industry employment, (2) average

Table 6.3. Estimated total earnings per worker of employed labor force in specified industry and total personal income per person, by planning region, northern Minnesota, 1970 and 1975.[1/]

Industry and Income Source	Northwest		Headwaters		Arrowhead	
	1970	1975	1970	1975	1970	1975
	(dollars)					
Per Worker (by place of work):						
Farm	9,864	15,975	4,378	4,425	2,012	1,459
Mining	2/	2/	2/	2/	9,477	12,798
Construction	6,113	7,924	6,139	8,194	10,772	14,714
Manufacturing	2/	2/	5,082	6,744	7,374	11,312
Trans., Comm., Util.	6,012	9,451	6,941	9,824	9,555	14,475
Trade	4,207	5,683	4,655	5,599	5,501	6,858
Fin., Ins., Real Est.	3,969	6,280	2/	2/	7,849	9,579
Services	3,119	4,543	3,534	4,572	5,469	7,451
Federal Govt.	10,920	17,363	10,261	15,586	10,227	15,979
State & Local Govt.	4,717	6,949	5,042	6,988	5,777	8,406
Total Earnings	5,300	7,693	4,569	5,914	6,882	9,547
Less: Personal Contr.	73	140	63	117	114	238
Net Earnings	5,229	7,553	4,506	5,797	6,768	9,309
Per Person (by place of residence):						
Plus: Residence Adj.	111	174	26	26	-38	-77
Net Earnings	2,235	3,780	1,394	1,985	2,415	3,628
Plus: Property Inc.	379	640	280	459	416	654
Plus: Transfer Payments	389	741	428	836	434	886
Total Personal Income	3,003	5,161	2,101	3,281	3,266	5,168

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

2/ Not available.

per worker industry earnings, and (3) non-labor income payments (table 6.4). Increases in income levels due to inflation are accounted for in the personal income series.

Part of the increase in personal income level is due to increase in total employment. A larger part of the projected increase (in real dollars), is due to the near-doubling of earnings per worker. High levels of labor productivity thus sustain high levels of personal income.

Peat resource development will add to total income payments in the extended Study Region by increases in industry employment and earnings per worker. Especially the high-technology development will be associated with high earnings per worker.

In summary, high earnings in export industries induce high earnings in other industries in a region. Thus, the high-technology development can increase productivity and, also, overall average income levels in the Study Region.

Table 6.4. Estimated total personal income per person, by planning region, northern Minnesota and U.S., 1965-1975.

Year	Total Personal Income per Person					Proportion of U.S. Average			
	North-west	Head-waters	Arrow-head	Minne-sota	United States	North-west	Head-waters	Arrow-head	Minne-sota
	(dollars)					(percent			
Estimated:									
1965	1,855	1,417	2,329	2,643	2,785	66.6	50.9	85.6	94.9
1966	1,868	1,515	2,432	2,856	3,001	62.2	50.5	81.0	95.2
1967	2,152	1,643	2,588	3,022	3,188	67.5	51.5	81.9	95.1
1968	2,059	1,840	2,743	3,285	3,457	59.6	53.2	79.4	95.0
1969	2,345	1,944	2,961	3,584	3,733	62.8	52.1	79.3	96.0
1970	3,003	2,102	3,266	3,859	3,966	75.7	53.0	82.4	97.3
1971	3,183	2,228	3,447	4,038	4,195	75.9	53.1	82.2	96.3
1972	3,523	2,386	3,679	4,328	4,537	77.6	52.6	81.1	95.4
1973	5,438	2,954	4,092	5,112	5,049	107.7	58.5	81.0	101.2
1974	5,803	3,092	4,546	5,469	5,486	105.8	56.4	82.9	99.7
1975	5,165	3,283	5,186	5,817	5,903	87.5	55.6	87.8	98.5

AGRICULTURAL PRODUCTION

In this chapter, the economic potential for farm crop production on peat land is assessed in the context of the total agricultural economy of northern Minnesota. Historical trends in agricultural production and income are examined for the pre-1975 period. Utilization of farm land and peat land in agricultural production is related to this historical assessment. Finally, a peat land data base is presented, for use in the economic forecast.

Agricultural Land Use

The production of farm crops is the principal use of peat land in northern Minnesota. Of the 5.8 million acres of farmland, 4 million acres were in crops, including pasture. Less than 100,000 acres of peat land were cultivated. Thus, the agricultural use of peat land accounted for less than 2.5 percent of total cropland in the extended Study Region.

A total of more than 5.3 million acres of peat land is reported in the 1977 inventory of peat land in the 19 counties in northern Minnesota (table 7.1). More than one million acres are located in Koochiching County. The Arrowhead Region accounts for 3.3 million acres, or 62.5 percent of the total peat land in northern Minnesota.

Of the 99,599 acres of peat land in crops in 1977, hay and pasture accounted for 36 percent, other unclassified crops for 27.5 percent, wild rice for 17.5 percent, and cash grain, grass seed, row crops, and vegetables for 8.5 percent, 8.3 percent, 2.1 percent, and 0.1 percent, respectively, of the total. Undeveloped peat land in farms totaled nearly 2.5 million acres in 1977.

Table 7.1. Estimated peat land in specified county and planning region, by land use, northern Minnesota, 1977. [1/]

Planning Region and County	Peat Land Total	Cropland							Undeveloped Farm Land
		Total	Cash Grain	Row Crops	Vegetables	Grass Seed	Wild Rice	Hay & Pasture	Other	
				(acres)						
Northwest:										
Kittson	60,314	1,587	1,587	0	0	0	0	0	0	45,619
Marshall	146,535	8,021	717	456	0	0	0	5,707	1,141	41,822
Norman	3,770	218	0	0	0	0	0	0	218	3,296
Pennington	37,803	6,632	888	0	0	0	95	2,173	3,476	31,171
Polk	29,517	2,509	435	77	128	0	1,741	128	0	20,792
Red Lake	7,450	2,061	435	0	0	0	0	512	1,114	5,388
Roseau	255,436	10,809	1,552	0	0	8,269	51	937	0	159,892
Total	540,825	31,837	5,614	533	128	8,269	1,887	9,457	5,949	307,980
Headwaters:										
Beltrami	785,661	8,047	0	0	0	0	2,263	79	5,705	293,812
Clearwater	108,109	17,437	282	0	0	0	6,758	9,531	866	27,260
Hubbard	62,864	179	0	0	0	0	0	179	0	42,545
Lake of the Woods	482,528	12,017	0	462	0	0	0	0	11,555	197,806
Mahnomen	26,432	10,268	0	1,092	0	0	0	6,991	2,184	16,164
Total	1,465,594	47,948	282	1,554	0	0	9,021	16,780	20,310	577,587
Arrowhead:										
Aitkin	575,936	14,087	2,534	0	0	0	6,067	4,333	1,152	425,068
Carlton	123,294	1,809	0	0	0	0	0	1,809	0	67,643
Cook	37,626	0	0	0	0	0	0	0	0	0
Itasca	356,558	2,028	0	0	0	0	310	1,718	0	166,128
Koochiching	1,154,899	154	0	0	0	0	154	0	0	363,073
Lake	165,171	0	0	0	0	0	0	0	0	11,264
St. Louis	929,827	1,736	0	0	0	0	0	1,736	0	546,154
Total	3,343,311	19,814	2,534	0	0	0	6,531	9,596	1,152	1,579,330
Northern Minnesota	5,349,730	99,599	8,430	2,087	128	8,269	17,439	35,833	27,411	2,464,897

[1/] Rouse Farnham, "1977 Inventory of Peat Land in Minnesota", Phase II Peat Program, Minnesota Department of Natural Resources, 1978.

Total farm land in northern Minnesota was 5,760,000 acres in 1969 and 1974 (table 7.2). This amounted to approximately 58.7 percent of the total land area. Total farms declined slightly, from 14,822 to 13,573, while commercial farms actually increased from 10,096 to 10,379 during this period. Thus, the average size of farms -- in farm land and cropland -- increased only slightly. Large differences in these statistics occur, of course, for individual counties in each of the three planning regions.

Most of the farm land on commercial farms (i.e., farms with sales of $2,500 or more) -- 4 million acres, or 75.8 percent of the total -- was in crops, including pasture, in 1974 (table 7.3). The Northwest Region, accounted for 3.3 million acres, or 82.8 percent, of the total.

The Arrowhead Region, which has the largest acreage of peat land, accounts for less than a quarter-million acres, or 6.2 percent, of total cropland. In this region, Aitkin County has the largest number of commerical farms and, also, acres in farm crops. Access to both cultivated land and undeveloped peat land is superior in this county because of its extensive road network. The economic potential of peat land for agricultural uses is, therefore, relatively high in Aitkin County.

Type of Farming

Geographical differences in agriculture in the extended Study Region are shown by the county-to-county distribution of type of farms (table 7.4). Crop farms, especially cash grain, are concentrated in the Northwest Region. Livestock farms which accounted for 4,008, or 38.6 of total farms in 1974,

Table 7.2. Estimated number of farms and acres in farm land in specified county and planning region, by type of farm, northern Minnesota, 1969 and 1974. 1/

Planning Region and County	All Farms						Farms with sales of $2,500 or more					
	Total Farms		Total Farmland		Prop. of Land Area		Total Farms		Total Farmland		Land per Farm	
	1969	1974	1969	1974	1969	1974	1969	1974	1969	1974	1969	1974
	(no.)	(no.)	(1,000 acres)	(1,000 acres)	(pct.)	(pct.)	(no.)	(no.)	(1,000 acres)	(1,000 acres)	(acres)	(acres)
Northwest:												
Kittson	772	713	545	533	75.7	74.1	655	649	519	522	793	804
Marshall	1,732	1,652	821	854	71.7	74.6	1,305	1,428	740	819	567	573
Norman	1,061	984	527	546	93.1	96.3	938	920	515	539	549	586
Pennington	817	785	334	326	83.8	82.0	599	650	298	311	498	478
Polk	2,361	2,049	1,116	1,112	86.6	86.3	1,839	1,836	1,037	1,085	564	591
Red Lake	586	481	236	207	85.8	74.8	439	425	212	199	482	469
Roseau	1,330	1,307	558	583	52.0	54.3	866	1,082	459	546	530	505
Total	8,659	7,971	4,137	4,161	75.7	76.1	6,641	6,990	3,780	4,021	569	575
Headwaters:												
Beltrami	807	722	228	221	14.2	13.8	469	463	168	181	359	391
Clearwater	801	751	233	223	36.4	34.8	488	522	181	189	370	363
Hubbard	540	484	134	128	22.5	21.5	251	288	83	96	332	333
Lake of the Woods	255	246	105	113	12.5	13.5	155	161	88	97	567	603
Mahnomen	528	476	220	214	61.1	59.5	442	413	206	205	467	497
Total	2,931	2,679	920	899	22.8	22.3	1,805	1,846	726	768	402	416
Arrowhead:												
Aitkin	791	711	181	182	15.4	15.6	462	442	131	143	284	324
Carlton	705	603	139	134	25.2	24.2	398	355	102	100	256	281
Cook	2/	5	2/	1	2/	2/	2/	0	2/	0	2/	0
Itasca	519	501	120	132	7.1	7.8	248	233	80	77	321	331
koochiching	267	274	75	83	3.8	4.2	128	133	47	58	369	435
Lake	35	31	7	5	0.5	0.4	13	13	3	3	202	203
St. Louis	915	798	181	163	4.6	4.2	401	367	108	99	269	271
Total	3,232	2,923	703	700	6.1	6.1	1,650	1,543	417	480	285	311
Northern Minnesota	14,822	13,573	5,760	5,760	58.7	58.7	10,096	10,379	4,923	5,269	488	508

1/ U.S. Census of Agriculture, 1969 and 1974.

2/ Data withheld to avoid disclosure.

Table 7.3. Estimated number of acres farmed on farms with sales of $2,500 or more in specified county and planning region, by type of land use, northern Minnesota, 1974. 1/

Planning region and county	Total Farm-land	Cropland			Woodland & woodland Pasture	Other Land
		Total	Harvested	Pasture		
			(acres)			
Northwest:						
Kittson	521,505	426,385	300,621	14,384	43,475	51,645
Marshall	818,528	683,819	490,585	37,669	63,246	71,463
Norman	538,965	465,061	360,240	21,012	25,290	48,614
Pennington	310,592	248,983	155,181	21,793	28,192	33,417
Polk	1,085,043	918,028	750,867	46,055	46,613	120,402
Red Lake	199,488	154,313	101,317	13,903	20,653	24,522
Roseau	546,028	407,874	242,746	45,588	60,998	77,156
Total	4,020,149	3,304,463	2,401,557	200,404	288,467	427,219
Headwaters:						
Beltrami	108,522	94,494	57,325	21,335	55,845	30,183
Clearwater	189,362	96,851	62,341	24,625	67,200	25,311
Hubbard	95,883	48,583	34,935	9,079	31,724	15,576
Lake of the Woods	97,130	63,127	39,500	10,775	18,419	15,584
Manhomen	205,077	137,480	90,132	12,371	25,651	41,946
Total	767,974	440,535	284,233	78,185	198,839	128,600
Arrowhead:						
Aitkin	143,247	73,640	44,736	21,409	41,378	28,200
Carlton	99,622	47,343	33,633	12,449	31,527	20,752
Cook	0	0	0	0	0	0
Itasca	77,047	38,446	26,602	9,683	27,667	10,934
Koochiching	57,868	31,382	18,867	7,962	19,102	7,384
Lake	2,644	1,012	651	220	1,538	94
St. Louis	99,300	54,664	39,881	11,772	34,230	10,406
Total	479,728	246,487	164,370	63,495	155,451	77,790
Northern Minnesota	5,267,851	3,991,485	2,850,160	342,084	642,757	633,609

1/ U.S. Census of Agriculture, 1974.

Table 7.4. Total farms with sales of $2,500 and over in specified county and planning region, by type of farm, northern Minnesota, 1974. [1/]

Planning Region And County	Total Farms	Crop						Livestock					Unclassified Farms
		Cash Grains (011)	Field Crops (013)	Vegetables (016)	Fruits & Trees (017)	Horticultural (018)	General Farms, Primary Crops (0191)	Livestock exc. Dairy Poultry & Animal Spec. (021)	Dairy (024)	Poultry & Eggs (025)	Animal Special. (027)	General Farms, 1° Livestock (0291)	
							(number)						
Northwest:													
Kittson	649	442	83	0	0	2	16	64	38	0	1	3	0
Marshall	1,428	900	192	0	1	0	54	153	107	2	3	13	3
Norman	920	576	83	1	0	2	39	90	113	1	1	13	1
Pennington	650	374	40	1	0	0	35	82	85	7	9	17	0
Polk	1,836	1,028	320	1	1	1	54	173	227	5	5	19	2
Red Lake	425	224	24	0	0	0	14	54	86	1	8	14	0
Roseau	1,082	526	146	0	0	0	69	115	175	24	6	19	2
Total	6,990	4,070	888	3	2	5	281	731	831	40	33	98	8
Headwaters:													
Beltrami	462	35	65	0	0	0	22	178	130	2	1	16	13
Clearwater	522	89	62	0	0	1	36	176	130	3	2	17	6
Hubbard	288	27	46	2	0	3	4	120	62	10	2	7	5
Lake of the Woods	161	32	55	0	0	0	6	44	16	3	0	5	0
Mahnomen	413	186	19	0	0	0	18	55	119	1	0	13	2
Total	1,846	369	247	2	0	4	86	573	457	19	5	58	26
Arrowhead:													
Aitkin	442	9	77	0	1	1	1	115	205	19	2	8	4
Carlton	355	3	49	2	0	3	1	66	219	1	6	1	4
Cook	0	0	0	0	0	0	0	0	0	0	0	0	0
Itasca	233	5	51	2	0	5	4	92	51	3	1	2	17
Koochiching	133	11	27	2	0	0	1	62	14	3	2	5	6
Lake	13	1	4	0	0	1	0	2	1	2	1	0	1
St. Louis	367	8	78	5	0	17	5	104	126	5	7	7	5
Total	1,543	37	286	11	1	27	12	441	616	33	19	23	37
Northern Minnesota	10,379	4,476	1,421	16	3	36	379	1,745	1,904	92	57	179	71

[1/] U.S. Census of Agriculture, 1974.

are distributed widely in the Study Region.

In the Arrowhead Region, the livestock farms were 75.8 percent of total farms in 1974. Aitkin County led all other counties in this region in livestock farms. Of the 374 crop farms, 286, or 76.5 percent, received 50 percent or more of their income from farm marketing of field crops (e.g., hay and potatoes).

Farm Operator Residence and Employment

Total farm operators in northern Minnesota declined by 31.1 percent in the 10-year period from 1964 to 1974 (table 7.5). Much of the decline occurred in the Arrowhead Region, particularly during the first half of this period.

While the total number of farm operators in the extended Study Region has declined, the number of farm operators reporting off-farm residence has increased. The majority of off-farm residents live in a town or a city. A majority of all farm operators, however, are engaged in farming as their principal occupation. In the Arrowhead Region, off-farm residence of farm operators has increased, also. A majority of farm operators in the Arrowhead Region are in a principal occupation other than farming. Only in Aitkin County is farming the principal occupation of a majority of farm operators.

The proportion of farm operators reporting off-farm work in the extended Study Region dropped from 50.6 percent in 1964 to 44.5 percent of total farm operators. For the Arrowhead Region this percentage increased slightly from 64.4 to 64.6 during the same period. Of those reporting

Table 7.5. Estimated number of farm operations in specified counties and planning regions, by residence and employment status, northern Minnesota, 1964, 1969, and 1974. [1/]

Planning region and County	Total Farm Operators			Farm Operators on Farm Operated			Farm Operators reporting work off farm						Principal Occupation of farm operator, 1974	
							Less than 100 days			100 Days or More				
	1964	1969	1974	1964	1969	1974	1964	1969	1974	1964	1969	1974	Farming	Other
	(number)													
Northwest:														
Kittson	894	772	701	751	581	477	243	188	125	168	228	151	601	100
Marshall	1,884	1,732	1,642	1,628	1,333	1,111	461	395	199	408	616	420	1,329	313
Norman	1,325	1,061	976	1,181	892	695	280	256	159	203	212	148	888	88
Pennington	850	817	780	753	667	574	164	159	82	196	283	231	580	200
Polk	2,766	2,361	2,027	2,411	1,875	1,454	592	533	221	545	674	439	1,730	297
Red Lake	642	586	476	584	450	349	122	107	54	185	225	138	380	96
Roseau	1,589	1,330	1,295	1,412	1,094	945	360	205	169	373	559	360	974	321
Total	9,950	8,659	7,897	8,720	6,892	5,605	2,222	1,888	1,009	2,078	2,797	1,887	6,482	1,415
Headwaters:														
Beltrami	1,067	807	716	1,024	700	604	272	136	85	326	356	260	477	239
Clearwater	1,038	810	747	982	674	569	183	170	83	281	285	245	519	228
Hubbard	751	540	483	690	463	392	140	87	64	250	238	206	264	219
Lake of the Woods	389	255	246	356	218	195	98	55	35	152	125	98	156	90
Mahnomen	647	528	475	590	445	366	114	93	53	115	106	92	396	79
Total	3,892	2,931	2,667	3,642	2,500	2,126	807	541	320	1,124	1,110	901	1,812	855
Arrowhead:														
Aitkin	1,132	791	706	1,094	687	573	188	111	76	386	355	301	426	280
Carlton	1,100	705	600	1,043	627	519	112	72	35	570	414	337	281	319
Cook	2/	2/	5	2/	2/	5	2/	2/	0	2/	2/	5	0	5
Itasca	1,041	519	498	965	465	418	126	68	42	620	362	306	213	285
Koochiching	469	267	271	438	230	229	89	51	35	246	139	140	123	148
Lake	86	45	31	81	36	24	10	3	2	55	39	23	4	27
St. Louis	1,844	915	784	1,776	835	690	205	84	62	1,043	592	505	293	491
Total	5,672	3,242	2,894	5,397	2,880	2,458	730	389	252	2,920	1,901	1,617	1,340	1,555
Northern Minnesota	19,514	14,832	13,459	17,759	12,272	10,189	3,759	2,818	1,581	6,122	5,808	4,405	9,634	3,825

1/ U.S. Census of Agriculture, 1964, 1969 and 1974.

2/ Data withheld to avoid disclosures.

off-farm work, the proportion reporting 200 days or more increased from 62 percent to 73.6 percent in the extended Study Region and from 80 percent to 86.5 percent in the Arrowhead Region. Off-farm work as an additional income source was becoming increasingly important for farm operators in both the extended Study Region and the Arrowhead Region.

Farm Income and Expenditures

Total net income of farm operators in the extended Study Region increased from $38,878,000 in 1969 to $242,744,000 in 1974 -- a 524 percent increase (table 7.6). This estimate, which corresponds to the one presented in the preceding chapter, excludes farm wages, prerequisites and other labor income, and, also, a statistical adjustment. Since the additional income originates from the agricultural sectors, it is included in the estimates of total farm income. It is part of the remuneration for the primary inputs used in agricultural production.

Cash receipts from farm marketings peaked in 1973 in the Headwaters Region and the Arrowhead Region (because of the large receipts from livestock marketing) and in 1974 in the Northwest Region (because of the large receipts from cash grain marketings). Production expenses rose sharply in 1973, which thus reduced the effect of the price increases on total farm labor and proprietors' income. For the extended Study Region total farm income peaked in 1974 and, then, declined sharply in 1975 as production expenses continued their upward trends.

Expansion of crop production on undeveloped peat land would increase cash receipts from both crop and livestock marketings. The additional hay production, for example, would be fed largely to livestock on farms

Table 7.6. Estimated farm income and expenditures, by planning region, northern Minnesota, 1969 and 1974. 1/

Item	Northwest		Headwaters		Arrowhead	
	1969	1974	1969	1974	1969	1974
		($1,000)				
Livestock and Livestock Products:						
Dairy	13,071	18,441	5,377	7,034	7,601	8,915
Poultry	6,393	10,030	2,109	3,309	2,502	3,926
Meat Animals	25,420	31,871	9,901	13,858	7,747	9,087
Total	44,884	60,342	17,387	24,201	17,850	21,928
Crops:						
Field Crops	93,753	347,862	6,758	24,999	2,769	11,180
Truck Crops	87	154	83	146	149	266
Fruits, Nuts, Greenhouse, Nursery, Forest	183	304	411	586	819	1,159
Total	94,023	348,320	7,252	24,731	3,737	12,605
Total Cash Receipts	138,907	408,662	24,639	49,932	21,587	34,333
Government Payments	16,491	5,039	1,521	497	350	353
Imputed Income and Rent Received	14,069	20,594	2,979	4,509	2,996	4,593
Total Cash Receipts and Other Income	169,467	434,295	29,139	54,938	24,933	39,479
Production Expenses	132,891	227,658	23,447	38,463	21,724	33,613
Realized Net Income	36,576	206,637	5,692	16,475	3,209	5,866
Value of Inventory Change	-6,282	12,754	-454	118	137	894
Total Net Income	30,294	219,391	5,238	16,593	3,346	6,760
REIS Adjustment	-322	51	25	3	-1	1
Total Net Farm Proprietors Income	29,972	219,442	5,263	16,596	3,345	6,761
Farm Wages and Perquisites	5,365	13,661	605	1,538	568	1,439
Farm, Other Labor Income	106	171	13	19	12	18
Total Farm Income	35,443	233,274	5,881	18,153	3,925	8,218

1/ U.S. Census of Agriculture, 1969 and 1974.

in the region. The additional row crops also would be sold to local buyers and processors, thus increasing the cash receipts of both farm and off-farm but farm-related, businesses. These direct and indirect effects of peat land development would be more noticeable in the Arrowhead Region, and especially Aitkin County, than in the Northwest Region where substantial farm income is derived already from livestock and crop production.

In summary, therefore, the findings show that many farm operators are taking up residence in local towns and cities (rather than living on the farm). Although most farm operators still consider farming their principal occupation, an increasing reliance is being placed on non-farm incomes. Finally, production expenses in farming have increased more rapidly than the value of farm marketings, which has eroded the large increases in net farm income of the 1973-74 period.

PEAT LAND AND MINING INDUSTRY DEVELOPMENT

Peat land development options are identified in five industry groups in this chapter. First, peat land development may result in an expansion of agriculturalproduction of certain crops (e.g., carrots, wild rice, forage grasses, sod and grain). Involved in this activity is the conversion of undeveloped peat land into cropland which entails initial investment in land clearing and drainage and subsequent expenditures in sustaining crop production. Currently, about 100,000 acres of northern Minnesota peat land are under agricultural production.

Second, peat development may result in an expansion of peat production for horticultural purposes (mostly for general soil improvement). In this option, the potential for industry expansion, though large, imposes a small total requirement for peat land. Low per capita use and high transportation costs limit peat output expansion. The supply of sphagnum peat, which is most highly valued for horticultural purposes, is limited. Reed sedge, can be substituted for sphagnum peat, however. Nontheless investment in facilities and total full-time employment in producing and distributing the peat product will be small. The total horticultural peat output of the five horticultural peat producers currently operating in Minnesota is less than five percent of total U.S. production.

Third, peat development may result in an expansion of industrial chemical production, including "activated carbon for wastewater filtration, coke for metallurgical purposes, and chemicals such as furfural, humic acid, phenols and alcohol', as reported in testimony presented

before the Minnesota Legislature.[17/] Peat is used, also, as an oil absorbent medium for controlling oil spills. Peat-sand filters are currently used in Minnesota for filtration of sewage effluent from campgrounds and wayside rest stops. However, no peat land is used currently for industrial chemicals in Minnesota.

Finally, peat land development may result in an expansion of energy production. Peat may be burned directly or it may be gasified to produce synthetic natural gas. Peat-fired district heating plants have been built in Finland to provide energy (electricity and heat) from small-to-intermediate size facilities for a single municipality or small groups of municipalities. Gasification of peat is less well developed than direct burning. A gasification plant is much larger, also, than a direct-burning facility. Although both types of energy-related peat resource are technically feasible development options, this report focuses on peat gasification. In this report, direct burning of peat is viewed as an unlikely development option in the United States with its large reserves of coal. Gasification, however, is much more likely in case of critical natural gas curtailment or price increases. A fifth industry option would occur in this case, namely, the distribution of synthetic natural gas to customers.

Peat Industry Classification

Calculation of Study Region peat development impacts depends on accurate and complete specification of goods and services produced by

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17/ Minnesota Department of Natural Resources Peat Program; Testimony presented to the Senate Natural Resources and Agricultural Committee, October 12, 1977.

regional industry which peat-utilizing industry will purchase as inputs. Impact calculation also depends on identification of markets for peat-industry products. Input-output techniques are used in this study to identify inputs and markets and to calculate impacts.

The first step in employing input-output techniques for this purpose is to precisely classify the peat-utilizing industries as to products produced and production techniques employed. The classification procedures are explained in this subsection.

Two industry listings or classifications are used in this study -- a detailed 111-industry listing for the two-region input-output computer program and an aggregative 55-industry listing for the regional resource development simulations and summarization of results. Only the 55-industry listing is presented in this report. The 1972 (rather than 1967) edition of the Standard Industrial Classification Manual is used in identifying each industry group. This Manual assigns a unique SIC code number to each of thousands of industrial processes, service industries, and wholesale/retail operations. Each code number is assigned on the basis of the kind of good and/or service being produced and/or sold. The industrial classifications or sectors found in published input-output tables are defined in terms of SIC codes.[18/] Input-output tables show the products used by each industry in its production process, thus showing interactions among all

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18/ Executive office of the President, Office of Management and Budget, Standard Industrial Classification Manual, 1972, U.S. Government Printing Office, Washington, D.C., 1972.

industries located in the area economy or Study Region. The most detailed input-output tables for the United States show all interactions at the 367 industrial sector level of detail.

The product (or products)that would be produced by each peat-related industry was assigned an SIC code number with the aid of explanations provided in already cited SIC Manual. Thus, peat land agriculture was associated with crop production, peat extraction for any purpose with a branch of the mining industry, and synthetic gas production and peat coke production with specific branches of the chemical industry. Distribution of synthetic gas from peat was associated with the gas utility industry. The SIC code numbers then permitted the identification of industries in the 367 sector input-output tables which have an input-structure most closely resembling the technology in utilizing peat.

Data on the input-output structure of peat-related industries were incorporated into U.S. input-output tables at the 111-sector level of detail and, subsequently, the two-region input-output program was used to construct a corresponding 111-industry input-output table of the primary (eight-county) Study Region economy. This detailed table was then aggregated to 55 sectors for peat development impact simulation and for summarization of results. In the 55-sector regional input-output table, each of the peat-related industries acquires production inputs from industries in its vicinity and, also, from outside the Study Region. The industry

outputs are disbursed to other industries (as an intermediate product input) and to households, businesses and government (as final product).

The production input requirements (or technology) of each peat industry were identified using special studies. Two principal sources were Charles H. Fuchsman, The Industrial Chemical Technology of Peat, submitted to The Minnesota Department of Natural Resources, St. Paul, Minnesota, February 1978; and Institute of Gas Technology, Experimental Program for the Development of Peat Gasification, submitted by the Minnesota Gas Company to the United States Energy Research and Development Administration, April 1977.

Peat Land Agricultural Production

Wild rice production (see, table 7.2) is presently the most valuable peat land crop in northern Minnesota. Hay and grain also are grown. Cold season vegetable crops, such as spinach, broccolli, carrots, celery and cabbage, are a possibility for the future. [19] The estimated total annual value of the peat land crops in the early 1970's is $5,770,000 (1970 dollars). The wild rice alone is valued at $5,500,000. [20]

19/ The discussion in this section has benefitted greatly from conversations with Professor Rouse Farnham, Department of Soils, and Professor Erwin Oelke, Department of Agronomy, University of Minnesota, St. Paul.

20/ U.S. Department of Agriculture and Minnesota Department of Agriculture, Crop and Livestock Reporting Service, Minnesota Agricultural Statistics, Annual. Data on wild rice yield is from Professor Erwin Oelke, Department of Agronomy, University of Minnesota, St. Paul.

Projected crop production on peat land is confined to Aitkin County in the agricultural development scenario. The Aitkin County road network and farm service center development is the most complete of any county in the extended Study Region in which a large acreage of undeveloped peat land is available. More than 425,000 acres of undeveloped peat land were reported for Aitkin County in 1977. Total cropland in commercial use in the entire Study Region in 1974 was slightly under 74,000 acres. Thus, future development of 425,000 acres of currently undeveloped peat land would represent a nearly six-fold expansion of total cropland. In this study it is assumed that the 425,000 Aitkin County acres will begin to be developed beginning in 1985, and that they will be developed at a steady rate until development is completed in the year 2000.

Crop production on peat land is confined to Aitkin County in the agricultural scenario. More than 425,000 acres of undeveloped peat land were reported for Aitkin County in 1977.

The agricultural development scenario further assumes that initial peat land production of hay and oats is equal in value to between 10 and 15 percent of the estimated value of study area livestock production in 1970, or about $6,000,000 (in 1970 dollars). This increase in the supply of feed is conservatively assumed to result in an increase of equal amount in the value of study area livestock production or, $6,000,000. At the average price reported for 1970, $6,000,000 represents 308,000 tons of hay or 9,520,000 bushels of oats. At yields reported for Aitkin County in recent years, 385,000 acres would be required to produce this much hay, or

137,000 acres would be needed to produce this much oats.[21]

Assuming that peat land crop production would not be feasible until suitable technology was available to make the value of production per worker equal to the value in conventional cropland production, yields an estimate of about 150 persons employed in peat land production. Assuming that earnings per worker in peat land agriculture are the same as earnings in other study area crop production, then total earnings would be about $1,200,000 (in 1970 dollars) for the 150 persons employed. Employment and earnings relationships in the livestock sector are assumed not to change.

Industrial Uses of Peat Land

The non-agricultural, peat-related industry groups cited earlier are peat mining, and synthetic gas, industrial chemical and coke production. The peat mining industry furnishes the industry gases (peat) industry and the miscellaneous chemicals (peat) industry with all of their peat requirements. Each of the three industry's production and market relationships are discussed in this chapter.

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[21] In 1970, the season average price for oats was $0.63 per bushel. For hay, the season average price was $19.50 per ton baled. In 1976, the yield for oats was 51 bushels per acre and for hay the yield was 0.8 tons per acre. These data are from the U.S. Department of Agriculture and Minnesota Department of Agriculture, Crop and Livestock Reporting Service, Minnesota Agricultural Statistics, 1977, St. Paul, Minnesota, 1977.

Synthetic Natural Gas Production

Peat gasification and production of chemical by-products head the list of potential uses for peat and have been the subject of extensive engineering study.[22] A peat gasification plant would produce synthetic natural gas (for fuel) plus valuable chemical by-products, including benezine, oils, phenol, ammonia, and sulfur. A pilot plant producing 80,000,000 cubic feet of synthetic gas per day would be constructed, operated, and evaluated preliminary to scaling up operation to produce 250,000,000 cubic feet of gas per day.[23] Total costs, employment, and production in the full-scale plant would be three times the estimates presented in the engineering study for the smaller plant.

The gasification plant scenario represents the economic characteristics of an economically feasible full-scale gasification plant. Annual synthetic gas plant cost estimates are as follows:

Peat Feed	$59,000,000
Supplies	29,460,000
Labor	14,700,000
Capital	78,750,000
Total	$181,910,000

These cost estimates were prepared as follows: A partial peat extraction technology may be implemented at a cost of as little as $5 (1976 dollars)

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[22] Institute of Gas Technology, Experimental Program for the Development of Peat Gasification, submitted by Minnesota Gas Company to the United States Energy Research and Development Administration, April 1977.

[23] Institute of Gas Technology, Ibid., p. ix.

per ton of peat.[24] In this report, it is assumed that, by the time the details have been worked out, the extraction cost would total $6, which yields a total annual extraction cost of $108,000,000 (1976 dollars) given a total input of 18,000,000 tons of 30 percent moisture peat annually.[25] The $108,000,000 total is deflated to $59,000,000 in 1970 dollars.[26] Operating expenses were projected using data reported in the pilot plant engineering report multiplied by three to reflect the scaling up to full production. The $29,460,000 total is the resulting operating cost estimate after deflating to 1970 dollars. The projected labor force was derived by multiplying the pilot plant work force[27] by three to yield an estimate of 1,400 workers. After taking into account the possibility that worker productivity in the full scale plant may be greater, and that worker productivity in a plant built in the 1980's may be slightly greater than in one built with the currently available technology described in the Institute of Gas Technology study, an estimate of 1,260 workers was used in this

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[24] Institute of Gas Technology, Ibid., p. ix.

[25] Minnesota Gas Company, Research Necessary to Develop Peat as a Source of Energy In Minnesota, by A. M. Rader, Assistant Vice President, Research, April 1977.

[26] The deflator is 1.83 for the mining sector. See the data on U.S. Gross National Product by sector in current and constant dollars in various issues of The Survey of Current Business.

[27] Institute of Gas Technology, op. cit., p. ix.

study. After evaluation of SIMLAB projections of average annual earnings per worker in study area industries for 1985, an estimate of $11,660 (1970 dollars) for gas plant workers was used to derive an estimated gas plant payroll of $14,700,000. At $11,660, each gas plant worker would be earnings about $3,600 or $300 per month more than the SIMLAB projected 1985 study area average of $8,000.[28/] This differential should be large enough to ensure the gas plant an adequate labor supply. At the same time, it is $100 annually less than the $12,760 in earnings per worker projected for the study area taconite industry. Taconite firms are likely to maintain a differential of at least this size in order to retain wheir work force. If the gas plant found it necessary to apy the taconite industry worker annual wage of $14,760 (1970 dollars) projected by SIMLAB by 1985, then the gas plant payroll would be about $18,600,000.

Capital costs are the return to investment in the plant which must be paid in investors are to recover the cost of the plant. The full scale plant is projected at $750,000,000, in 1976 dollars, or about $525,000,000 in 1970 dollars.[29/] Assuming that investors will require a 15 percent annual rate of return on the $525,000,000 yields an annual capital cost estimate of $78,750,000.

Once annual operating costs have been projected, it is possible to derive the price of synthetic gas which must be received if production

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28/ Minnesota Department of Employment Security data are the basis for projections.

29/ Institute of Gas Technology, Op. Cit., p. 12.

costs are to be covered. Gas revenues need not cover all production costs because some $45,000,000 of chemical by-products will also be produced. The estimated value of by-products was made by first noting that the pilot plant would produce by-products worth $30,000,000 in 1977.[30/] This figure was multiplied by three to estimate the value of by-products from the full-scale plant, which was then divided by two in order to convert to 1970 dollars and obtain the $45,000,000 estimate. Considering the annual revenue of approximately $45,000,000 from by-products, a price at the plant for synthetic gas of approximately $1.70 (1970 dollars) per 1,000 cubic feet would cover all costs, including capital costs.

Operating at 90 percent of capacity (360 days per year) the full-scale plant would produce 81 billion cubic feed of gas per year. Letting the algebraic variable P_G be the price of 1,000 cubic feet of gas, the total annual revenues, P_T, of the plant are given by the formula,

$$P_T = 81,000,000 \times P_G + \$45,000,000.$$

If all annual costs are to be recovered, then total revenues must equal total costs, or

$$P_T = 81,000,000 \times P_G + \$45,000,000 = \$181,910,000$$

Solving algebracially for P_G, then,

$$P_G = \frac{\$181,910,000 - \$45,000,000}{81,000,000}, \text{ or}$$

$$P_G = \$1.70$$

30/ Institute of Gas Technology, Ibid., p. 15.

Thus, a synthetic gas price of approximately $1.70 (1970 dollars) per 1,000 cubic feet would cover all costs, including capital.

Construction of the full-scale synthetic gas plant would require an employed work force of about 2,700 each year for three years and an annual study area expenditure of about $105,000,000 (in 1970 dollars). These projected values were arrived at by first assuming that the $525,000,000 (in 1970 dollars) cost of the plant is 60 percent buildings and 40 percent equipment. The cost of equipment was ignored since it would be manufactured outside the study area and shipped in. Sixty percent of $525,000,000 is $315,000,000, which, spread over three years, is $105,000,000 annually. Construction employment was projected from U.S. data, which show $33,240 worth of construction performed per worker in 1970 and a projected $39,100 worth to be performed during the early 1980's.31/

Synthetic Natural Gas Delivery

Synthetic gas delivery incurs expenses and generates added employment. These expenditures and employment are for day-to-day operation,

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31/ Initial estimates of regional output per worker by industry are their National counterparts calculated from output data in the U.S. Department of Commerce, Bureau of Economic Analysis, Summary Input-Output Tables of the U.S. Economy: 1968, 1969, 1970, BEA Staff Paper No. 27, Washington, D.C., September 1975. Employment data are from the U.S. Department of Labor, Bureau of Labor Statistics, The Structure of the U.S. Economy in 1980 and 1985, Bulletin 1831, Washington, D.C., 1975. These estimates are then adjusted upward or downward to correspond to what is known about regional productivity. Future trends in productivity over time are in the Bureau of Labor Statistics document.

maintenance, and repair of the synthetic gas delivery system.

Synthetic gas from peat may be delivered to users through existing pipelines, by truck and/or rail, and/or through separate pipelines. In this report it is assumed that the synthetic gas will simply be fed into an expanded existing regional pipeline system. Thus, unit synthetic gas delivery employment and other expenses will be the same as those incurred for delivery of a similar volume of natural gas.

Available data indicate that in 1970, 57.2 billion cubic feet of natural gas was delivered in the Study Region.[32] Gas utility employment was 187 persons. On the basis of this information, delivery of 81 billion cubic feet of synthetic gas would result in added employment of 225 persons.[33] SIMLAB projects the average annual earnings of study area gas utility employees to be $9,550 (1970 dollars) in 1985. Since workers hired to operate the expanded system would be new employees, it is assumed that they would earn a little less. Assuming annual earnings of $9,450 (1970 dollars) per employee, annual earnings generated by synthetic gas distribution would total $2,126,000 (1970 dollars).

32/ Minnesota Energy Agency, Management Information Systems Research Center and Agricultural Experiment Station, University of Minnesota, Economic Data Base for Long-Range Energy Planning in Northeast Minnesota and Douglas County, Wisconsin, August 1975, Chapter 6. Employment data is from the U.S. Department of Commerce and the Minnesota Department of Employment Security.

33/ The estimate of 225 persons is calculated as follows: 81 billion cubic feet ÷ 57.2 billion cubic feet = 1.42. Then, 1.42 x 187 - 265, an estimate of the number of persons required to operate the pipeline if it existed today. Projected increases in pipeline worker productivity expected to occur by the mid-1980's result in the estimate of 225 persons used in this study.

The gas distribution scenario assumes that the gas utility purchases gas at $1.70 per 1,000 cubic feet from the synthetic gas plant. Purchases of supplied materials, and business services from study area firms were projected on the basis of those made by the natural gas utility. Synthetic gas utility annual capital costs were assumed to total $20,000,000 (1970 dollars), which, at a 15 percent rate of return, would service an investment of $113,000,000 (1970 dollars). Total annual gas utility costs are thus projected at $170,000,000 (1970 dollars). If revenues were to cover these costs, then the price of synthetic gas, delivered, would be $2.10 (1970 dollars) per 1,000 cubic feet.

At least two alternatives for marketing of synthetic gas exist and are considered in this report. One alternative would be to sell all the gas outside the study area. In this case, the only social and economic impacts occurring within the study area would be those resulting from the production of the gas. Another alternative would be to sell part of the gas to users within the study area as a substitute for some, but not all, of the natural gas utilized currently. If the peat gas is more expensive, then user costs will rise, thus resulting in lower profits for gas-using businesses and/or higher consumer prices for goods and services produced in the study area. More details of these alternatives are presented in the next chapter.

Peat Coke Production

Peat coke is the principal chemical currently produced from peat. A peat coke plant of minimum viable size would produce 10,000 tons per year of coke. Total plant employment is projected to be 30 full-time

persons. Additional persons would be needed to harvest peat, but the number is uncertain since the harvesting methods to be used are unknown. About 300,000 tons of peat, in its natural state, would be required annually. Capital investment in the plant would be about $3,100,000 (1970 dollars).[34/]

Assuming a capital investment of $3,100,000 and a 15 percent rate of return, annual capital costs would be about $465,000 (1970 dollars). Assuming peat extraction costs of $6 (1970 dollars) per ton, then the costs would total $980,000 (1970 dollars).

Labor costs would add $350,000 (1970 dollars) annually, assuming an annual wage of $11,660 (1970 dollars), the same as in the synthetic gas plant. Maintenance, local taxes, and insurance would add another $300,000 to annual costs.[35/] Finally, preparation of peat for coking would equal the cost of mining or harvesting the peat (i.e., $980,000) annually.

No attempt was made by the authors of this report to calculate the revenue a peat coke plant would earn since the peat coke could command different prices, depending on the exact nature and use of the carbon product it is turned into and, the value of the by-products of the coking

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34/ Peat coke plant data are from Fuchsman, op. cit., p. 114. The capital investment estimate presented by Fuchsman has been deflated to 1970 dollars by the authors.

35/ Estimates of the annual cost of maintenance, taxes, and insurance were derived from financial ratios in the gasification plant engineering study. See Institute of Gas Technology, op. cit., Table 6.

process are unknown.[36] It is assumed, however, that the peat coke would be sold outside the study area.[37]

Peat Mining

Both a peat coke plant and a gasification plant would require the mining or extraction of peat. The mining scenario used in this report is a peat mining industry producing sufficient peat for a gas plant, a coke plant, and a small production for horticultural purposes.

Discussion of the peat input requirements of a coke plant and a gas plant presented earlier in this chapter indicates that about 18,500,000 tons of peat would be needed at a total projected extraction cost of about $60,000,000 (1970 dollars). At the time of this writing, details on how the peat will be extracted have not been worked out and no estimates of peat mining employment were available to the authors. Thus, it was necessary to estimate peat mining employment. It seems reasonable to assume that worker productivity in a new Northern Minnesota extractive industry would have to be somewhat greater than in the existing taconite industry if the new industry were to be economically viable. The principal reason for this is that the new industry would probably have greater capital costs per worker than the established industry with its older stock of

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36/ See Fuchsman, op. cit., pp. 112-115, for a discussion of possible final products and by-products.

37/ Fuchsman, Ibid, p. 115, doubts that a market exists anywhere in Minnesota.

plant and equipment. In view of the SIMLAB 1985 projection of $42,000 (in 1970 dollars) for taconite industry production per worker, it was assumed that production per worker in the peat mining industry would be about 25-30 percent greater or about $53,500 (1970 dollars). At this level of productivity, about 1,120 workers will be needed to extract the 18,500,000 tons of peat annually. Assuming that peat mine workers are paid the same as taconite industry workers are projected to be in 1985, or $12,760 (1970 dollars) total annual earnings will be about $14,300,000 (1970 dollars).

Relation of Peat Development to Iron Mining Industry

The projected peat land development will occur in the midst of an expanding iron mining industry. In 1970, total production of iron ore in the United States was 89.8 million long tons, while imports totaled 44.9 million long tons (Table 8.1). Thus, total consumption of iron ore was 131.6 million long tons, of which 56.1 million long tons originated from Minnesota. This was 42.7 percent of total U.S. consumption of iron ore.

U.S. iron production is projected to total 106.2 million long tons by 1985 and 154.5 million long tons by 2000 -- a 72 percent increase in 30 years. Imports in this period are projected to decrease gradually from 39.7 million long tons in 1985 to 30.6 million long tons in 2000 -- a 46.7 percent decline from the 1970 level of 44.9 million long tons. Meanwhile, Minnesota production of iron ore, including taconite pellets, is projected to increase to 73.1 million long tons in 1985 and 101.3 million long tons in 2000 -- an 80.6 percent increase from the 1970 level of 56.1 million long tons. Total iron ore consumption in the United States thus is projected to

Table 8.1. Estimated and projected iron ore production, imports and consumption, United states and Minnesota, 1970-2000. 1/

Year	United States			Minnesota Production
	Production	Imports	Consumption	
	(mil. tons)			
1970	89.8	44.9	131.6	56.1
1971	80.8	40.1	116.2	51.3
1972	75.4	35.8	126.9	49.0
1973	87 7	43.3	146.9	60.0
1974	84.4	48.0	138.2	58.5
1975	78.9	46.7	114.1	51.2
1976	80.0	44.4	125.4	50.1
1977	57.0	37.0	118.0	51.0
1978	85.9	44.7	130.6	58.4
1979	88.6	44.0	132.6	63.9
1980	91.4	43.4	134.8	65.6
1981	94.2	42.7	136.9	67.0
1982	97.1	42.0	139.1	68.5
1983	100.0	41.3	141.3	70.0
1984	103.1	40.5	143.6	71.6
1985	106.2	39.7	145.9	73.1
1986	109.4	38.8	148.2	74.8
1987	112.7	37.9	150.6	76.4
1988	116.0	37.0	153.0	78.1
1989	119.4	36.1	155.5	79.8
1990	122.9	35.0	157.9	81.5
1991	126.5	34.0	160.5	83.3
1992	130.1	32.9	163.0	85.2
1993	133.9	31.8	165.7	87.0
1994	137.7	30.6	168.3	89.0
1995	140.4	30.6	171.0	90.9
1996	143.1	30.6	173.7	92.9
1997	145.9	30.6	176.5	95.0
1998	148.7	30.6	179.3	97.0
1999	151.6	30.6	182.2	99.1
2000	154.5	30.6	185.1	101.3

1/ U.S. Department of the Interior, Bureau of Mines, Mineral Commodity Summaries, U.S. Government Printing Office, Washington, D.C. The projections of future United States iron ore consumption and imports of iron ore are based on information supplied by F. L. Klinger, U.S. Bureau of Mines, Washington, D.C. Mr. Klinger also supplied the historical Minnesota porduction data. The projection of future Minnesota production was derivce from information on the expansion plans of taconite firms complied by the Minnesota Environmental Quality Board, Regional Copper-Nickel Study.

increase at an annual rate of approximately 1.6 percent per year over the next 20 years. Meanwhile the Minnesota market share is projected to increase by 0.6 percent per year from its 1980 level of 48.6 percent of total U.S. consumption.

Increases in iron ore production are converted from long tons to dollars by using 1970 unit prices for iron ore and taconite pellets. Total value of iron ore consumption in 1970 is estimated at $1,930 million. The Minnesota iron ore production in 1970 is valued at $571 million.[38/] Use of 1970 prices yields projected total values of $762 million and $1,057 million for the Minnesota iron ore production in 1985 and 2000, respectively.

Projected expansion of the iron mining industry is assumed gradual over the post-1985 period. This expansion would not impose heavy demands for related services. However, the projection of taconite pellets is energy-intensive. Total energy requirements in the study area are projected to increase sharply with additional taconite pellet production capacity.

38/ U.S. Department of the Interior, Bureau of Mines, Minerals Yearbook 1970, Volume 1, U.S. Government Printing Office, Washington, D.C., 1972, p. 587.

LOCAL GOVERNMENT FINANCING

Local government financing is a critical issue in resource development planning. The income and expenditures of local governments -- counties, municipalities, townships, school districts and special districts -- will vary with the type or level of regional and community economic development. Peat land development relates to local government financing insofar as it affects the levels of (1) taxable valuation, (2) transfer payments, and (3) public service and investment requirements of the resident population and industry.

Elements of local government financing are included in the presentation of (1) local government income, (2) local government disbursements, and (3) local government expenditures. Local government income refers to the revenues derived from current local sources, including taxes and charges, transfer payments from federal, state and other local governments, and non-revenue sources, including refunds received, sale of investments, and borrowing. Fund withdrawals and accruals are simply accounting entries (to balance total income with total disbursements). Local government disbursements refer to the general areas of local government expenditure -- current and capital outlays, debt-retirement and other non-revenue obligations. Local government expenditures pertain to the current and capital outlays for specific governmental functions, such as general government, safety, sanitation and health, education, welfare (and charities), libraries, recreation, roads, and natural resources (including parks). Estimates of local government financing under each of the three categories are presented

for the fiscal years starting in 1970.

Local Government Income

Sources of local government income are identified for each type of local government - counties, municipalities, townships, school districts, and special districts (e.g., Airport Commission, County Sanitorium, Hospital District, Housing and Redevelopment Authority, Library District, Mental Health District, Minnesota State Armory Building Commission, Port Authority, Soil Water Conservation District and Watershed District). The level of dependence on each source differs among local governments and, also, from year to year. Transfer payments, especially from state government to school districts, are becoming increasingly important as a source of local government income.

County governments depend heavily upon transfer payments from state government as a major income source (table 9.1). In the fiscal years starting in 1970, local real estate taxes accounted for less than 30 percent of total county government income. Other income sources were much less important than either state government transfer payments or even local taxes.

Municipal governments are more heavily dependent on local real estate taxes than county governments. In 1970, for the nine municipalities in Kittson County, for example, the local taxes provided 45.4 percent of their total revenue (table 9.2). For the 27 municipalities in St. Louis County, local taxes provided 53.2 percent of total revenues. In individual municipalities this percentage was even larger. Borrowing, on the other hand, is

Table 9.1. Estimated income of county government in specified county and planning region, by type of income, northern Minnesota, 1970. [1/]

Planning Region and County	Current Local				Transfers			Total Revenue	Non-Revenue			Total Receipts	Fund Withdrawal	Total Income [2/]
	Taxes	Charges	Other	Total	Federal	State	Total		Refunds Received	Sales of Investment	Total			
	($1,000)													
Northwest:														
Kittson	581.5	27.6	67.0	676.1	129.5	1,356.9	1,486.4	2,162.5	73.2	23.2	96.4	2,258.9	384.1	2,643.0
Marshall	749.4	52.7	57.1	859.2	31.5	1,815.0	1,846.5	2,705.7	112.3	0	112.3	2,818.0	135.9	],953.9
Norman	617.8	28.0	29.2	675.0	20.9	1,123.0	1,143.9	1,818.9	120.7	0	120.7	1,939.6	72.2	2,011.8
Pennington	581.8	55.8	19.9	657.5	0	1,317.2	1,317.2	1,974.7	78.6	323.0	401.6	2,376.3	0	2,376.3
Polk	1,823.1	172.3	90.9	2,086.3	22.5	3,495.5	3,518.0	5,604.3	175.1	724.2	899.3	6,503.6	0	6,503.6
Red Lake	366.4	16.5	24.8	407.7	.1	705.2	705.3	1,113.0	26.7	0	26.7	1,139.7	0	1,139.7
Roseau	682.5	73.1	73.6	829.2	193.4	1,490.1	1,683.5	2,512.7	160.6	0	160.6	2,673.3	312.5	2,985.8
Total	5,402.5	426.0	362.5	6,191.0	397.9	11,302.9	11,700.8	17,891.8	742.2	1,070.4	1,817.6	19,709.4	904.7	20,614.1
Headwaters:														
Beltrami	1,023.4	87.4	54.3	1,165.1	0	3,570.2	3,570.2	4,735.3	167.0	0	167.0	4,902.3	0	4,902.3
Clearwater	573.4	147.0	22.8	743.2	1.4	1,667.3	1,668.7	2,411.9	69.9	0	69.9	2,481.8	0	2,481.8
Hubbard	556.3	42.1	40.5	638.9	0	1,309.4	1,309.4	1,948.3	63.4	0	63.4	2,011.7	0	2,011.7
Lake of the Woods	277.5	23.2	10.9	311.6	0	614.0	614.0	925.6	45.0	0	45.0	970.6	0	970.6
Mahnomen	282.3	17.1	16.3	315.7	396.9	879.9	1,276.8	1,592.5	44.0	10.0	54.0	1,646.5	0	1,646.5
Total	2,712.9	316.8	144.8	3,174.5	398.3	8,040.8	8,439.1	11,613.6	389.3	10.0	399.3	12,012.9	0	12,012.9
Arrowhead:														
Aitkin	777.7	119.8	8.4	905.9	.7	2,334.8	2,335.5	3,241.4	153.7	0	153.7	3,395.1	0	3,395.1
Carlton	1,603.4	154.1	18.3	1,775.8	4.9	2,515.3	2,320.2	4,296.0	253.9	0	252.9	4,549.9	0	4,599.9
Cook	219.0	34.6	3.4	257.0	91.2	787.0	878.2	1,135.2	41.1	108.3	149.4	1,284.	0	1,284.6
Itasca	3,070.1	187.8	315.3	3,573.2	377.8	4,043.4	4,421.2	7,994.4	483.0	0	483.0	8,477.4	0	8,477.4
Koochiching	1,134.0	74.6	46.4	1,255.0	1.5	2,219.4	2,220.9	3,475.9	132.9	8.0	140.9	3,616.8	66.1	3,682.9
Lake	426.7	46.6	35.4	508.7	125.2	1,542.9	1,668.1	2,176.8	63.6	55.4	119.0	2,295.8	0	2,295.8
St. Louis	12,552.8	893.7	495.2	13,941.7	144.3	21,425.9	21,570.2	35,511.9	2,317.2	18.9	2,336.1	37,848.0	0	37,848.0
Total	19,783.7	1,511.2	922.3	22,217.3	745.6	34,868.7	35,614.3	57,831.6	3,445.4	190.6	3,636.0	61,467.6	66.1	61,533.7

Table 9.2. Estimated income of municipalities in specified county and planning region, by type of income, northern Minnesota, 1970. [1/]

Planning Region And County	Revenue					Non-Revenue		Total Receipts	Fund Withdrawal [2/]	Total Income
	Taxes	Charges	Transfers	Other	Total	Borrowing	Other			
						($1,000)				
Northwest:										
Kittson	205.8	83.1	102.5	61.9	453.3	0	52.9	506.2	20.1	526.3
Marshall	242.3	93.7	193.6	214.6	744.2	0	150.1	894.3	46.1	940.4
Norman	112.5	232.8	99.9	143.0	588.2	0	516.3	1,104.5	-97.1	1,007.4
Pennington	382.5	285.0	459.9	252.0	1,379.4	991.0	851.1	3,221.5	-23.5	3,198.0
Polk	1,339.0	509.9	674.8	759.2	3,282.4	0	265.0	3,547.4	256.7	3,804.1
Red Lake	100.4	20.3	192.4	66.6	379.7	285.8	3.7	669.2	-71.3	597.9
Roseau	332.4	69.1	129.6	192.7	713.8	147.6	68.9	930.3	76.3	1,006.6
Total	2,704.9	1,293.9	1,852.2	1,690.0	7,541.0	1,424.4	1,908.0	10,873.4	207.3	11,080.7
Headwaters:										
Beltrami	538.1	303.0	419.9	181.2	1,442.2	302.5	239.1	1,983.8	-61.6	1,922.2
Clearwater	97.3	23.0	67.3	91.3	278.9	0	6.1	285.0	-8.6	276.4
Hubbard	96.2	25.4	69.4	67.0	258.0	0	0	260.1	44.5	304.6
Lake of the Woods	35.3	32.4	126.1	81.0	274.8	0	48.6	323.4	130.7	454.1
Mahnomen	53.7	3.2	257.7	71.7	268.4	75.0	87.7	549.0	-19.5	529.5
Total	820.6	387.0	940.4	492.2	2,640.2	377.5	383.6	3,401.3	85.5	3,486.8
Arrowhead:										
Aitkin	77.2	36.5	48.7	99.3	261.7	0	14.3	276.0	-10.7	265.3
Carlton	774.5	186.6	923.5	151.8	2,136.4	29.1	706.9	2,872.4	-43.9	2,828.5
Cook	21.7	30.5	24.5	157.6	234.3	0	0	241.0	-24.1	216.9
Itasca	1,164.5	218.8	790.5	438.2	2,611.9	429.6	1,082.2	4,123.6	-478.0	3,645.6
Koochiching	781.3	157.0	1,238.0	360.7	2,537.0	16.0	1,855.7	4,408.7	-210.2	4,198.5
Lake	495.2	159.0	446.2	132.7	1,233.1	0	568.9	1,802.0	60.1	1,862.1
St. Louis	11,964.7	2,793.1	6,830.9	915.6	22,504.3	1,746.0	1,744.7	25,995.0	-1,641.3	24,353.7
Total	15,279.1	3,681.5	10,302.3	2,255.9	31,518.7	2,220.7	5,972.7	39,718.7	-2,348.1	37,370.6

more important as an income source for municipal governments than county governments.

Township governments, like municipalities, depend on local taxes as the principal, if not major, source of income (table 9.3). State government transfer payments are a close second, in many townships, as an income source.

School districts depend to an increasingly greater extent on state government transfer payments. In 1970, however, local taxes were a major source of revenues for school districts (table 9.4).

Special districts are only slightly dependent on local taxes (table 9.5). Because of their special functions, special districts usually are funded directly from federal and state programs.

The total income derived from local taxes and revenues of the five types of local government is summarized for each county and planning region (table 9.6). The distribution of tax revenues among local government shows the importance of school district financing in accounting for the level of local taxes. More than one-half of the local tax levy is due to the burden of primary and secondary education. Much of the difference between tax revenues and total revenues represents transfer payments, primarily state government to local government.

Local Government Disbursements

Local government disbursements include current and capital expenditures and, also, debt retirement. Fund withdrawals again are simply school district balancing entries.

Table 9.3. Estimated income of townships in specified county and planning region by type of income, northern Minnesota, 1970.

Planning Region And County	Taxes	Transfers		Total Revenue	Borrowing	Total Receipts	Fund Withdrawal	Total
		State	County					
				($1,000)				
Northwest:								
Kittson	86.0	60.8	----	146.8	----	146.8	----	146.8
Marshall	121.2	123.9	2.9	248.0	----	248.0	----	248.0
Norman	54.0	88.8	----	142.8	----	142.8	----	142.8
Pennington	16.2	62.4	----	78.6	----	78.6	----	78.6
Polk	274.9	221.4	----	496.3	----	496.3	.2	496.5
Red Lake	16.8	43.5	----	60.3	----	60.3	----	60.3
Roseau	72.4	97.2	----	169.6	----	169.6	.1	169.7
Total	641.5	698.0	2.9	1,342.4	----	1,342.4	.3	1,342.7
Headwaters:								
Beltrami	44.4	124.7	----	169.1	----	169.1	----	169.1
Clearwater	53.8	86.6	.1	140.5	----	140.5	.1	140.6
Hubbard	50.7	82.8	.8	134.3	----	134.3	----	134.3
Lake of the Woods	----	----	----	----	----	----	----	----
Mahnomen	30.9	60.4	1.1	42.4	----	92.4	----	92.4
Total	179.8	354.5	2.0	536.3	----	536.3	.1	536.4
Arrowhead:								
Aitkin	76.8	128.7	1.1	206.6	----	206.6	----	206.6
Carlton	128.9	190.2	----	319.1	200.0	519.1	----	519.1
Cook	----	----	----	----	----	----	----	----
Itasca	334.6	242.8	3.4	580.8	110.0	690.8	----	690.8
Koochiching	0000	----	----	----	----	----	----	----
Lake	26.4	47.6	----	74.0	----	74.0	----	74.0
St. Louis	788.5	690.4	.2	1,479.1	200.0	1,679.1	----	1,679.1
Total	1,355.2	1,299.8	4.7	2,659.7	510.0	3,169.7	----	3,169.7

Table 9.4. Estimated income of school districts in specified county and planning region, by type of income, northern Minnesota, 1970.

Planning Region And County	Taxes	Charges	Other	Total	Federal	State	County	School District	Total	Total Revenue	Borrowing	Total Receipts
					($1,000)							
Northwest:												
Kittson	1,230.1	48.2	52.7	1,331.0	167.0	712.5	24.8	.3	904.6	2,235.8	0	1,735.8
Marshall	2,176.5	102.3	244.8	2,523.8	233.9	1,532.1	83.5	14.9	1,867.9	4,391.5	0	4,391.5
Norman	1,121.8	75.8	65.1	1,262.7	117.5	957.3	14.4	6.3	1,100.4	10,949.0	0	10,949.0
Pennington	1,816.3	106.3	84.0	1,986.7	145.0	1,865.0	328.8	40.2	2,369.0	4,355.6	0	4,355.6
Polk	5,025.1	233.6	484.1	4,742.9	592.0	3,411.0	105.0	36.5	4,415.7	8,888.7	0	8,888.7
Red Lake	623.6	37.0	81.6	742.3	135.9	917.6	20.5	20.4	1,093.5	1,838.8	0	1,836.8
Roseau	1,224.2	74.4	76.3	1,125.0	297.7	2,208.8	117.2	45.8	2,431.9	3,742.6	454.2	4,196.8
Total	13,217.6	677.5	1,088.6	1,351.4	1,689.0	11,424.3	694.2	165.4	14,183.0	36,400.0	454.2	36,854.2
Headwaters:												
Beltrami	1,723.1	128.0	233.9	2,085.2	1,108.8	2,972.7	301.9	51.2	4,434.4	11,151.5	0	11,151.5
Clearwater	739.8	44.5	44.3	828.6	190.0	836.0	160.0	4.8	1,211.0	2,039.5	0	2,039.5
Hubbard	1,396.1	63.8	49.5	1,519.5	293.9	1,370.6	55.4	61.7	1,781.6	3,291.0	0	3,291.0
Lake of the Woods	135.9	26.1	20.3	182.3	100.3	584.7	50.4	5.0	740.3	922.6	0	922.6
Mahnomen	430.0	23.1	30.8	484.0	266.3	880.1	96.2	20.5	1,263.2	1,747.2	0	1,747.2
Total	4,289.0	259.4	358.5	4,917.3	1,859.0	6,059.4	613.5	138.2	8,690.2	18,229.2	0	18,229.2
Arrowhead:												
Aitkin	1,341.2	74.3	256.2	1,681.7	160.0	1,319.5	37.4	6.1	1,523.0	3,204.7	0	3,204.7
Carlton	4,073.2	275.7	237.7	4,586.8	265.9	3,979.8	67.4	10.8	8,751.0	8,910.6	0	8,910.6
Cook	450.5	30.2	121.0	60.2	266.4	1,084.0	8.6	0	1,319.0	2,040.8	0	2,040.8
Itasca	5,843.3	96.0	398.2	6,337.5	549.6	4,973.6	324.7	21.7	5,849.0	8,197.0	1,990.6	10,187.6
Koochiching	2,049.1	117.3	132.8	2,299.3	149.3	2,059.1	132.5	35.7	2,376.7	4,736.0	0	4,736.0
Lake	279.7	113.2	585.3	978.2	200.5	3,910.3	17.4	0	4,128.2	5,106.4	0	5,106.4
St. Louis	16,258.1	948.0	2,268.3	19,474.4	3,581.6	25,060.9	524.3	718.3	30,431.0	62,506.4	405.0	62,911.4
Total	30,295.1	1,654.7	3,999.5	35,418.1	5,133.3	42,387.2	1,112.3	792.6	54,377.9	94,701.9	2,395.6	101,566.1

Table 9.5. Estimated income of special districts in specified county and planning region, by type of income, northern Minnesota, 1970. [1/]

Planning Region And County	Type of Special District [2/]	Current Transfer Payments: Taxes	Municipal	County	State	Federal	Other	Charges & Assessments	All Other	Total Receipts	Borrowing	Total Income
		($1,000)										
Northwest:												
Kittson	6, 9, 10	34.9	0	9.0	7.9	99.0	0	2.4	.9	119.2	55.0	174.1
Marshall	6, 9, 10	0	0	11.4	14.6	0	0	7.6	.3	33.4	0	33.9
Norman	6, 9, 10	0	0	5.5	11.8	0	0	20.7	12.0	50.0	0	50.0
Pennington	5, 6, 7, 9, 10	0	0	55.3	100.8	0	5.0	13.5	.6	175.3	0	175.3
Polk	4, 6, 9, 10	0	0	21.3	38.1	0	0	45.6	49.9	154.9	1,130.0	1,284.9
Red Lake	4, 6, 9, 10	0	0	6.9	5.6	16.6	0	9.5	4.6	43.2	377.0	420.2
Roseau	3, 6, 9, 10	46.1	0	8.1	13.5	0	0	799.9	32.9	854.4	0	854.4
Total		81.0	0	117.5	192.3	115.6	5.0	899.2	101.2	1,430.8	1,562.0	2,992.8
Headwaters:												
Beltrami	4, 6, 9, 10	.2	0	12.6	48.3	14.2	0	18.5	41.0	134.6	904.0	1,038.9
Clearwater	6, 9, 10	0	0	3.4	14.5	0	0	3.0	.2	21.1	0	21.1
Hubbard	4, 6, 9, 10	0	0	4.5	19.3	0	0	4.0	.2	28.0	0	28.0
Lake of the Woods	6, 9, 10	.8	0	2.0	7.3	0	0	1.5	.1	10.9	0	10.9
Mahnomen	6, 9, 10	0	0	4.2	6.7	0	0	1.0	.9	12.8	0	12.8
Total		1.0	0	26.7	96.1	14.2	0	28.0	42.4	207.4	904.0	1,111.5
Arrowhead:												
Aitkin	3, 4, 6, 9, 10	27.1	0	11.5	16.7	48.0	0	311.6	16.3	404.1	899.5	1,303.6
Carlton	3, 6, 9	22.2	0	0	0	0	0	894.1	27.2	921.3	0	921.3
Cook	6, 9	0	0	0	0	0	0	0	0	0	0	0
Itasca	6, 7, 9	0	0	32.2	45.5	0	5.8	5.2	5.3	94.0	0	94.0
Koochiching	4, 6, 9, 10	0	0	15.9	22.3	60.3	0	3.8	41.7	144.0	0	144.0
Lake	4, 6, 9	0	0	0	0	63.2	0	0	20.5	83.7	955.0	1,038.7
St. Louis	1, 2, 4, 5, 6, 7, 8, 9	59.5	68.2	887.3	422.7	1,137.2	20.4	2,377.2	937.5	5,850.5	4,416.1	10,266.6
Total		108.8	68.2	946.9	507.2	1,308.7	26.2	3,591.9	1,048.5	7,497.6	5,371.1	12,868.7
3 Region Total		190.8	68.2	1,091.1	795.6	1,438.5	31.2	4,519.1	1,192.1	9,135.8	7,837.1	16,973.0

1/

2/ Special districts include the following (with total numbers of special districts in parentheses):

1. Airport Commission (3)
2. County Sanitorium (1)
3. Hospital Districts (3)
4. Housing and Redevelopment Authority (14)
5. Library District (2)
6. Mental Health District (17)
7. Minnesota State Armory Building Commission (5)
8. Port Authority (1)
9. Soil and Water Conservation District (2)
10. Watershed District (6)

Table 9.6. Estimated taxable valuation, taxes and total revenue of local government in specified county and planning region, by type of government, northern Minnesota, 1970.

Planning Region And County	Taxable Valuation	Taxes						Total Receipts					
		County	Municipality	Township	School District	Special District	Total	County	Municipality	Township	School District	Special District	Total
						($1,000)							
Northwest:													
Kittson	7,795.7	581.5	205.8	86.0	1,230.1	34.8	2,138.2	2,258.9	506.2	146.8	2,235.8	119.2	5,266.9
Marshall	10,491.1	749.4	112.5	121.2	2,176.5	0	3,159.6	2,818.0	894.3	248.0	4,391.5	33.4	8,385.2
Norman	8,944.8	617.8	1,339.0	54.0	1,121.8	0	3,132.6	1,939.6	1,104.5	142.8	10,949.0	50.0	14,185.9
Pennington	5,675.1	581.8	382.1	16.2	1,816.3	0	2,796.8	2,376.3	3,221.5	78.6	4,355.6	175.3	10,207.3
Polk	26,279.4	1,823.1	358.1	274.9	5,025.1	0	7,481.2	6,503.6	3,547.4	496.3	8,888.7	154.9	19,590.9
Red Lake	2,646.1	366.4	100.4	16.8	623.6	0	1,107.2	1,139.7	669.2	60.3	1,737.7	43.2	3,751.2
Roseau	4,237.0	682.5	322.4	72.4	1,224.2	46.2	2,347.7	2,673.3	930.3	169.6	3,742.6	854.4	8,370.2
Total		5,402.5	2,720.7	641.5	13,217.6	81.0	22,163.3	19,709.4	10,873.4	1,342.4	36,402.0	1,430.8	69,758.0
Headwaters:													
Beltrami	8,334.6	1,023.4	538.1	44.4	1,723.1	.2	3,329.2	4,902.3	1,983.8	169.1	11,151.5	134.6	18,341.3
Clearwater	4,219.5	573.4	97.3	53.8	739.8	0	1,464.3	2,481.8	285.0	140.5	2,039/5	21.1	4,967.9
Hubbard	5,668.2	556.3	96.2	50.7	1,396.1	0	2,099.3	2,011.7	260.1	134.3	2,391.0	28.0	5,725.1
Lake of the Woods	12,690.7	277.5	35.3	0	135.9	.8	449.5	970.6	323.4	---	922.6	10.9	2,227.5
Mahnomen	3,636.4	282.3	53.7	30.9	430.0	0	796.9	1,646.5	549.0	92.4	1,747.2	12.8	4,047.9
Total		2,712.9	820.6	179.8	4,424.9	1.0	8,139.2	12,012.9	3,401.3	536.3	19,151.8	207.4	35,309.7
Arrowhead:													
Aitkin	4,858.3	777.7	77.2	76.8	1,341.2	27.1	2,300.0	3,395.1	276.0	206.6	3,204.7	404.1	7,486.5
Carlton	16,885.6	1,603.4	774.5	128.8	4,073.2	22.2	6,602.1	4,549.9	2,872.4	519.1	8,910.6	921.3	17,773.3
Cook	3,235.1	219.0	21.7	0	450.5	0	691.2	1,284.6	241.0	---	2,040.8	0	3,566.4
Itasca	27,956.4	3,070.1	1,164.5	334.6	5,843.3	0	10,412.5	8,477.4	4,123.6	690.8	8,197.0	94.0	21,582.8
Koochiching	9,492.5	1,134.0	781.3	0	2,049.1	0	3,964.4	3,616.8	4,408.7	---	4,736.0	144.0	12,905.5
Lake	5,786.6	426.7	495.2	26.4	978.2	0	1,926.5	2,295.8	1,802.2	74.0	5,106.4	83.7	9,361.9
St. Louis	21,890.1	12,553.8	11,964.7	788.5	19,474.4	59.5	44,839.9	37,848.0	25,995.0	1,678.1	62,506.4	5,850.5	133,879.0
Total		19,783.7	15,279.1	1,355.1	34,209.9	108.8	70,736.6	61,467.6	39,778.7	3,169.6	94,701.9	7,497.6	206,555.4

County government disbursements in 1970 were primarily for current expenditures in most counties (table 9. 7). In Kittson, Marshall and Roseau counties however, capital outlays were more than 50 percent of total outlays.

Municipal government disbursements generally included a large allocation for capital expenditures (table 9. 8). However, the distribution of expenditures varied widely among municipalities.

Township government disbursements were almost entirely on current account in 1970 (table 9. 9). Capital outlays were almost non-existent.

School district disbursements also were largely on current account in 1970 (table 9. 10). A large capital outlay was associated with recent rapid growth in population in and enrollment in the school district.

Special district disbursements were more evenly balanced between current and capital outlays than in the case of school districts (table 9. 11). Many special districts were established originally to make possible special-purpose capital improvements.

Current and capital outlays of each type of local government are summarized for internal comparisons (table 9, 12). The service orientation of each type of government is indicated by the distribution of total expenditures between the two categories.

Local Government Expenditures

A functional breakdown of current and capital outlays of local governments provides an additional perspective on the distribution of public service responsibilities in local communities. A total of 10 functional

Table 9.7. Estimated disbursements and accruals of county government in specified county and planning region, by type of disbursement, northern Minnesota, 1970.

Planning Region and County	Disbursements					Fund Accrual	Total
	Current	Capital	Debt Retirement	Other Non-Revenue	Total		
				($1,000)			
Northwest:							
Kittson	1,503.1	1,083.7	15.0	41.2	2,643.0	0	2,643.0
Marshall	1,876.1	984.4	86.0	7.4	2,953.9	0	2,953.9
Norman	1,472.6	456.2	71.0	12.0	2,011.8	0	2,011.8
Pennington	1,737.0	291.8	20.0	301.9	2,350.7	25.6	2,376.3
Polk	4,632.6	1,120.8	290.0	308.3	6,351.7	151.9	6,503.6
Red Lake	828.2	218.6	16.0	3.8	1,066.6	73.1	1,139.7
Roseau	1,710.3	1,172.2	100.0	3.3	2,985.8	0	2,985.8
Total	13,759.9	5,328.7	598.0	677.9	20,363.5	250.6	20,614.1
Headwaters:							
Beltrami	4,156.4	647.9		15.7	4,820.0	82.3	4,902.3
Clearwater	2,000.1	434.0	35.0	7.6	2,476.7	5.1	2,481.8
Hubbard	1,527.0	407.1	60.0	8.6	2,002.7	9.0	2,011.7
Lake of the Woods	693.3	171.8	9.7	.8	875.6	95.0	970.6
Mahnomen	1,365.3	209.5			1,574.8	71.7	1,646.5
Total	9,742.1	1,870.3	104.7	32.7	11,749.8	263.1	12,012.9
Arrowhead:							
Aitkin	2,485.3	588.2	50.0	12.4	3,135.9	259.2	3,395.1
Carlton	3,635.3	726.5		21.6	4,383.4	166.5	4,549.9
Cook	901.9	233.8		101.0	1,236.7	47.9	1,284.6
Itasca	6,391.2	1,348.4		203.7	7,943.3	534.1	8,477.4
Koochiching	3,014.9	663.1		4.9	3,682.9		3,682.9
Lake	1,414.7	629.2	15.0	40.4	2,099.3	196.5	2,295.8
St. Louis	33,160.9	2,724.6	225.0	74.1	36,184.6	1,663.4	37,848.0
Total	51,004.2	6,913.8	290.0	458.1	58,666.1	2,867.6	61,533.7

Table 9.8. Estimated disbursements of municipalities in specified county and planning region, by type of disbursement, northern Minnesota, 1970. 1/

Planning Region And County	Current	Capital	Debt Retirement	Other	Total
			($1,000)		
Northwest:					
Kittson	304.0	129.9	57.5	34.9	526.3
Marshall	442.0	201.6	114.4	182.4	940.4
Norman	408.2	24.6	56.2	518.4	1,007.4
Pennington	1,204.1	603.2	521.3	833.4	3,198.0
Polk	2,145.6	1,017.1	308.4	333.0	3,804.1
Red Lake	355.1	216.6	23.0	3.2	597.9
Roseau	503.6	387.4	55.0	60.6	1,006.6
Total	5,398.6	2,580.4	1,135.8	1,965.9	11,080.7
Headwaters:					
Beltrami	979.3	503.3	97.5	342.0	1,922.2
Clearwater	200.4	43.9	21.0	21.1	276.4
Hubbard	211.3	58.0	33.2	3.1	204.6
Lake of the Woods	162.3	175.4	115.2	1.2	454.1
Mahnomen	186.4	159.8	90.0	93.4	529.5
Total	1,739.7	940.4	356.9	460.8	3,486.8
Arrowhead:					
Aitkin	182.6	28.4	31.0	23.5	265.3
Carlton	1,740.5	336.8	104.0	646.1	2,828.5
Cook	132.0	78.1	0	6.7	216.9
Itasca	1,526.4	925.4	201.0	992.8	3,645.6
Koochiching	1,138.7	1,607.6	78.0	1,373.8	4,198.5
Lake	833.5	186.0	232.0	610.5	1,862.1
St. Louis	18,103.1	3,400.5	1,006.0	1,843.3	24,353.7
Total	23,656.8	6,562.8	1,652.0	5,496.7	37,370.6

Table 9.9. Estimated disbursements of townships in specified county and planning region, by type of disbursement, northern Minnesota, 1970. 1/

Planning Region And County	Current	Capital	Debt Retirement	Other Non-Revenue	Total Disbursements	Fund Accural	Net Disbursement
			($1,000)				
Northwest:							
Kittson	127.0	---	---	19.8	146.8	---	146.8
Marshall	214.5	---	---	33.5	248.0	---	248.0
Norman	123.4	---	---	19.3	142.7	.1	142.8
Pennington	69.7	---	---	8.9	78.6	---	78.6
Polk	433.9	---	---	62.6	496.5	---	496.5
Red Lake	52.2	---	---	8.1	60.3	---	60.3
Roseau	146.8	---	.5	22.4	169.7	---	169.7
Total	1,167.5	---	.5	174.6	1,342.6	.1	1,342.7
Headwaters:							
Beltrami	146.3	---	---	22.8	169.1	---	169.1
Clearwater	121.6	---	---	19.0	140.6	---	140.6
Hubbard	116.2	---	---	18.1	134.3	---	134.3
Lake of the Woods	0	---	---	0	---	---	0
Mahnomen	79.9	---	---	12.5	92.4	---	92.4
Total	464.0	---	---	72.4	536.4	---	536.4
Arrowhead:							
Aitkin	179.5	---	1.0	26.1	206.6	---	206.6
Carlton	278.3	---	4.0	236.8	519.1	---	519.1
Cook	---	---	---	---	---	---	---
Itasca	612.4	---	---	78.4	690.8	---	690.8
Koochiching	---	---	---	---	---	---	---
Lake	64.0	---	---	10.0	74.0	---	74.0
St. Louis	1,323.7	---	69.0	286.5	1,679.2	---	1,679.2
Total	2,457.9	---	74.0	637.8	3,169.7	---	3,169.7

Table 9.10. Estimated disbursements of school districts in specified county and planning region, by type of dusbursement, northern Minnesota, 1970.

Planning Region And County	Current	Capital	Debt Retirement	Total
		($1,000)		
Northwest:				
Kittson	1,927.1	85.2	110.0	2,122.4
Marshall	3,932.6	494.7	287.0	4,714.4
Norman	2,285.8	57.6	98.0	2,441.6
Pennington	4,195.9	239.6	162.0	2,597.6
Polk	8,055.2	1,565.9	347.0	9,968.0
Red Lake	1,494.9	79.0	56.0	1,629.8
Roseau	3,331.8	279.1	128.0	3,678.9
Total	25,223.3	2,801.2	1,188.0	27,152.7
Headwaters:				
Beltrami	5,637.4	1,158.1	175.0	7,151.3
Clearwater	1,881.2	30.7	56.0	1,967.9
Hubbard	2,708.8	531.5	99.0	3,089.3
Lake of the Woods	902.8	33.9	18.0	954.7
Mahnomen	1,704.4	64.3	40.0	1,808.8
Total	12,834.6	1,817.2	1,370.0	12,374.4
Arrowhead:				
Aitkin	2,527.2	420.7	77.0	3,025.1
Carlton	8,225.1	1,074.8	429.0	9,678.9
Cook	1,374.7	126.7	20.1	1,521.5
Itasca	10,740.8	1,985.5	545.0	13,271.4
Koochiching	6,857.6	1,526.8	290.0	8,674.4
Lake	4,055.2	20.8	395.7	4,659.0
St. Louis	240,275.8	6,786.3	1,687.0	58,049.4
Total	274,056.4	11,941.6	3,443.8	98,879.7

Table 9.11. Estimated disbursements of special districts in specified county and planning region by type of disbursement, northern Minnesota, 1970. 1/

Planning Region And County	Current Expense	Interest	Capital Expense	Debt Redemption	Total Disbursement
			($1,000)		
Northwest:					
Kittson	27.3	5.9	213.6	6.5	253.3
Marshall	28.5	9	.7	0	29.2
Norman	38.3	9	12.6	0	50.9
Pennington	119.1	.5	7.6	5.0	132.2
Polk	111.3	28.6	72.9	1,098.3	1,311.1
Red Lake	21.8	0	366.1	378.5	766.4
Roseau	794.8	17.1	16.8	27.1	855.8
Total	1,141.1	52.1	690.3	1,515.4	3,398.9
Headwaters:					
Beltrami	127.2	0	.2	10.0	137.4
Clearwater	22.7	0	0	0	22.7
Hubbard	29.3	0	890.0	0	919.3
Lake of the Woods	11.7	0	.2	0	11.9
Mahnomen	11.3	0	.4	0	11.7
Total	202.2	0	890.8	10.0	1,103.0
Arrowhead:					
Aitkin	327.8	6.0	1,014.0	24.5	1,372.3
Carlton	778.1	31.6	11.9	22.0	843.6
Cook	0	0	0	0	0
Itasca	83.5	.6	.4	3.0	87.5
Koochiching	73.6	56.7	12.4	0	142.7
Lake	18.2	47.7	47.4	861.4	974.7
St. Louis	5,229.0	280.1	2,350.8	255.0	8,114.9
Total	6,510.2	422.7	3,436.4	1,165.9	11,535.7
3 Region Total	7,853.5	474.8	5,018.0	2,691.3	16,037.6

Table 9.12. Estimated current and capital disbursements of local government in specified county and planning region, by type of disbursement and local government, northern Minnesota, 1970.

Planning Region And County	Current						Capital						Total
	County	Municipality	Township	School District	Special District	Total	County	Municipality	Township	School District	Special District	Total	
	($1,000)												
Northwest:													
Kittson	1,503.1	304.0	127.0	1,927.1	27.3	3,888.5	1,083.7	129.9	0	85.2	213.6	1,512.4	5,400.9
Marshall	1,876.1	442.0	214.5	3,932.6	28.5	6,493.7	984.4	201.6	0	494.7	.7	1,681.4	8,175.1
Norman	1,472.6	408.2	123.4	2,285.8	38.3	4,328.3	456.2	24.6	0	57.6	12.6	55.10	4,879.3
Pennington	1,737.0	1,240.1	69.7	4,195.9	119.1	7,361.8	291.8	603.2	0	239.6	7.6	1,142.2	8,504.0
Polk	4,632.6	2,145.6	433.9	8,055.2	111.3	15,378.6	1,120.8	1,017.1	0	1,565.9	72.9	3,776.7	19,155.3
Red Lake	828.2	355.1	52.2	1,494.9	21.8	2,752.2	218.7	216.6	0	79.0	366.1	880.3	3,632.5
Roseau	1,710.3	503.6	146.8	3,331.8	794.8	6,487.3	1,172.2	387.4	0	279.1	16.8	1,855.5	8,342.8
Total	13,759.9	5,398.6	1,167.5	25,223.3	1,141.1	46,690.4	5,327.7	2,580.4	0	2,801.2	690.3	11,399.6	58,090.0
Headwaters:													
Beltrami	4,156.4	979.3	146.3	5,637.4	127.2	11,046.6	647.9	503.3	0	1,158.1	.2	2,309.5	13,356.1
Clearwater	2,000.1	200.4	121.6	1,881.2	22.7	4,226.0	434.0	43.9	0	30.7	0	580.6	4,734.6
Hubbard	1,527.0	211.3	116.2	2,708.8	29.3	4,592.6	407.1	58.0	0	531.5	890.0	1,886.6	6,479.2
Lake of the Woods	693.3	162.3	0	902.8	11.7	1,700.1	171.8	175.4	0	33.9	.2	381.3	2,151.4
Mahnomen	1,365.3	186.4	79.9	1,704.4	11.3	3,347.3	209.5	159.8	0	64.3	.4	434.0	3,781.3
Total	9,742.1	1,739.7	464.0	12,834.6	202.2	24,982.6	1,870.3	940.4	0	1,817.2	890.8	5,518.7	30,501.3
Arrowhead:													
Aitkin	2,485.3	182.6	179.5	2,527.2	327.8	5,702.4	588.2	28.4	0	420.7	1,014.0	2,051.3	7,753.7
Carlton	3,635.3	1,704.5	278.3	8,225.1	778.1	14,657.3	726.5	336.8	0	1,074.8	11.9	2,150.0	16,807.3
Cook	901.9	132.0	0	1,374.7	0	2,408.6	233.8	78.1	0	126.7	0	438.6	2,847.2
Itasca	6,391.2	1,526.4	612.4	10,740.8	83.5	19,354.3	1,348.4	925.4	0	1,985.5	.4	4,259.7	23,614.0
Koochiching	3,014.9	1,138.7	0	6,857.6	73.6	11,084.8	663.1	1,607.6	0	1,526.8	12.4	3,809.9	14,894.7
Lake	1,414.7	833.5	64.0	4,055.2	18.2	6,385.6	629.2	186.0	0	20.8	47.4	883.4	7,269.0
St. Louis	33,160.9	18,103.1	1,323.7	240,275.8	5,229.0	298,082.5	2,724.6	3,400.5	0	6,786.3	2,350.8	15,262.2	313,354.7
Total	51,004.2	23,656.8	2,457.9	274,056.4	6,510.2	357,685.5	6,913.8	6,562.8	0	11,941.6	3,436.9	28,855.1	386,540.6

areas of expenditures are identified for the current outlays of county government, while nine areas are identified for municipalities. Nine are identified for other local governments.

County government current expenditures are primarily for welfare, roads and general government (table 9.13). Road building accounts for a major portion of capital expenditures.

Municipal government current expenditures are distributed more uniformly than county government current expenditures among nine (or ten) functional areas (table 9.14). Road construction and sanitation, however, account for a major part of total capital expenditures.

Peat land development will affect some functional areas more than others, first, in capital outlays, and, finally, in current outlays. Roads, sanitation, education and general government are most responsive to initial increases in total resident population and economic activity.

The study findings thus summarize the fiscal relationships in the extended Study Region in terms of three categories of public financing, namely, income, disbursements, and expenditures.

Income includes all revenues and funds received by a local government. Income sources vary widely by type of local government. State and federal funding is becoming increasingly important to many local governments.

Disbursements refer to the allocation of income for various purposes, such as current and capital expenditures, debt retirement, and so on. These disbursements differ in size and extent from county to county.

Expenditures refer to specific current and capital outlays of local governments. The largest expenditures occur for welfare, sanitation, road building and general government purposes.

Table 9.13. Estimated current and capital expenditures of county government in specified county and planning region, by type of expenditure, northern Minnesota, 1970.

Planning Region And County	Current										Capital				Total Capital & Current
	General Government	Safety	Health	Education	Welfare	Libraries	Recreation	Natural Resources	Other	Total Current	General Government	Roads	Other	Total Capital	
	($1,000)														
Northwest:															
Kittson	176.2	38.8	22.1	.6	594.3	0	.1	67.1	8.3	1,503.1	19.3	709.8	134.3	863.4	2,366.5
Marshall	225.0	52.1	33.7	55.3	894.0	4.1	5.3	78.1	61.0	1,876.0	1.3	938.6	44.6	984.4	2,860.4
Norman	188.1	36.3	12.3	1.3	674.3	21.7	.2	139.4	38.2	1,472.5	25.9	429.8	.4	456.2	1,928.7
Pennington	158.9	48.5	17.9	100.6	1,092.5	0	4.8	38.7	16.7	1,737.1	5.2	284.3	2.2	291.8	2,028.9
Polk	372.3	108.3	131.0	254.4	2,556.0	43.5	20.9	172.2	158.1	4,632.6	7.7	1,076.9	36.2	1,120.8	5,753.4
Red Lake	120.5	19.7	21.5	22.4	390.1	0	.1	37.4	37.1	828.2	.2	218.4	0	218.6	1,046.8
Roseau	160.2	50.8	2.9	115.4	917.9	0	2.3	89.6	88.4	1,710.2	6.5	1,165.2	.5	1,172.2	2,882.4
Total	1,401.2	354.5	241.4	550.0	7,119.1	69.3	33.7	622.5	407.8	13,759.7	66.1	4,823.0	218.2	5,107.3	18,867.0
Headwaters:															
Beltrami	267.5	98.5	34.8	205.6	2,863.4	0	6.9	86.4	39.8	4,156.4	35.3	594.9	17.8	647.9	4,804.3
Clearwater	148.3	27.8	119.3	87.3	1,360.0	5.8	5.4	27.3	21.9	2,000.0	1.2	430.3	2.4	434.0	2,434.0
Hubbard	164.6	34.7	13.6	48.5	907.9	1.0	0	21.7	77.7	1,527.0	15.7	389.6	1.9	407.1	1,934.1
Lake of the Woods	109.9	17.5	2.2	26.4	292.1	.7	2.9	19.4	36.6	693.3	1.1	170.5	.2	171.8	865.1
Mahnomen	124.8	20.2	406.9	10.1	580.0	.5	.2	11.0	19.0	1,365.3	1.5	208.0	0	209.5	1,574.8
Total	815.1	198.7	576.8	385.9	6,003.4	8.0	15.4	165.8	195.0	9,742.0	54.8	1,793.3	22.3	1,870.3	11,612.3
Arrowhead:															
Aitkin	224.7	70.8	71.4	4.3	1,494.8	11.5	9.7	116.7	63.4	2,485.3	4.0	575.5	8.7	588.2	3,073.5
Carlton	501.9	154.4	80.0	0	2,374.9	32.3	21.6	41.1	140.4	3,635.3	25.5	693.9	7.1	726.5	4,361.8
Cook	151.5	36.7	46.3	0	350.5	5.6	1.2	10.5	69.5	901.9	2.3	228.0	3.4	233.8	1,135.7
Itasca	681.3	249.8	46.3	0	3,689.7	15.0	0	90.3	304.5	6,391.2	58.4	1,274.2	15.9	1,348.4	7,739.6
Koochiching	232.7	107.4	24.0	112.3	1,903.4	19.4	.3	22.8	99.9	3,014.9	11.8	632.2	19.0	663.0	3,677.9
Lake	215.4	82.8	34.0	0	444.4	18.8	10.4	11.4	66.7	1,414.7	0	619.0	10.2	629.2	2,043.9
St. Louis	2,912.2	1,401.2	1,732.0	630.4	23,482.6	111.8	13.6	214.2	69.2	33,161.3	38.4	2,483.3	202.8	2,724.5	35,885.6
Total	4,919.7	2,103.1	2,450.9	747.0	33,740.3	214.4	56.8	507.0	813.6	51,004.4	140.4	6,506.1	267.1	6,913.6	57,918.0

Table 9.14a. Estimated current expenditures of municipalities in specified county and planning region by type of expenditure, northern Minnesota, 1970.

Planning Region And County	General Government	Safety	Roads	Sanitation	Health	Libraries	Recreation	Welfare	Other	Total
					($1,000)					
Northwest:										
Kittson	54.6	41.2	61.6	26.6	0	8.5	21.9	0	89.5	303.9
Marshall	38.7	73.2	77.0	44.9	.1	1.1	18.1	0	189.1	442.2
Norman	40.3	71.6	94.0	41.3	0	1.5	23.7	0	77.6	350.3
Pennington	152.3	211.2	116.7	110.0	2.3	81.0	139.3	3.3	424.1	1,239.2
Polk	239.4	456.3	341.8	283.4	3.4	20.3	227.5	1.9	570.9	2,145.6
Red Lake	31.9	42.1	45.7	9.7	0	.4	14.5	0	210.8	355.1
Roseau	58.1	76.5	58.3	43.3	0	9.0	96.1	0	162.2	503.6
Total	615.9	972.0	795.1	599.5	5.9	121.9	541.0	5.1	1,724.2	5,340.5
Headwaters:										
Beltrami	122.0	255.7	176.4	151.6	3.6	30.1	110.6	0	129.1	919.1
Clearwater	20.4	44.2	45.6	7.2	0	0	5.5	0	72.3	196.2
Hubbard	34.5	48.6	58.1	27.1	.2	4.8	9.7	0	24.9	207.8
Lake of the Woods	24.9	23.9	30.7	32.3	0	1.0	10.0	0	39.5	162.3
Mahnomen	11.8	26.9	29.8	4.5	.1	1.1	.8	0	111.2	186.3
Total	213.7	399.2	340.6	222.7	3.9	37.0	137.7	0	377.0	1,731.8
Arrowhead:										
Aitkin	21.6	27.6	21.9	18.9	1.7	1.6	8.4	0	42.9	182.5
Carlton	146.4	372.3	262.0	101.6	7.5	36.7	130.7	0	683.3	1,740.6
Cook	21.5	27.6	21.9	18.9	1.7	2.9	8.4	0	2.9	132.0
Itasca	254.5	321.0	305.1	106.5	1.9	50.2	109.7	0	344.4	1,493.2
Koochiching	180.3	268.1	350.0	34.1	1.1	61.7	48.0	0	195.1	1,138.5
Lake	106.1	168.2	161.3	116.4	0	37.9	58.5	0	185.1	833.5
St. Louis	2,137.9	6,154.7	3,041.7	1,631.4	10.7	730.1	1,237.6	9.7	3,149.1	18,103.1
Total	2,868.3	7,367.9	4,187.2	2,019.7	23.0	921.2	1,597.3	9.7	4,629.0	23,623.3

Table 9.14b. Estimated capital expenditures of municipalities in specified county and planning region by type of expenditure, northern Minnesota, 1970.

Planning Region And County	General Government	Safety	Roads	Sanitation	Recreation	Libraries	Other	Total
				($1,000)				
Northwest:								
Kittson		3.2	30.2	50.0	1.0		45.5	129.9
Marshall	.1	11.2	28.3	126.1	1.4		5.6	172.7
Norman	2.5	13.9	2.7	3.6	.2		.4	23.2
Pennington	10.0	1.6	351.7	121.5	99.6	6.9	12.1	603.3
Polk	1.2	212.7	264.5	405.5	60.8	31.7	39.8	1,616.1
Red Lake			5.0	211.5				216.6
Roseau	94.3	7.5	251.9	3.0	10.8		20.1	387.6
Total	108.0	249.9	934.2	921.3	173.8	38.6	123.5	2,549.2
Headwaters:								
Beltrami	3.5	33.1	327.3	39.8	5.8	.5	93.2	503.3
Clearwater		1.1	40.9				1.9	44.0
Hubbard		.1	53.4	.9	.2		3.4	58.0
Lake of the Woods				161.6			13.8	175.4
Mahnomen	.1	22.9	4.9	129.1	.2	0	2.6	159.8
Total	3.6	57.2	426.5	331.4	6.2	.5	115.0	940.5
Arrowhead:								
Aitkin		.1	9.9	2.9	1.3		14.2	28.4
Carlton	9.9	8.7	240.1	59.4	13.8		4.8	336.7
Cook	.1	1.4	4.9	62.4	.9	0	8.3	78.1
Itasca	71.7	8.2	439.0	68.1	14.4	109.0	213.5	923.9
Koochiching	13.4	3.6	80.9	30.2	3.9		1,475.7	1,607.6
Lake		17.2	30.4	.8	5.5	1.5	130.5	186.9
St. Louis	46.2	1,062.4	1,262.0	345.0	416.6	1.0	262.3	3,400.4
Total	141.4	1,101.6	2,072.2	558.8	456.5	111.5	2,109.2	6,561.2

APPENDIX A: GLOSSARY OF SIMLAB METHODOLOGY AND TERMINOLOGY

This glossary presents a numerical example of SIMLAB socio-economic impact estimation prodedures. SIMLAB is an acronym for the University of Minnesota Regional Development Simulation Laboratory, a computer-based regional socio-economic impact forecasting system. Impact is defined in terms of changes in the output of regional industries, the number of jobs and earnings in those industries, and the composition and level of regional population. SIMLAB uses an input-output table of the regional economy in the measurement of these changes.

The first section of this glossary explains what an input-output model is and the assumptions upon which it is based. The next section contains a numberical illustration of how an input-output model is used to trace and account for the effects of industry expansion. A third section explains the logic of the SIMLAB procedure. A final section defines baseline and development projections and explains their use in deriving impact forecasts.

Construction of Input-Output Models

The effects of regional industry activities and/or new industry development are traced and accounted for using a table of data showing transactions between regional industries and between these industries and local households and export markets. Both industries and households have multiple roles in this transactions table.[1/]

1/ The transactions matrix is prepared using procedures described in Chapter 5.

Each industry produces goods which it sells to other industries for use in their production processes. At the same time each industry purchases goods from other industries for use in its production process. Goods exchanged among industries are called intermediate goods. Each industry also sells goods to area households and to export markets for final consumption. In turn, households sell labor services to industry which are combined with raw materials and intermediate goods to produce products or output. Because the table shows flows of goods and services used as inputs in production processes, and flows of goods to final consumers, the interindustry transactions table is also an input-output table (table A-1).

Interindustry Transactions

The illustrative input-output table shows only three intermediate producing and purchasing sectors. Both existing industry and new industry activity may be included in each of the three sectors. However, in this illustration, we use the manufacturing sector as a surrogate for all industries being analyzed. For discussion purposes, therefore, manufacturing is synonymous with the industry whose impacts are under study.

Interrelationships between primary and intermediate inputs and gross outputs are illustrated by the hypothetical three-industry economy. All numerical values are given in millions of dollars. Thus, the $2 million listed in the manufacturing column and the services row means that $2 million worth of services are supplied to the manufacturing sector for use in producing manufactured goods. The manufacturing sector also purchased $4 million worth of agricultural products, $7 million worth of its own

Table A-1. Interindustry transactions showing specified gross output disbursements, by purchasing sector.

Producing Sector	Purchasing Sector: Intermediate Demand: Agriculture	Intermediate Demand: Manufacturing	Intermediate Demand: Services	Final Demand: Household	Final Demand: Exports	Gross Output
Agriculture	2	4	3	7	0	16
Manufacturing	5	7	5	2	5	24
Services	3	2	4	8	3	20
Households	4	6	7	0	3	21
Imports	2	5	0	4	--	11
Total (Gross) Outlay	16	24	20	21	11	92

products, $6 million worth of labor services from households, and $5 million of imports from outside the region -- a total of $24 million worth of purchased inputs. The entry in the manufacturing row of the gross output column indicates that the output of the manufacturing sector was sold for a total of $24 million. Of the $24 million of product, #2 million was purchased by local households and $5 million was exported to buyers outside the area. The $7 million of final demand is viewed as exogeneous, or external, to the three producing sectors. Similarly, the household inputs and imports, are viewed as external inputs. They are not part of the local interindustry transactions, which include only the sales and purchases of intermediate product, not final product.

Since total manufacturing costs are listed as $24 million, it may seem as though the manufacturing industry made zero profit. This is not so because the primary inputs fro m the household sector are defined, in this illustration, to include stockholder's equity, or dividends, and retained earnings. Thus, the input-output table is a balance sheet of histrocial facts. Like a balance sheet, the illustrative input-output table summarizes the results of business activity carried on over one production period.

Input-Output Coefficients

SIMLAB analysis is based on an input-output table prepared by the U.S. Department of Commerce for the year 1970. This is the most recent table currently available. An input-output table already eight years old is more useful than it first seems because it can be used to derive

information about underlying economic relationships which are not likely to change much over time. This information is derived by calculating the ratio of the amount purchased from an industry named in the left-hand column to the amount in the column total of the purchasing industry. The results is the amount that is purchased from the industry listed at the left in order to produce $1 of product by the industry shown at the top of the column, as shown in table A-2.

The input-output ratios are sometimes called technical coefficients of production, an interpretation which is based on certain assumptions:

1. If the coefficients of production are to represent the mix of inputs used per unit of input in the production process, then the relative prices of all goods and services must remain fixed since microeconomic theory demonstrates that in a competitive economy the mix of inputs used by producers, and the mix of outputs produced, will vary with changes in relative prices. It is important to note, however, that it is relative prices or price ratios which matter, not the overall levels of prices. If all prices double, relative prices are unaffected. Thus, to the extent that all prices move together, the constant relative price assumption is not entirely unrealistic.

2. Interpreting the coefficient as representing the value of goods a producing industry must purchase from a supplyinv industry to produce one dollar's worth of output implies that this relationship holds true at all levels of output. However, microeconomic theory demonstrates that changes in the scale of output may change the efficiency

Table A-2. Purchases of specified gross output per $1 of gross outlay, by purchasing sector.

Producing Sector	Purchasing Sectors		
	Agriculture	Manufacturing	Services
	(dollars)		
Agriculture	.1250	.1667	.1500
Manufacturing	.3125	.2917	.2500
Services	.1875	.0833	.2000
Households	.2500	.2500	.4000
Imports	.1250	.2083	.0000
Total	1.0000	1.0000	1.000

with which, one or more inputs is utilized, changing the yield of product per unit of input. This phenomenon is referred to as economies of scale. Input-output analysis ignores economies of scale, as assumption which becomes generally more accurate as changes in scale of production become smaller.

Because relative prices and/or the scale of production generally change over periods of time, these assumptions of input-output analysis can cause errors in projections made using input-output information. Since the northern Minnesota input-output table is based on 1970 data, the technical coefficients of production derived from it pertain to 1970. Provided the commodity flow data in the input-output table is accurate, the technical coefficients are valid statements of historical fact. However, if the 1970 coefficients are used to analyze events in a later year, then the possibility of error arises either from changes in relative prices or from economies of scale. There is insufficient data on the Minnesota economy to determine if relative prices have changed, or if there have been substantial economies of scale since 1970.

Knowledge of the technical coefficients of production makes it possible to trace the effects on the economy of industry expansion. Once expansion gets underway, supplies and materials are purchased from regional industries, adding a new component to interindustry transactions. These industries are assumed to expand their output in response. As each industry selling supplied and materials to the expanding industry, more intermediate goods from the industries supplying are purchased, also. The input-output coefficients prescribe how much the output of all

industries supplying intermediate products to that industry will increase. In turn, a third tier of industries supplying this second tier of industries will increase their output, that total output of the regional economy increases by more than the original purchase of supplies and material for the expanding industry. Similarly, wages paid to workers who, in turn, spend on consumer goods, lead to an increase in total output which exceeds the amount of the total salary expenditure, provided the new industry jobs represent a net addition in the number of jobs in the economy and/or an increase in the total earnings of a fixed number of workers. If the hiring of workers leads to a reshuffling of existing workers at the same earnings levels, then there is no net impact from wage expenditures. SIMLAB automatically calculates the net number of new jobs and the resulting net change in earnings attributed to the industry expansion, as explained later on in this paper.

Using Input-Output Tables to Trace and Measure the Impact of Industry Expansion

Tracing the spending and respending of industry expansion from their point of initial appearance in the northern Minnesota economy through successive tiers of intermediate goods producers could be a tedious task which is made unnecessary once the matrix of input-output coefficients of production is known.

Algebraic rearrangement of the data in tables A-1 and A-2 demonstrates a means of estimating the effects of industry expansion on the output of northern Minnesota industries when, of course, the real

northern Minnesota input-output table is used. The total output of each sector can be represented for the three producing sectors -- agriculture (1.1), manufacturing (1.2) and services (1.3) -- as follows:

Table III

$$16 = .1250 \times 16 + .1667 \times 24 + .1500 \times 20 + 7 \qquad (1.1)$$

$$24 = .3125 \times 16 + .2917 \times 24 + .2500 \times 20 + 7 \qquad (1.2)$$

$$20 = .1875 \times 16 + .0833 \times 24 + .2000 \times 20 + 11 \qquad (1.3)$$

Thus, in Equation 1.1, total agriculture output equals the total amount of agricultural output needed to produce a dollar's worth of agricultural output times total agricultural output (.1250 x 16), plus the amount of agricultural output needed to produce a dollar's worth of manufactured goods times the total manufacturing output (.1667 x 24), plus the amount of agricultural output needed to produce a dollar's worth of services times the total output of services (.1500 x 20), and plus agricultural output sent to final demand (7). Equations 1.2 and 1.3 are similarly interpreted.

The three preceding equations may be arranged in matrix form as follows:

$$\begin{bmatrix} 16 \\ 20 \\ 24 \end{bmatrix} = \begin{bmatrix} .1250 & .1667 & .1500 \\ .3125 & .2917 & .2500 \\ .1875 & .0833 & .2000 \end{bmatrix} \cdot \begin{bmatrix} 16 \\ 20 \\ 24 \end{bmatrix} + \begin{bmatrix} 7 \\ 7 \\ 11 \end{bmatrix} \qquad (2.1)$$

each array, or matrix, in brackets can be treated algebraically. Hence this expression can be rearranged to give

$$\begin{bmatrix}16\\20\\24\end{bmatrix} - \begin{bmatrix}.1250 & .1667 & .1500\\.3125 & .2917 & .2500\\.1875 & .0833 & .2000\end{bmatrix} \begin{bmatrix}16\\20\\24\end{bmatrix} = \begin{bmatrix}7\\7\\11\end{bmatrix} \qquad (2.2)$$

or

$$\left(\begin{bmatrix}1 & 0 & 0\\0 & 1 & 0\\0 & 0 & 1\end{bmatrix} - \begin{bmatrix}.1250 & .1667 & .1500\\.3125 & .2917 & .2500\\.1875 & .0833 & .2000\end{bmatrix}\right) \begin{bmatrix}16\\20\\24\end{bmatrix} = \begin{bmatrix}7\\7\\11\end{bmatrix} \qquad (2.3)$$

or

$$\begin{bmatrix}16\\20\\24\end{bmatrix} = \left(\begin{bmatrix}1 & 0 & 0\\0 & 1 & 0\\0 & 0 & 1\end{bmatrix} - \begin{bmatrix}.1250 & .1667 & .1550\\.3125 & .2917 & .2500\\.1875 & .0833 & .2000\end{bmatrix}\right) \begin{bmatrix}7\\7\\11\end{bmatrix} \qquad (2.4)$$

or

$$\begin{bmatrix}16\\20\\24\end{bmatrix} = \begin{bmatrix}1-.1250 & -.1667 & -.1550\\-.3125 & 1-.2917 & -.2500\\-.1875 & -.0833 & 1-.2000\end{bmatrix}^{-1} \begin{bmatrix}7\\7\\11\end{bmatrix} \qquad (2.5)$$

Thus, Equation 2.5 shows total outputs on the left as a function of an inverse matrix containing the input-output coefficients of production multiplied by the matrix of final consumption. The remaining problem is to compute the inverse matrix. Texts on linear algebra show how to

compute the inverse.[2/] This done, Equation 2.5 becomes the following:

$$\begin{matrix} 16 \\ 20 \\ 24 \end{matrix} = \begin{matrix} 1.3500 & .3606 & .3658 \\ .7344 & 1.6619 & .6569 \\ .3930 & .2577 & 1.4041 \end{matrix} \begin{matrix} 7 \\ 7 \\ 11 \end{matrix} \qquad (2.6)$$

The large nine element array in Equation 2.6 shows the relationship between final consumption, represented by the single column array on the right, and total output in the three sectors represented by the single column array to the left of the equal sign. Each element in a column of the large array shows the total dollar production required directly and indirectly from the industry listed at the top of the column for each dollar of delivery to final demand by the industry listed for that row. For example, it shows that agricultural output will have to increase by $1.35 for each extra dollar of agricultural product delivered to final consumption. Why does output increase by more than a dollar? For two reasons: One, as shown in table A-1, agriculture consumes some of its own output, It takes feed grain to raise livestock, for instance. Second, because, as agriculture expands, it requires more intermediate goods from other industries which, in turn, require more intermediate goods from agriculture.

The nine-element array of numbers in Equation 2.6 is often called

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2/ See: Richard A. Bilas, Microeconomic Theory: A Graphical Analysis, McGraw Hill, 1967, p. 298. The illustrative problem is taken from this text.

the matrix of final demand multipliers, or the "Leontief inverse", in input-output terminology. An array of multipliers fifty-five elements square is used by SIMLAB.

The nine element array of multipliers in Equation 2.6 provides a means of illustrating how SIMLAB estimates the impact of industry expansion. Suppose final demand in the hypothetical, three-sector economy is projected to reach \$9 million, \$8 million and \$12 million, respectively, for agriculture, manufacturing, and services. Given the projected final demand, total output required to meet this demand can be calculated using the demand multipliers. Rewriting Equation 2.6 with a new final demand column, but with x's to represent the as yet unknown new levels of total sectoral output, yields:

$$\begin{matrix} x_a \\ x_m \\ x_s \end{matrix} = \begin{matrix} 1.3500 & .3606 & .3658 \\ .7344 & 1.6619 & .6569 \\ .3930 & .2577 & 1.4041 \end{matrix} \begin{matrix} 9 \\ 8 \\ 12 \end{matrix} \qquad (3.1)$$

which, in turn, yields:

$$x_a = 9(1.3500) + 8(.3606) + 12(.3658) = 19.42$$

$$x_m = 9(.7344) + 8(1.6619) + 12(.6569) = 27.79$$

$$x_s = 9(.3930) + 8(.2577) + 12\ (1.4041) = 22.45$$

Thus, total output attributable to the increase in final demand from the levels in Equation 2.6 is the sum of the differences in total sectoral output before and after the increase (in million dollars), or:

$$(19.42-16)+(27.79-24)+(22.45-20) = 3.42+3.79+2.45 = 9.66 \quad (3.3)$$

Using data on the number of persons employed in each sector, the number of persons employed per dollar of output in each sector in the base period can be calculated. Suppose the number of persons employed per dollar of output in each sector is 0.0003 in agriculture, 0.0002 in manufacturing and 0.0005 in services. Then the total employment attributable to the projected levels of production are as follows:

$$.0003 \times \$19.42 \text{ million} = 5,826 \text{ (agriculture)} \quad (4.1)$$

$$.0002 \times \$27.79 \text{ million} = 5,558 \text{ (manufacturing)} \quad (4.2)$$

$$.0005 \times \$22.45 \text{ million} = 11,225 \text{ (services)} \quad (4.3)$$

The dollar figures are the projected levels of agricultural, manufacturing, and service output required to meet the projected levels of final demand.

APPENDIX B

Table B.1. Estimated purchases of specified intermediate and primary inputs (in dollars), by purchasing industry, Northeast Minnesota and Douglas County, Wisconsin, 1970.

	LIVESTOCK	OTHER AG.	PEATLAND A	AG. FORFIS	IRON ORE	OTHER MEIO	COPPER OI
1	6587.688	825.476	0	777.322	0	0	
2	5625.892	325.349	0	1566.527	0	0	
3	0	0	0	0	0	0	
4	725.385	934.263	0	16.746	0	0	
5	0	0	0	0	31695.342	4.421	
6	0	0	0	0	1451.716	47.524	
7	0	0	0	0	0	0	
8	0	0	0	0	0	0	
9	0	0	0	0	0	0	
10	2.282	73.274	0	0	534.929	3.397	
11	0	0	0	0	0	0	
12	42.186	37.862	0	0	1917.214	2.443	
13	2852.589	0	0	117.618	0	0	
14	.027	1.785	0	1.378	0	0	
15	0	0	0	0	1287.715	8.440	
16	5.232	58.513	0	46.581	0	0	
17	22.594	3.065	0	651.049	87.799	.301	
18	9.391	8.789	0	1.084	26.565	.091	
19	13.523	101.922	0	6.187	630.889	2.179	
20	0	0	0	0	0	0	
21	0	0	0	0	0	0	
22	228.199	656.325	0	37.066	1551.111	4.521	
23	5.045	12.455	0	.222	597.163	.744	
24	1.353	8.914	0	.547	140.833	.352	
25	0	0	0	0	14750.187	26.324	
26	0	0	0	0	0	0	
27	0	0	0	0	0	0	
28	0	0	0	0	0	.100	
29	35.674	25.620	0	62.528	609.462	3.082	
30	6.897	3.971	0	0	8120.485	59.690	
31	0	0	0	0	8.430	.045	
32	2.614	4.131	0	6.334	177.180	.814	
33	60.409	66.524	0	13.914	25578.697	59.580	
34	272.911	119.743	0	44.815	2633.962	5.225	
35	0	0	0	0	0	0	
36	353.806	86.126	0	49.065	617.126	.723	
37	.050	.560	0	.919	0	0	
38	78.868	41.088	0	0	587.573	.556	
39	116.299	54.125	0	5.602	11413.835	29.840	
40	4.960	2.682	0	3.089	2830.462	.368	
41	0	0	0	0	0	0	
42	7.492	112.151	0	0	58.533	.301	
43	1106.152	794.179	0	136.355	6175.177	25.319	
44	846.084	404.717	0	48.439	1024.319	2.311	
45	316.037	210.913	0	17.460	3036.504	24.089	
46	370.706	897.691	0	241.394	26946.285	24.097	
47	6.736	0	0	0	0	0	
48	20.788	177.470	0	.107	4206.056	3.217	
49	78.134	46.859	0	1.913	148.490	.892	
50	0	0	0	0	0	0	
51	244.133	12.957	0	0	321.929	.301	
52	3.518	3.258	0	1.722	502.759	.959	
53	2.309	0	0	0	0	0	
54	39.900	31.456	0	77.581	1107.539	4.702	
55	0	0	0	0	0	0	
56	20095.773	6143.313	0	3927.564	150776.266	346.948	
57	12910.000	5976.000	0	5048.000	122287.000	907.000	
58	11484.000	4694.000	0	2673.000	97178.000	283.000	
59	334.856	4484.889	0	5140.575	192781.230	82.047	
60	44824.629	21298.202	0	16789.139	563022.496	1618.995	

Table 3.7. Estimated purchases of specified intermediate and primary inputs (in dollars), by purchasing industry, Northeast Minnesota and Douglas County, Wisconsin, 1970.

	LIVESTOCK	OTHER AG.	PEATLAND A	AG. FORFIS	IRON ORE	OTHER METO	COPPER ORE
1	6587.688	825.476	0	777.322	0	0	0
2	5625.802	325.349	0	1566.527	0	0	0
3	0	0	0	0	0	0	0
4	725.385	934.263	0	16.746	0	0	0
5	0	0	0	0	31695.342	4.421	0
6	0	0	0	0	1451.716	47.524	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	2.282	73.274	0	0	534.929	3.397	0
11	0	0	0	0	0	0	0
12	42.186	37.862	0	0	1917.214	2.443	0
13	2852.589	0	0	117.618	0	0	0
14	.027	1.785	0	1.378	0	0	0
15	0	0	0	0	1287.715	8.440	0
16	5.232	58.513	0	46.581	0	0	0
17	22.594	3.065	0	651.049	87.799	.301	0
18	9.391	8.789	0	1.084	26.565	.091	0
19	13.523	101.922	0	6.187	630.889	2.179	0
20	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0
22	228.199	656.325	0	37.066	1551.111	4.521	0
23	5.045	12.455	0	.222	597.163	.744	0
24	1.353	8.014	0	.547	140.833	.352	0
25	0	0	0	0	14750.187	26.324	0
26	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0
28	0	0	0	0	0	.100	0
29	35.674	25.620	0	62.528	609.462	3.082	0
30	6.897	3.971	0	0	8120.485	59.690	0
31	0	0	0	0	8.430	.045	0
32	2.614	4.131	0	6.334	177.180	.814	0
33	60.409	66.524	0	13.914	25578.697	59.580	0
34	272.911	119.743	0	44.815	2633.962	5.225	0
35	0	0	0	0	0	0	0
36	353.806	86.126	0	49.065	617.126	.723	0
37	.050	.560	0	.919	0	0	0
38	78.868	41.988	0	0	587.573	.556	0
39	116.299	54.125	0	5.602	11413.835	29.840	0
40	4.960	2.682	0	3.089	2830.462	.368	0
41	0	0	0	0	0	0	0
42	7.492	112.151	0	0	58.533	.301	0
43	1106.152	794.179	0	130.355	6175.177	25.319	0
44	846.084	404.717	0	48.439	1024.319	2.311	0
45	316.037	210.913	0	17.460	3036.504	24.089	0
46	370.706	897.691	0	241.394	26946.285	24.097	0
47	6.736	0	0	0	0	0	0
48	20.788	177.470	0	.107	4206.056	3.217	0
49	78.134	46.859	0	1.913	148.490	.892	0
50	0	0	0	0	0	0	0
51	244.133	12.957	0	0	321.929	.301	0
52	3.518	3.258	0	1.722	502.759	.959	0
53	2.309	0	0	0	0	0	0
54	39.900	31.456	0	77.581	1107.539	4.702	0
55	0	0	0	0	0	0	0
56	20095.773	6143.313	0	3927.564	150776.266	346.948	0
57	12910.000	5976.000	0	5048.000	122287.000	907.000	0
58	11484.000	4694.000	0	2673.000	97178.000	283.000	0
59	334.856	4484.889	0	5140.575	192781.230	82.047	0
T	44824.629	21298.202	0	16789.139	563022.496	1618.995	0

3.7. Estimated purchases of specified intermediate and primary inputs (in dollars), by purchasing industry, Northeast Minnesota and Douglas County, Wisconsin, 1970.

LOGGING	WOODPROD	PAPERPROD	PRINTING	CHEMICALS	PEATCHEM	PEAT COKE
0	0	0	0	1.373	0	0
308.392	0	0	0	7.754	0	0
0	0	0	0	0	0	0
423.306	0	0	0	.158	0	0
0	0	0	0	4.357	0	0
0	0	0	0	1.676	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	8.470	357.342	0	4.742	0	0
0	0	0	0	0	0	0
27.304	29.065	222.727	13.392	4.299	0	0
0	1.101	756.783	0	73.380	0	0
35.941	34.035	120.530	19.164	1.432	0	0
8073.206	5983.289	11737.936	.659	3.032	0	0
832.894	3216.417	472.145	4.402	1.842	0	0
106.016	388.356	35664.505	3496.685	96.979	0	0
4.964	7.280	1334.678	2216.932	4.668	0	0
17.691	131.664	483.594	35.988	59.941	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
457.725	60.217	1225.830	39.932	163.231	0	0
16.050	15.869	291.584	8.672	6.406	0	0
36.624	162.555	137.562	0	4.587	0	0
172.486	75.369	101.800	8.206	18.921	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
.841	.584	20.579	22.273	29.714	0	0
249.139	528.062	1501.768	69.695	29.613	0	0
30.314	61.631	71.855	5.406	5.234	0	0
.067	.865	3.293	7.751	.136	0	0
23.000	39.971	95.290	26.307	2.693	0	0
514.094	341.805	689.084	4.606	12.374	0	0
370.215	747.246	3710.142	152.904	50.086	0	0
0	0	0	.775	0	0	0
75.945	102.448	1168.498	69.742	19.901	0	0
.089	.031	1.205	.148	.054	0	0
45.726	81.460	416.239	173.005	14.069	0	0
240.219	221.796	1924.698	92.207	38.699	0	0
26.418	46.721	567.727	11.796	13.574	0	0
0	0	0	0	0	0	0
7.993	2.719	511.006	8.655	4.300	0	0
865.798	1565.233	6328.175	517.748	108.152	0	0
94.236	60.425	287.368	109.086	26.471	0	0
189.934	172.404	709.247	116.366	19.199	0	0
133.180	186.362	1355.772	477.925	68.745	0	0
0	1.252	231.657	28.886	10.632	0	0
90.731	102.226	744.105	160.199	74.488	0	0
108.327	13.914	64.077	22.064	1.911	0	0
0	0	0	0	0	0	0
8.414	15.084	85.857	40.123	5.348	0	0
14.454	23.486	135.771	243.176	6.846	0	0
9.381	.003	42.042	1.415	.959	0	0
58.726	169.596	768.082	306.291	52.307	0	0
0	0	0	0	0	0	0
13669.835	14598.921	74339.953	8512.581	1054.283	0	0
6598.000	4234.000	33999.000	8241.000	1265.000	0	0
6861.000	3235.000	27975.000	2910.000	1729.000	0	0
10097.449	9739.453	41081.746	3000.713	339.658	0	0
37226.284	31907.374	177395.699	22664.294	4387.941	0	0

Table 3.7. Estimated purchases of specified intermediate and primary inputs (in dollars), by purchasing industry, Northeast Minnesota and Douglas County, Wisconsin, 1970.

	PETROLEUM	RUBBERPLAS	STONECLAY	IRONMETAL	COPPERMET	COPPERROLL	OTHERMETAL
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	6.020	4388.969	0	0	2.132
6	0	0	1.687	35.434	0	0	73.695
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	117.779	.402	395.760	135.405	0	0	.823
11	0	0	0	0	0	0	0
12	136.285	1.408	9.679	158.434	0	0	1.274
13	79.225	.785	3.436	1.228	0	0	.075
14	5.291	4.103	5.032	65.791	0	0	1.535
15	1.341	.427	9.403	104.790	0	0	0
16	1.878	7.210	8.414	161.439	0	0	0
17	317.756	49.103	145.426	85.288	0	0	4.169
18	5.174	1.132	1.766	12.154	0	0	2.235
19	104.316	5.951	9.132	88.305	0	0	1.610
20	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0
22	3757.466	3.365	59.205	394.710	0	0	4.879
23	12.685	8.130	6.558	10.636	0	0	.728
24	53.586	4.394	311.022	152.935	0	0	4.642
25	17.939	6.466	76.867	17993.959	0	0	110.044
26	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0
28	58.847	.803	2.040	1915.917	0	0	534.637
29	27.688	25.685	53.033	1153.721	0	0	29.992
30	.883	4.728	46.203	795.861	0	0	49.478
31	0	.511	1.558	39.097	0	0	1.889
32	1.161	11.410	15.485	66.944	0	0	.942
33	2577.064	5.248	30.846	966.145	0	0	29.323
34	91.294	17.539	139.506	2534.762	0	0	45.856
35	0	0	0	0	0	0	0
36	152.730	9.408	113.662	626.823	0	0	15.739
37	.059	.079	.042	.759	0	0	.170
38	39.224	7.449	24.111	220.260	0	0	5.575
39	316.209	19.372	93.883	1336.950	0	0	21.649
40	274.696	1.934	47.730	514.474	0	0	10.162
41	0	0	0	0	0	0	0
42	74.036	1.519	2.488	100.424	0	0	1.800
43	645.040	60.841	162.093	3418.785	0	0	201.851
44	25.484	14.903	17.165	127.495	0	0	4.358
45	512.861	8.150	42.273	501.586	0	0	16.273
46	752.087	15.864	65.963	136.816	0	0	16.623
47	24.295	2.300	3.038	35.037	0	0	.293
48	307.013	12.926	29.883	494.935	0	0	7.427
49	10.274	.886	7.615	36.430	0	0	.541
50	0	0	0	0	0	0	0
51	13.267	1.431	5.473	45.118	0	0	1.942
52	34.183	1.857	5.650	59.728	0	0	1.401
53	1.198	.253	2.827	20.519	0	0	.341
54	80.702	21.038	43.467	320.456	0	0	10.938
55	0	0	0	0	0	0	0
56	10630.936	339.010	2005.441	39198.519	0	0	1217.042
57	4804.000	412.000	1543.000	21221.000	0	0	414.000
58	29948.000	824.000	1452.000	17472.000	0	0	1073.000
59	9316.665	624.727	1325.234	23806.620	0	0	973.457
60	54699.601	2199.737	6325.675	101698.139	0	0	3677.499

Table 3.7. Estimated purchases of specified intermediate and primary inputs (in dollars), by purchasing industry, Northeast Minnesota and Douglas County, Wisconsin, 1970.

	METAL FAB	MACHINERY	ELECMACH	MISCMANUF	TRANSEXC	RAIL TRAN	LOCAL TRA
1	0	0	0	0	0	1.150	
2	0	0	0	3.770	0	13.798	
3	0	0	0	0	0	0	
4	0	0	0	.169	0	.065	
5	.679	0	0	0	0	0	
6	0	0	0	0	0	0	
7	0	0	0	0	0	0	
8	0	0	0	0	0	0	
9	0	0	0	0	0	0	
10	.575	0	0	3.415	0	0	
11	0	0	0	0	0	0	
12	8.130	13.974	7.134	6.906	149.919	836.522	1.09
13	0	.768	0	15.075	57.847	8.180	
14	12.633	15.992	9.919	27.929	14.343	9.033	3.04
15	16.128	25.104	4.810	154.088	0	0	
16	49.362	7.426	24.189	297.547	3.542	0	
17	178.768	37.233	52.367	394.811	119.826	121.195	1.97
18	9.599	4.458	38.551	28.177	170.934	16.108	
19	35.567	12.553	3.654	23.076	70.752	31.946	1.44
20	0	0	0	0	0	0	
21	0	0	0	0	0	0	
22	49.663	93.741	22.735	37.643	1263.188	1649.179	84.98
23	18.008	33.923	9.058	45.391	8.907	3.094	3.08
24	28.083	71.050	5.894	23.747	20.916	3.356	.25
25	2933.024	3227.847	92.480	856.983	373.053	878.667	3.73
26	0	0	0	0	0	0	
27	0	0	0	0	0	0	
28	337.963	191.875	73.654	194.842	0	15.341	
29	447.506	273.359	99.746	311.703	684.866	208.001	5.98
30	167.760	1244.696	59.936	80.266	16.528	12.887	2.19
31	5.352	24.378	1000.100	23.823	7.579	2.663	.09
32	37.130	87.941	15.451	580.180	1065.185	398.543	4.01
33	19.860	15.257	19.048	27.004	21918.667	240.857	26.35
34	88.287	85.144	23.454	113.641	322.880	1341.204	3.07
35	0	0	0	0	0	95.743	10.39
36	51.120	62.797	22.389	58.311	1360.052	73.970	13.96
37	.114	.363	.795	.506	1.040	4.948	.01
38	56.885	86.490	87.588	47.489	332.232	369.072	11.60
39	87.491	105.590	51.576	60.457	796.280	479.796	16.17
40	19.481	19.701	3.653	7.355	79.815	33.401	1.00
41	0	0	0	0	0	0	0
42	5.348	6.203	6.787	3.037	49.583	126.948	10.02
43	388.640	764.382	387.196	640.579	793.329	827.274	101.23
44	66.184	80.358	52.722	72.710	123.958	70.186	30.59
45	74.677	110.855	48.330	70.530	938.931	346.306	47.51
46	104.347	206.706	116.988	112.725	707.858	1724.479	21.09
47	20.012	13.744	7.461	9.272	124.860	21.725	.90
48	59.852	84.007	72.473	73.056	271.442	139.246	10.26
49	7.156	11.746	10.826	15.346	19.467	36.162	31.19
50	0	0	0	0	.170	1.434	.0
51	10.711	18.030	17.170	11.783	56.666	90.129	4.75
52	12.973	20.880	20.690	22.458	237.731	162.152	6.56
53	1.005	.962	.695	.351	1305.165	9.104	689.57
54	129.492	171.361	143.663	139.711	403.717	219.391	7.44
55	0	0	0	0	0	0	0
56	5539.565	7229.534	2613.176	4595.862	33871.228	10623.255	1155.66
57	5021.000	7202.000	1852.000	1244.000	11700.000	24624.000	1828.00
58	3125.000	7009.000	4693.000	4521.000	8164.000	8923.000	548.00
59	1876.153	8679.266	5887.334	5984.010	28895.242	15081.053	900.03
60	15561.718	36119.800	15045.510	16344.872	82630.470	59251.308	4431.69

Table 3.7. Estimated purchases of specified intermediate and primary inputs (in dollars), by purchasing industry, Northeast Minnesota and Douglas County, Wisconsin, 1970.

	TRUCKTRAN	AIR TRAN	COMMUNICAT	ELECTRICAL	GAS SERVIC	PEAT GAS	WATER
1	0	.310	0	0	0	0	0
2	46.386	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	.019	0	0	0	0	0
5	0	0	0	.830	0	0	0
6	0	0	0	.280	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
12	8.555	.262	98.590	426.122	52.870	0	57.702
13	0	12.925	0	3.557	0	0	0
14	14.830	.029	6.103	21.693	2.024	0	1.777
15	0	0	0	2.213	0	0	0
16	1.754	0	0	.287	0	0	0
17	30.334	1.260	24.655	85.207	7.223	0	7.843
18	1.535	1.337	44.429	17.327	1.467	0	.454
19	2.305	.086	.388	8.568	0	0	2.037
20	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0
22	703.752	50.584	71.501	1118.210	16.822	0	18.022
23	18.938	.226	2.774	7.666	.090	0	.507
24	.671	0	.035	.847	0	0	0
25	.950	.055	0	65.566	19.863	0	0
26	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0
28	0	0	0	1.107	0	0	0
29	5.980	.483	.378	52.246	0	0	15.733
30	5.140	.131	.162	.277	0	0	0
31	.117	.010	294.334	7.780	0	0	0
32	5.439	.280	3.029	.586	0	0	0
33	72.290	30.945	4.157	210.252	1.426	0	1.502
34	44.661	1.012	8.513	1575.232	4.182	0	8.510
35	0	0	0	0	0	0	0
36	333.976	3.566	20.728	207.020	1.369	0	2.146
37	0	2.398	.116	.078	0	0	.012
38	157.175	6.269	582.645	158.391	32.043	0	16.405
39	9.429	.282	192.291	16320.556	1.331	0	328.070
40	2.446	.054	19.441	3797.290	95.880	0	98.592
41	0	0	0	0	0	0	0
42	3.070	1.391	33.049	168.479	.190	0	8.344
43	609.637	21.388	121.488	585.940	5.702	0	19.691
44	265.259	3.670	178.133	130.301	11.595	0	11.514
45	296.386	7.009	186.952	423.958	71.024	0	68.787
46	123.776	10.389	406.432	103.906	49.770	0	44.320
47	13.068	1.139	191.007	58.764	18.169	0	26.584
48	37.662	3.823	197.001	111.946	25.306	0	9.642
49	281.516	.076	50.438	54.742	1.527	0	11.783
50	0	.487	590.212	0	0	0	0
51	1.681	.771	28.878	25.175	5.702	0	2.670
52	21.695	.112	99.502	2197.755	48.526	0	26.755
53	71.977	7.880	13.173	5653.347	265.172	0	3205.761
54	121.026	7.534	587.615	315.224	73.934	0	36.153
55	0	0	0	0	0	0	0
56	3313.386	178.192	3978.149	33918.725	813.207	0	4031.316
57	7434.000	192.000	11481.000	10562.000	1491.000	0	630.000
58	1652.000	128.000	3922.000	15037.000	3894.000	0	1985.000
59	2743.950	244.460	9999.561	22921.120	7498.310	0	1121.794
60	15143.336	734.652	29380.710	82438.845	13696.517	0	7768.110

Table 3.7. Estimated purchases of specified intermediate and primary inputs (in dollars), by purchasing industry, Northeast Minnesota and Douglas County, Wisconsin, 1970.

	WHOLE SALE	RETAIL	F. I.	REAL EST.	HOTELS	BUSS SERVI	CAR REPAIR
1	0	0	0	843.269	0	0	0
2	0	9.216	0	599.195	10.998	0	0
3	0	0	0	0	0	0	0
4	226.203	0	0	179.070	0	0	0
5	.348	0	0	8.876	0	0	0
6	.308	0	0	2.375	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	9.064	0	0	24.489	0	0	0
11	0	0	0	0	0	0	0
12	33.138	157.863	24.406	1284.933	98.469	14.376	3.726
13	1501.372	75.419	0	170.115	1.396	0	0
14	203.878	20.299	0	49.489	168.708	.003	5.128
15	55.537	0	0	21.893	0	0	0
16	287.573	25.230	0	24.375	24.850	0	0
17	1131.361	2024.159	240.987	81.740	246.147	30.414	3.237
18	683.148	52.275	441.394	121.496	27.750	2674.674	.144
19	118.618	17.333	.067	35.529	76.400	7.336	7.550
20	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0
22	1351.647	1307.273	90.795	748.421	421.292	38.859	106.535
23	80.751	64.651	1.424	14.681	32.195	11.721	14.180
24	85.483	26.718	0	18.526	41.630	10.616	27.133
25	70.645	0	0	65.848	4.258	2.218	0
26	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0
28	34.278	0	0	23.753	0	0	0
29	267.659	111.044	0	41.144	136.837	63.100	78.593
30	171.753	17.485	0	135.998	32.053	128.636	207.025
31	354.725	0	0	89.913	1.260	1.392	35.635
32	271.231	123.866	1.170	65.886	379.118	105.750	39.964
33	46.116	222.374	53.029	128.738	145.520	3.822	6.473
34	45.241	325.731	15.176	693.308	53.962	22.984	35.814
35	0	0	0	23.785	0	.632	0
36	680.307	426.064	30.952	186.199	72.547	35.559	15.445
37	.037	6.318	.018	1.496	.365	.965	.310
38	1581.791	1209.679	737.630	182.693	298.541	1301.723	42.793
39	492.600	3189.447	253.895	209.632	661.676	25.256	46.319
40	29.988	357.863	24.986	35.645	80.678	13.365	1.600
41	0	0	0	0	0	0	0
42	170.000	394.983	93.663	205.152	159.100	10.183	3.873
43	2647.441	1838.674	327.944	609.032	816.690	187.962	691.232
44	2189.467	1013.733	350.360	1183.408	299.514	179.623	359.252
45	1900.739	2652.025	8062.152	3261.713	914.678	103.666	108.462
46	2726.442	7242.981	1121.373	2155.793	1769.597	377.252	140.320
47	97.483	646.496	0	465.468	1068.653	98.399	7.044
48	1634.231	1678.541	743.635	620.604	247.444	154.001	19.048
49	1051.028	579.145	65.015	63.474	253.152	69.213	7.425
50	0	117.599	.903	50.736	1.698	15.073	0
51	201.320	265.526	590.649	94.504	158.417	36.106	4.987
52	474.444	3535.649	809.593	374.644	126.633	199.537	4.304
53	84.482	877.236	132.750	736.852	36.545	2.672	77.395
54	3944.971	1682.367	1474.810	164.576	746.431	415.231	47.916
55	0	0	0	0	0	0	0
56	24936.791	31695.262	15688.176	16038.466	9615.202	6342.319	2149.070
57	43801.000	102711.000	25380.000	9224.000	13033.000	8319.000	3808.000
58	19857.000	21802.000	8899.000	18233.000	7600.000	2394.000	2413.000
59	56495.658	75484.439	10037.270	83832.461	8845.006	1534.065	1982.323
60	147090.449	231692.701	60004.446	127327.927	39093.208	18589.384	10352.393

Table 3.7. Estimated purchases of specified intermediate and primary inputs (in dollars), by purchasing industry, Northeast Minnesota and Douglas County, Wisconsin, 1970.

	AMUSEMENT	MEDICAL ED	FED. GOVT	ST. LOC. G	OTHER	OTHER GOVT	SUBTOTALS
1	13.923	41.855	-.099	0	35.550	0	42353.656
2	36.004	42.158	-7.875	1.796	85.400	0	18400.489
3	0	0	0	0	0	0	0
4	10.094	.038	0	1.859	6.463	0	2964.369
5	0	0	0	0	0	0	36111.974
6	0	0	0	0	0	0	1615.011
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	2788.137
11	0	0	0	0	0	0	0
12	6.683	362.482	19.184	454.599	0	0	6882.966
13	0	1365.226	-28.377	0	3040.729	0	62136.142
14	0	106.892	1.203	8.322	7.340	0	7163.727
15	0	0	0	0	0	0	30283.980
16	0	0	0	0	5.132	0	10873.874
17	3.268	339.734	16.286	14.996	647.478	0	56049.725
18	7.706	1651.221	41.222	36.397	1969.774	0	13285.856
19	1.029	315.956	3.330	13.635	13.942	0	2930.704
20	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0
22	6.115	574.729	68.165	134.964	0	0	22297.611
23	.089	45.500	2.156	3.846	2.043	0	1754.821
24	.453	15.915	.115	3.090	1.632	0	6143.120
25	0	0	.131	10.782	6.354	0	44386.251
26	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0
28	0	0	.919	0	0	0	3465.137
29	0	12.000	.716	9.376	10.518	0	13938.004
30	0	1.148	1.669	19.360	5.333	0	12011.583
31	.010	0	.263	.194	87.965	0	2161.908
32	10.104	367.078	5.898	1.973	385.844	0	4895.935
33	2.427	35.488	149.988	16.111	112.292	0	56331.225
34	9.253	112.937	666.936	64.322	102.904	0	21595.950
35	0	0	.899	0	1183.153	0	1315.377
36	9.618	192.275	307.683	51.630	161.620	0	12012.287
37	.052	8.419	33.567	.009	350.362	0	424.094
38	18.412	1276.793	24.641	48.134	0	0	11571.630
39	22.680	2955.110	169.820	1291.766	0	0	44877.321
40	2.121	305.174	20.829	147.641	0	0	9892.135
41	0	0	0	0	0	0	0
42	4.530	775.158	19.307	48.334	0	0	3372.242
43	39.472	1991.351	61.992	144.259	0	0	54677.112
44	37.369	982.507	10.376	27.018	62.465	0	17859.522
45	35.633	936.160	143.083	210.084	0	0	28748.010
46	149.312	4245.859	165.817	137.450	0	0	57830.319
47	1.947	563.385	4.068	6.033	1995.586	0	6183.255
48	27.083	676.246	63.128	97.199	0	0	16668.576
49	4.843	397.299	28.488	18.707	0	0	4184.109
50	198.223	24.392	3.060	0	72.135	0	1076.122
51	7.992	1884.664	1.051	18.342	113.134	0	4746.091
52	14.574	935.979	4.136	19.161	0	0	10728.562
53	1.164	147.861	2.834	10.163	0	0	13515.544
54	87.288	2654.781	56.322	96.115	0	0	18715.454
55	0	0	0	0	0	0	0
56	769.471	26349.670	2062.931	3167.667	10465.148	0	0
57	1706.000	63744.000	7780.000	5637.000	10574.000	158011.000	0
58	981.000	17424.000	1691.000	3918.000	8497.000	0	0
59	602.784	53218.003	1545.079	2095.698	-10042.591	9.950	0
60	4859.255	160735.073	13079.010	14818.365	19493.557	158020.950	0