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SOME IMPACTS ON RESOURCE USE BY THE WOODPULP INDUSTRY IN MANISTEE COUNTY

By

Joseph Evan Diamond

A DISSERTATION

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ABSTRACT

SOME IMPACTS ON RESOURCE USE
BY THE WOODPULP INDUSTRY
IN MANISTEE COUNTY

By

Joseph Evan Diamond

The objectives of the study are: to assess some of the locational advantages of woodpulp firms in Michigan, and to evaluate a set of economic alternatives for the woodpulp industry and other sectors in Manistee County using an input-output model.

The locational portion of the study looked at the three major determinants of woodpulp location: access to timbersheds, water availability and marketing potential. The second part of the study utilizes a county input-output model derived from secondary sources. The data reduction technique used treats imports and exports as a residual and final demands are taken from other secondary data.

Research findings are that Packaging Corporation of America, the woodpulp firm located in Manistee County, is a very solid company from a locational perspective compared to other Michigan companies. It has good access to timbersheds in the central region of the Lower Peninsula and sufficient water for a hypothetical plant expansion of one-third of its present capacity. PCA is a subsidiary of Tenneco, one of the top twenty largest industrial companies according to Forture Magazine. It produces corrugated medium which has a steadily growing national market and is integrated into carton box production with other PCA-owned plants.

The relative distance to key Midwestern markets when compared to other woodpulp companies in the northern Lower Peninsula is good.

The reduction technique used in this study allowed the input-output model for the State of Michigan to be reduced to Manistee County. A transaction table, technical coefficients and output, income and unemployment multipliers were developed for Manistee County using a 15 sector input-output model. The output and income multipliers were within reasonable ranges when compared with other studies using primary data collection techniques. Furthermore, a procedure to include economic-ecologic linkages was outlined. More data is needed to show the full range of economic-ecologic trade-offs by use of environmental multipliers. The economic input-output portion of this study can be used as a basis for a linear programming land allocation model that can predict possible land-use shifts which have important land-use policy implications.

Detailed recommendations are made in the final chapter. They included the need for specific goals if input-output analysis were utilized for public policy, the desirability of greater economic definition of sectors for Manistee County, use of regional input-output studies for setting guidelines in community development studies, advantages and disadvantages of secondary data for regional input-output studies, and guidelines for a hybrid regional input-output model by collection of primary data for household, retail, import and export sectors.

ACKNOWLEDGMENTS

I am deeply indebted for the assistance and encouragement received from a number of people. Without their help, this work could not have been completed.

Special thanks is due to Dr. Chappelle, Chairman of the Guidance Committee. He initiated the study, retained the faith in my ability, provided me with many important comments and was a fine editor.

Professors Dersch, Kruger and Farness served on my committee. I appreciate their helpful comments and reading of my dissertation.

Ray Pfeifer and Al Boelter of the Michigan Department of Natural Resources' Forestry Division lent me their valuable time. They provided me with helpful suggestions and information. Bob Davis and Steve Cole of Packaging Corporation of America made available data from the Filer Mill in Manistee County.

Programming assistance was done by Nelson Bolyard. Peter Niehoff gave me many useful suggestions. Lillian and Bertram, my parents, kept my determination to finish this dissertation strong through their interest.

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CHAPTER I

INTRODUCTION

Problem Statement

Just a few years ago economic studies concentrated on economic growth often overlooking the impact of resource use on communities, regions or the entire economy. Left untouched were considerations of environmental impact or depletion of resources. Currently analysis usually takes two paths: those emphasizing growth and others stressing conservation, zero growth rates and recycling of resources wherever possible. Here we will be concerned with finding the middle ground of economic growth with safeguards to the environment and conservation of resource use.

Economic analysis traditionally looked at the firm in a spaceless and timeless context. Often community development studies investigate communities without any attempt at indepth economic analysis. In this study the economic relationships of a woodpulp firm and a county in Michigan will be investigated from two divergent perspectives. From the firm's point of view inputs are seen as a means to maximize profits given the legal environment in which it operates. But from the county's regional perspective more or less concern may be shown for conservation, land use, the firm's impact on the distribution of income, employment and its effect on levels of public services. The point here is that the firm and the county may have different sets of priorities

and interests.

Or another way of restating a similar point is that the present state of resource management is too narrow in scope. Recent thought in this field has led to a re-valuation of policies and procedures. This has resulted in a new set of guidelines for planning which is becoming widely accepted by institutions. For example, the Forest Service has accepted the recommendations of the President's Water Resource Council regarding multi-objectives in federal resource management.[1] These guidelines reflect a concern not only with economic flow of priced goods and services but, also, the importance of the impact on the environment and flows of non-priced goods and services in resource management decisions. A recent study focused on the problem:

> generally, many environmental goods are not bought and sold in markets. As a result, the information (i.e., price and quantity sets desired by or acceptable to consumers) necessary to apply traditional economic analysis is lacking. This vastly complicates the difficulty of quantifying the trade-offs between economic development and conservation of natural resources which would result in the 'wisest' use of resources for the economy under scrutiny.[2]

In the past, planning models by resource analysts have focused on commodity production--timber, recreation, water, etc. Regional impacts, both economic and ecologic, have been ignored in past planning by resource managers. This has resulted in a failure to utilize

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[1]See Water Resources Council, "Water and Related Land Resources: Establishment of Principles and Standards for Planning," Federal Register, XXXVIII, No. 174 (Washington: U. S. Government Printing Office, 1973).

[2]Eugene A. Laurent and James C. Hite, Economic-Ecologic Analysis in the Charlestown Metropolitan Region: An Input-Output Study (Clemson, South Carolina: Water Resources Research Institute in cooperation with the South Carolina Agricultural Experiment Station, Clemson University, Report No. 19, April 1971), p. 11.

multi-objective planning models which in turn may lead to a decline in environmental quality. This is due to the very close linkages between economic and ecological systems. Furthermore, a narrow perspective on resource planning can lead to negative impacts on regional income and employment. These impacts can be important not only from a quantitative perspective but also because of their distribution. Our interest in this study is to reflect the interrelationships between regional economic growth, timber production on state and federal lands and the growth or contraction of a woodpulp firm.

Finally, the State of Michigan is committed to high levels of employment and the diversification of its economy. Is the woodpulp industry a potential "growth" industry for this state which can raise levels of employment and help diversify the economy? If so, what are the spatial implications that market forces can generate within Michigan on regions. Then we will look at a case study, Manistee County, and try to assess what the impacts on resource use will be.

The Study Area

Some of the characteristics of the inter-firm competitiveness of woodpulp plants in Michigan were investigated in this study. However, existing profitability for woodpulp firms was not calculated. Rather the study presented some of the most important advantages and disadvantages from a cost perspective of a Michigan location.

A second thrust is an analysis of impacts of Packaging Corporation of America's (PCA) woodpulp plant on Manistee County via its demand for inputs.

Most regional resource analysis has focused on commodity production. The model used here is a regional input-output model. This type of model can test alternative public policies to get some idea of their economic impacts--regional production, regional income and employment. Only in recent years have impact models been expanded to not just economic sectors but ecologic sectors. This study focuses on Manistee County and assesses some economic-ecologic impacts of a woodpulp mill expansion or contraction. The following factors are investigated:

- industrial linkages and locational advantages and disadvantages of the existing plant.
- ecological impact on the county and the firm's efforts at residuals management.
- manpower effects on the county given a plant expansion or contraction.
- county development--levels of income distribution by sector for alternative development plans.

The Study Region

Manistee County provides a perfect study area for a number of reasons. It is a rural area bordering Lake Michigan on one side while other rural counties are to the north, south and east. Since it has a small rural based economy (though not too small a population--the population is within a 10,000-20,000 range) this makes the economic and ecological interactions easier to trace. It has a unusually diversified character for a rural county. There are a wide variety of natural resource industries ranging from wood products, food processing, primary

metals, machinery and chemicals. Nevertheless, the wood products industry does play an important role in the economic life of the county. Approximately 25% of all county land is in state or federal ownership with lumber and wood products accounting for "13% of employment in the county in 1965."[1] And finally, the county does have a growth center, the city of Manistee, as defined by the Michigan Department of Commerce.

While the question of regionalization and the techniques utilized is an intriguing one for economists, regional scientists, geographers, sociologists and others; it can become one in which your perspective decides what definition of region is appropriate. We accept the definition of a region as Manistee County as the relevant geographic area for answering the specific set of policy questions outlined in the study's objectives.

The Description of the Study Region

A description of the study region will be left to Chapter III-- A Socio-Economic Description of Manistee County. In this Chapter the location of the study area, economic history, human resources, economic sectorial analysis and finally land use by type of resource are discussed.

Objectives of the Study

The general objectives of this study were:

1) To assess some of the spatial variability of interfirm competitiveness of woodpulp firms in Michigan. The costs and availability of

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[1]Consumers Power Company. Data on Manistee, Michigan (Jackson, Michigan, March 1966), p. 4.

wood and water are looked at as well as access to markets.

2) An evaluation of a set of growth alternatives for Manistee County. The effects of woodpulp plant expansion or contraction are evaluated against impacts on the various economic-ecologic relationships.

The general objectives have been further defined in terms of several more specific research objectives. These specific objectives are:

- to list the past characteristics of Michigan pulp mills.
- to show the nature of woodpulp raw materials and their markets.
- to find what some of the advantages and limitations are in terms of some interspatial costs.
- to focus only on water availability, wood procurement costs and access to markets (transportation costs) of existing woodpulp plants.
- to evaluate levels of woodpulp mill interfirm competition in Michigan.
- to show economic linkages in Manistee County and their relation to a single woodpulp mill.
- to assess employment effects of PCA's possible future "expansion" or "contraction".
- to investigate the extent of some ecologic impacts to Manistee County. That is, to investigate intensity of demand for county resources such as wood and water.

Research Methods and Hypothesis

This study will attempt to uncover the answers to these two issues:

- Are there significant spatial differences in woodpulp costs for wood, water, and access to markets (transportation costs) in Michigan?
- To show economic and ecologic linkages in Manistee County with the Packaging Corporation of America and what impacts might arise with an expansion or contraction of the industry using an input-output model.

Research Procedures

The first part of the study relies on existing secondary sources for data. Comparative costs of the more important location variables for woodpulp plant operation are reviewed (that is, water, wood and market availability-transportation costs to the market).

The second part of the study also uses secondary data and proceeds through the following steps:

I. A Socio-Economic Description of Manistee County

II. Setting Up a Current Industrial Listing for Manistee County

Robert Harrell's work on Manistee County can be used as a starting point for this study. He has compiled an industrial listing of Manistee County[1] as of December 31, 1970 by SIC code. Karen Polenske's data[2] was put into a form useful for data reduction to Manistee County.

III. Construction of a Hypothetical Technical Coefficient Table.

Technical coefficient tables show in percentage form the direct

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[1]Robert A. Harrell, The Development of Foundational Materials and a Study for a Combined Economic and Environmental Quality Study of Manistee County, Michigan (Michigan State University, Department of Resource Development, 1971).

[2]Karen Polenske, Multiregional Input-Output Model for the United States, 1970.

purchases made by each processing sector. A technical coefficients table was derived from Polenske's State Input-Output Tables utilizing the supply-demand reduction technique.[1]

IV. Disaggregate the Woodpulp Industry from Other Wood Products Industries.

Using statewide data available from the Polenske computer tapes, the woodpulp industry (really the Paper and Allied Products Industry), a single plant--the Packaging Corporation of America, was broken out from the sector which includes all wood products industries. Its technical coefficients are taken to be equal to the national average for woodpulp mills. This will be done using the 1963 national transaction table.[2]

V. Estimation of Final Demands for Manistee County.

Final demands for Manistee County were derived from Polenske's state estimates of final demands based on percentages of county to state levels of sales for 1947, 1958 and 1963. For 1970 and 1980 final demands were estimated by Scheppach[3] on a state level and then reduced to Manistee County. The increase or plant termination for a single woodpulp mill was used to trace impacts in Manistee County.

VI. Calculation of the Income and Employment Multipliers for Manistee County.

A Michigan State University computer program (regional input-output

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[1]Karen Polenske, Multiregional Input-Output Analysis, Vol. II (Lexington, 1972).

[2]U. S. Department of Commerce, Input-Output Structure of the U. S. Economy, Vol. I (Washington: U. S. Government Printing Office, 1969).

[3]Raymond C. Scheppach, Jr., Multiregional Input-Output Analysis, Vol. III (Lexington, 1972).

modeling system) was used to calculate a county technical coefficient matrix and direct and indirect coefficients needed to develop type I and type II income multipliers and employment multipliers. Data reduction techniques will be described in a later chapter. These techniques can be used to tally effects on county income levels and employment given a change in the level of demand and therefore output for a woodpulp plant.

VII. Environmental Impact

In this study we are only concerned with the ecologic impacts of the woodpulp industry in Manistee County. This analysis will follow closely the methods used in a study of the Charleston Metropolitan Region.[1] This model is linear and assumes constant costs. It shows in physical units, the wood and water requirements of the woodpulp industry imports to produce one dollar's worth of gross output. Also shown are ecological exports, the amount of biochemical oxygen demand (BOD) in the water associated with one dollar of output by a woodpulp plant. Hence, impacts on the environmental input and export sectors were shown given an expansion or contraction of the firm's output.

The economic input-output model of Manistee County was linked with an environmental matrix when the data were collected and put into sectors which represent a natural resource input or emission (in this case we are only dealing with two inputs, water and wood, and one emission BOD from a woodpulp plant). Then post-multiplying the environmental matrix by the inverse of the input-output matrix you develop the

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[1]Laurent and Hite, Op. Cit.

r matrix. The income multipliers from the input-output table divided by the r matrix yield a resource income or environmental-income multiplier which are said to show the direct and indirect environmental linkages per dollar of local pecuniary income generated by the woodpulp industry.[1]

The decision makers interested in the results of this study should be:

- woodpulp plant corporation executives in Michigan and in other areas.
- city and county government officials dealing with impacts of woodpulp plant resource use.
- regional and state planning agencies interested in economic development for the State of Michigan.
- Michigan State Department of Natural Resources.
- federal agencies such as the U. S. Forest Service.

Every effort was made to assess their needs and to guide my research into areas which will be most fruitful and productive given the problems they face.

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[1]Ibid, pp. 71-72.

CHAPTER II

THE HISTORY AND DEVELOPMENT OF WOODPULP MILLS IN MICHIGAN

Past Characteristics of Michigan Woodpulp Mills

In 1957 there was a change in the classification of woodpulp mills by the U. S. Bureau of the Census. Previous to this revision all woodpulp mill economic activity was together. It made no difference whether the woodpulp mill was integrated with a paper or board mill at the same location or not. Thereafter, woodpulp mills received a narrower treatment and went under SIC code 2611. Henceforth, woodpulp mills were defined as:

> -those pulp mills which are not affiliated with any paper and board mills and ship all their products to the market.
> -pulp mills affiliated or associated with a primary or board mill but which are separately located from the pulp mill.
> -a few pulp mills affiliated or associated with a primary paper or board mill at the same physical location where a separate departmental records of employment, materials, and fuel costs, shipments, etc. are maintained for the pulp mill from those covering the paper board mill at that location and the company elected to file such a separate report.[1] (See appendix 1.)

So, in effect, when we are speaking of woodpulp mills in Michigan we are really talking about integrated woodpulp mills engaged in a variety of activities ranging from paper mills to paperboard mills since no mills in Michigan produce and sell just woodpulp. There is a

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[1]United States Bureau of the Census, Census of Manufacturing, Vol. I, Summary Statistics (Washington, D.C.: U.S. Government Printing Office, 1961), p. 26-A.

particle board plant in Michigan, U.S. Plywood-Champion Papers, Incorporated, at Gaylord. Though it does not produce woodpulp the raw materials are similar to woodpulp and so it was treated as a woodpulp mill in this study. There are no mills in Michigan which under the new 1958 Census of Manufacturing can be wholly classified as woodpulp mills or 2611. Paper and Allied Products or industry SIC 26 is the industrial classification considered in this study. (See appendix 2 and 3.)

The woodpulp industry manufactures woodpulp from pulpwood. Pulpwood can be defined as any timber used to produce pulp. Michigan's production is shown in table 1. Michigan's share of national paper production has fallen from 4.9% in 1958 to 4.2% in 1974. In paperboard the figures are slightly different but reveal the same basic conclusion --a decline in Michigan's share of production from 6.7% to 4.0% (1958 to 1974) despite an increase in overall production levels for the state. Along with these trends Michigan has seen a decline in the number of plants producing woodpulp from "11 in 1954 to 8 in 1974."[1]

Table 2 shows the distribution of Paper and Paperboard Products by type of product and potential growth rates. Corregating Medium, which is what PCA produces, had a projected growth rate of 6.0% which is higher than the average growth rates for paper and paperboard products. But it is only below one other product--particle board, which was estimated to grow at 15% during this period.

In 1961 roughly one-half of the production of Michigan mills was

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[1]Michigan Department of Natural Resources, Forestry Division, Directory of Primary Woodusing Plants (Lansing, 1970 and 1974); and Michigan State University Agricultural Experiment Station and Cooperative Extension Service, Michigan Timber Production-Now and 1985 (East Lansing, 1973).

TABLE 1

HISTORICAL TRENDS IN MICHIGAN AND NATIONAL PRODUCTION

TABLE 1

HISTORICAL TRENDS IN MICHIGAN AND NATIONAL PRODUCTION
(THOUSANDS OF TONS)

	1958	1963	1967	1974	Average Annual Growth 1958-67	1963-67	1967-74
Paper							
Michigan	655	802	822	1,133	2.5	0.6	5.3
National	13,497	17,300	20,703	26,861	4.9	4.7	4.2
State's Share	4.9%	4.6%	4.0%	4.2%			
Paperboard							
Michigan	951	1,066	1,130	1,341	2.0	1.5	2.6
National	14,141	18,267	22,346	33,074	5.2	5.1	6.4
State's Share	6.7%	5.8%	5.1%	4.0%			

SOURCE: The Arthur D. Little Report, Overview of Pulp and Paper Expansion Possibilities in the Upper Great Lakes Region; and, Michigan State University, Michigan Statistical Abstract, 1976.

TABLE 2

MICHIGAN PRODUCT CAPACITIES AND NATIONAL GROWTH OUTLOOK, 1968
(TONS PER DAY)

	Michigan	Total for Upper Great Lakes Region	Growth Outlook in Total U.S. Market 1968-1975 %/Year
Paper			
Groundwood			
Coated	280	2,560	4.5
Uncoated	150	425	2.5
Book			
Uncoated	800	1,100	6.5
Coated	370	570	6.5
Fine			
Chemical	700	2,615	6.0
Rag	70	270	0
Glassine & Related	-	715	2.0
Wrap & Converting	-	575	3.0
Tissue			
Sanitary	250	2,460	6.0
Industrial	280	430	0
Special Industrial	30	240	6.0
Subtotal	2,930	11,960	4.9
Paperboard			
Cylinderboard	3,360	4,780	1.5
Corrugating Medium	850	2,015	6.0
Insulation Board	270	1,160	0
Hardboard	280	795	7.0
Particleboard	160	495	15.0
Subtotal	4,920	9,245	3.5

SOURCE: The Arthur D. Little Report, Overview of Pulp and Paper Expansion Possibilities in the Upper Great Lakes Region.

produced by a sulfite or groundwood pulp process. Both processes use a low-resin content species such as balsam and spruce for the largest amount of its timber volume. The sulfate process, which is used by approximately 15% of Michigan's mills and is well suited to high resin softwoods such as pine. The soda and semi-chemical process are used principally for the pulping of hardwoods. (See table 3 for 1961 Michigan data on number and types of pulping processes.) By 1974 (see appendix 4) there were no sulfite mills; sulfate accounted for 28.7%, groundwood and other mechanical 39.1% and semi-chemical 32.1%.

TABLE 3

MICHIGAN WOODPULP MILLS BY PULPING PROCESS, 1961

Chemical Pulps				
Sulfite	Sulfate Soda	Semi-chemical	Groundwood	Miscellaneous
2	2	4	4	2

Total Mills
14

SOURCE: U.S. Forest Service, Woodpulp Mills in the United States, (Washington, D.C.: Division of Forest Economics Research, 1961).

Current Mills in Operation

As of 1974 there were eight integrated woodpulp mills in Michigan and one particleboard plant:

- S. D. Warren in Muskegon is a division of Scott Paper Company and is included in SIC number 2641. It is a kraft pulp mill with five paper machines and a production capacity of 225 tons per 24 hours. It

consumes 430 cords of pulpwood daily.

- Hoerner Waldorf Corporation of Ontonagon, Michigan, with an SIC number of 2621 produces paper. Total production should have reached 220 tons per 24 hours by 1974.

- Packaging Corporation of America, a subsidiary of Tenneco Corporation in Filer City, SIC 2631 (paperboard and corrugated medium), has a capacity of almost 700 tons per day. It is a semi-chemical pulp mill. There are three machines. The number 1 machine was built in 1923, the number 2 machine in 1953, and the number 3 machine in 1958. The number 3 machine was rebuilt for corrugated medium product from bleached kraft production in 1972. These machines are updated continually and have been modernized.

- Menasha Corporation's Paperboard Division with SIC number 2631 produces corrugated medium in Otsego. It has a capacity of producing 225 tons daily.

- Celotex Corporation in L'Anse is a subsidiary of Jim Walter Corporation, a major producer of building materials. The mill produces insulation board and is listed as SIC number 2661. It has a plant capacity of 270 tons per day.

- Mead Corporation at Escanaba produces paper, hence its SIC number 2621. Its capacity in 750 tons daily.

- The Manistique Pulp and Paper Company is owned by Field Enterprises and is classified by a SIC number 2621 which means it produces paper. It has a capacity of 90 tons daily.

- The Abitibi Corporation in Alpena makes insulation board and is classified by SIC number 2661. It produces 430 tons daily by the

groundwood process.

- Finally, U.S. Plywood-Champion Industries at Gaylord makes particle-board and therefore has a SIC number of 2661.

The information on plant size, location and type of process is summarized in table 4. It shows a drop in the number of plants from 14 in 1961 to 8 in 1974. Table 5 shows similar information for 1961 but only for plants still in existence in both 1961 and 1974. Table 6 then makes a comparison between tables 4 and 5 and shows that the percentage of pulp production capacity dropped in the northern Lower Peninsula from 66% to 55%. In 1961, PCA was the largest woodpulp mill in Michigan but was second in 1974. It registered a 135-ton increase per 24 hours which ranked third by total increase in volume and sixth by percentage increase. The relative ranking of the mills has not changed much except for Mead jumping from 8 to 1 in relative rank. Other mills in the northern Lower Peninsula while still smaller than PCA show larger percentage increases in volume. In summary, PCA has expanded production from 1961 to 1974, but not as much as the other competing mills in the northern Lower Peninsula. It is no longer the largest mill in Michigan. However, it is still a very large mill and the relative rankings for the northern Lower Peninsula mills were unchanged over this time span.

The Employment and Economic Importance of Michigan Pulp Mills

Employment in paper and allied products for Michigan has fallen off in the past 20 years and will likely continue to so so in the future (see tables 7 and 8). Table 7 shows that 3,500 jobs in the

TABLE 4

ACTIVE MICHIGAN PULPMILLS FOR 1974

Firm	Plant Location	Mill Capacity in Tons Per 24 Hours					
		Total	Sulfite	Sulfate	Groundwood	Soda	Semi-Chemical
1. Abitibi Corporation	Alpena	430			430		
2. Celotex Corporation	L'Anse	270			270		
3. Hoerner Waldorf Corporation	Ontonagon	220					220
4. Manistique Pulp & Paper Company	Manistique	90			90		
5. Mead Corporation	Escanaba	750	600		150		
6. Menasha Corporation	Otsego	225					225
7. *PCA	Filer City	700					700
8. S.D. Warren Company	Muskegon	240	240				
GRAND TOTAL		2,925					

*PCA mill capacity changed to 700 tons per 24 hours in 1974.

SOURCE: Lockwood's Directory, 1974.

TABLE 5

1961 PLANT CAPACITY FOR PULP MILLS CURRENTLY LOCATED IN MICHIGAN

Firm	Plant Location	Mill Capacity in Tons Per 24 Hours				
		Total	Sulfite Sulfate	Groundwood	Soda Semi-Chemical	Miscellaneous
1. Abitibi Corporation	Alpena	250				250
2. Celotex Corporation	L'Anse	175				175
3. Huss-Ontonagon Pulp & Paper Company	Ontonagon	200			200	
4. Manistique Pulp & Paper Company	Manistique	80		80		
5. Otsego Falls Paper Mills, Incorporated	Otsego	110			110	
6. PCA	Filer City	565	165		400	
7. S.D. Warren	Muskegon	135	135			
8. Mead Corporation	Groos	100				
GRAND TOTAL		1,615				

SOURCE: Lockwood's Directory, 1961.

TABLE 6

SUMMARY OF EXPANSION OF PLANT CAPACITY FOR MICHIGAN PULP MILLS FROM

TABLE 6

SUMMARY OF EXPANSION OF PLANT CAPACITY FOR MICHIGAN PULP MILLS FROM 1961 TO 1974

Firm	Change In Output 1961-1974	Percentage Change From 1961-1974	Ranking By Change In Volume	Ranking By Percentage Change	Ranking 1961	Ranking 1974
1. Abitibi Corporation	180	72%	2	4	2	3
2. Celotex Corporation	95	35%	6	5	4	4
3. Hoerner Waldorf Corporation	20	10%	7	8	3	7
4. Manistique Pulp & Paper Company	10	13%	8	7	8	8
5. Menasha Corporation	110	105%	4	2	6	6
6. PCA	135	24%	3	6	1	2
7. S.D. Warren	105	78%	5	3	5	5
8. Mead Corporation	650	650%	1	1	7	1

SOURCE: Lockwood's Directory, 1961 and 1974.

TABLE 7

EMPLOYMENT IN MICHIGAN PAPER AND ALLIED PRODUCTS INDUSTRY, 1954-1966 (THOUSANDS OF JOBS)

	1954	1958	1963	1966
Employment	33.0	27.8	29.1	29.5

SOURCE: Michigan State University, Michigan Statistical Abstract, 1976.

TABLE 8

EMPLOYMENT IN MICHIGAN PAPER AND ALLIED PRODUCTS INDUSTRY, 1965 AND PROJECTED TO 1995 (THOUSANDS OF MAN-YEARS)

Industry	1965	1975	1985	1995
Pulp, Paper & Allied	4.0	3.4	2.6	1.9

SOURCE: Michigan State University Agricultural Experiment Station and Cooperative Extension Service, Michigan Timber Production-Now and 1985.

Note: One man-year is equal to one man employed for 250 eight-hour days.

Paper and Allied Products Industry were lost from 1954 to 1966. Future employment levels are expected to drop from 4,000 man-years in 1965 to 1,900 man-years in 1995. This future trend is a result of expected increases in labor productivity that will be combined with more efficient manufacturing methods. Employment in timber harvesting will decrease as more machines replace men in the woods. To some extent this trend will be offset by an increase in forest management activities related to the Pulp, Paper and Allied Products Industries.

The Paper and Allied Products Industry in Michigan has grown in total sales since 1954. But percentagewise, the yearly payroll and value added as a percentage of the total state output has fallen slightly since 1954 (see table 9).

Michigan's Woodpulp Locational Advantages and Disadvantages

Locational decisions for woodpulp mills whether for expansion, contraction or closing of existing mills or the formation of a new mill present an unique set of circumstances in every case. But all mills have common requirements for wood, water, labor, fuel and other inputs. The three major determinants considered in this study are wood availability, water availability and access to markets. Other factors such as state and local taxes, construction costs, electricity costs, labor costs, chemicals and transportation rates are assumed to be constant in the state.

Woodpulp manufacturing is a weight losing activity (raw-material oriented) and tends to be located near timber supply areas. Paper mills are more market oriented. In Michigan all mills are integrated hence

TABLE 9

PAYROLL, VALUE-ADDED AND CAPITAL EXPENDITURES IN MICHIGAN'S PAPER AND ALLIED PRODUCTS INDUSTRY, 1954-1973

	Yearly Payroll	Value Added By Manufactures Unadjusted (1,000)	Capital Expenditures (1,000)
1954 Paper & Allied Products	$ 132,100	$ 236,147	$ 26,705
Michigan	5,252,352	8,707,194	870,465
Percentage of Total	2.5%	2.7%	
1958 Paper & Allied Products	$ 90,031	$ 163,823	$ 4,396
Michigan	5,172,363	8,350,781	438,866
Percentage of Total	1.7%	2.0%	
1973 Paper & Allied Products	$ 272,100	$ 560,900	
Michigan	14,868,300	27,170,400	
Percentage of Total	1.8%	2.1%	

SOURCE: Michigan State University, Michigan Statistical Abstract, 1975 and 1976.

the chief market for pulp is the very same integrated woodpulp mill in almost all cases. In a few cases the pulp is turned into paper.

The pulping process usually determines the type of tree species utilized. One would surmise that the original decision for a new pulping process, its replacement or even termination, is a function of wood availability.

Chemicals make up a large part of the total cost for woodpulp mills but do not vary greatly over space.

Several other locational factors for woodpulp mills are worth discussing. Water availability for woodpulp manufactures is important for the manufacture of woodpulp as well as the dilution of waste materials. Other important factors in mill locational decisions are the need for transportation linkages (rail connections are of course important when the final product such as corrugating medium is quite heavy and bulky). A final factor in location decisions is forest land ownership. Any disruption in the flow of wood to a woodpulp mill could be disastrous because of the level of capacity needed to maintain profits. As a rule, company land holdings guarantee a future source of supply and can give varying degrees of monopoly power. At the very least, such holdings could counter monopolistic or collusive actions on the part of sellers of pulpwood to the mill. State or federal forests and other large sellers of timber selling to a mill without any or small holdings, other things remaining equal, will not be in as favorable a bargaining position as a mill which has a fairly sizable source of owned timber.

A study done by the Battelle Memorial Institute listed three locational disadvantages the Upper Great Lakes have compared to the Pacific

Northwest and the South for the wood products industry. These are:

-saw logs reach maturity twice as slowly in the Great Lakes area.

-the concentration of saw timber in the Great Lakes is less per acre.

-the forest area is basically privately owned by small landowners often not primarily engaged in the production of timber.[1]

Naturally these comments apply to Michigan as well. But the Michigan timber resource, especially hardwoods, has increased from a low in 1935 of only 19 million acres of forest land from an original 35.5 million acres. The original forest lands were depleted by fires, overcutting and land going into agricultural production. Roundwood production increased "51% from 1954 to 1965 and remained almost constant (declining slightly) in 1969."[2] It has been projected that over the period "1965 to 1995 total pulpwood production is expected to almost triple."[3] In short, there is a large growing timber resource base which can be utilized to meet the increased demand for wood. Secondly, wise public timber sale policies and efforts to encourage better use and the sale of forest products from private lands can to some extent overcome the land ownership problem (lack of large private tracts by woodpulp mills in the lower peninsula by woodpulp mills) though this is not as much of a problem in the Upper Peninsula.

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[1]David Sweet, John Griffen and Hal S. Maggied, Industries Suited for the Upper Great Lakes Region (Battelle Memorial Institute Columbus, Ohio, 1970), p. 13-15.

[2]Michigan State University Agricultural Experiment Station and Cooperative Extension Service, Marketing Timber Production-Now and 1985 (East Lansing, 1972), p. 9.

[3]Ibid, p. 11.

Michigan's Wood Supply for Woodpulp Mills is Surveyed and Analyzed--PCA's Competitive Advantage

Availability of Timber by Volume and Species for Integrated Woodpulp Mills in Michigan

The eight integrated woodpulp mills in Michigan and the single particleboard plant vary in their access to various timbersheds and consequently their demands for selected tree species due to the type of pulping process used. Sulfite and groundwood mills use long fibered, low-resin-content species such as spruce and balsam. Various pines and hardwoods are also utilized in the production of sulfite and groundwood pulp but generally in small amounts when compared to spruce and balsam. The sulfate process is especially suited to highly resinous softwoods especially pine though it can be used with many species. Hardwoods are used primarily with the soda and semichenical processes. PCA uses a semichenical process. The Fourdrinier machines require a specific mix of tree species. Table 10 lists mill locations and principal species used. PCA uses 65% aspen and 35% dense hardwoods. It seems to have the most rigid requirements of any Michigan woodpulp mill for particular tree species.

Table 11 (table 12 summarizes these data) shows the pulpwood surplus for 1966 by regions within the state. This table shows:

- the expectation is of larger amounts of surplus growth in the Western Upper Peninsula than the Eastern Upper Peninsula and less in the Northern Lower Peninsula followed finally by the Southern Lower Peninsula.
- the 1970 report by the Arthur D. Little Company date updated in 1966-67 from the preliminary U.S. Forest Service 1965 Michigan Forest Survey

TABLE 10

LIST OF MICHIGAN INTEGRATED PULP MILLS, PARTICLEBOARD PLANTS AND PRINCIPAL TREE SPECIES USED FOR PRODUCTION

	Firm	Plant Location	Principal Species Used
1.	Abitibi Corporation	Alpena	Aspen, red & white oak, hardwood chips
2.	Celotex Corporation	L'Anse	Aspen
3.	Hoerner-Waldorf Corporation	Ontonagon	Aspen, dense hardwood chips, yellow birch, hard and soft maple
4.	Manistique Pulp & Paper Company	Manistique	Balsam fir, spruce, pine, aspen
5.	Mead Corporation	Escanaba	Aspen, balsam fir, spruce
6.	Menasha Corporation	Otsego	5-10% aspen, white ash, black cherry, hard and soft maple, red oak, 35% mixed hardwood chips
7.	PCA	Filer City	65% aspen, 35% dense hardwood chips, mostly maple or oak
8.	S.D. Warren Company	Muskegon	Aspen, jack & red pine, mixed hardwood chips
9.	U.S. Plywood-Champion International	Gaylord	Aspen, jack pine

SOURCE: Michigan Department of Natural Resources, Directory of Primary Woodusing Plants in Michigan, 1970 and 1974.

NOT FOR CIRCULATION OUTSIDE MICHIGAN

TABLE 11

PULPWOOD GROWING-STOCK[a] GROWTH, ALLOWABLE CUT, AND ACTUAL CUT IN MICHIGAN, BY SPECIES GROUP AND SURVEY DISTRICT, 1966 (THOUSANDS CORDS)

Species Group	Annual Growth	Allowable Cut	Actual Cut	Surplus Growth Over Cut[b]	Annual Growth	Allowable Cut	Actual Cut	Surplus Growth Over Cut[b]
	Eastern Upper Peninsula				Western Upper Peninsula			
Softwoods:								
Spruce	132	78	29	103	142	86	37	105
Balsam fir	152	141	48	104	161	153	32	129
Red and jack pines	165	65	67	98	68	25	47	21
Hemlock	23	59	26	33	52	102	84	18
Other softwoods	229	256	68	188	119	176	32	144
Total	701	599	238	526	542	542	232	417
Hardwoods:								
Aspen	120	226	148	76	266	302	233	33
Other hardwoods	361	303	-5	356	725	334	-1	724
Total	481	529	143	432	991	636	232	757
TOTAL ALL SPECIES	1,182	1,128	381	958	1,533	1,178	464	1,174
	Northern Lower Peninsula				Southern Lower Peninsula			
Softwoods:								
Spruce	31	31	1	30	---	---	---	---
Balsam fir	67	113	3	110	---	---	---	---
Red and jack pine	321	109	131	190	41	---	1	38
Hemlock	24	33	1	32	2	8	1	7
Other Softwoods	260	174	16	244	37	6	7	30
Total	703	460	152	506	80	14	11	75

TABLE 11--Continued.

Species Group	Annual Growth	Allowable Cut	Actual Cut	Surplus Growth Over Cut[b]	Annual Growth	Allowable Cut	Actual Cut	Surplus Growth Over Cut[b]
	Northern Lower Peninsula				Southern Lower Peninsula			
Hardwoods:								
Aspen	297	495	448	8	104	28	35	69
Other hardwoods	595	430	56	539	230	99	69	161
Total	892	925	504	547	334	127	104	230
TOTAL ALL SPECIES	1,595	1,385	656	1,053	414	141	115	305

SOURCE: Michigan State University Agricultural Experiment Station and Cooperative Extension Service, Research Report 192, Michigan Timber Production-Now and 1985.

[a]Includes all softwood and aspen trees 5.0 inches in diameter at breast height and larger, but only trees 5.0-10.9 inches in diameter of other hardwoods.

[b]In hemlock, where allowable cut is greater than growth, surplus shown is for allowable cut over actual cut.

(table 12) differs slightly from the data in table 11. Both correctly note that the largest expansion possibilities for wood products industries exist in the Upper Peninsula where the largest surplus of wood is. Indeed, Mead's expansion at Escanaba has utilized a large part of the hardwood surplus in the Western Upper Peninsula and the Eastern Upper Peninsula as well. The expansion of the Manistique Paper Company --Field Enterprises has not materialized. It was expected to use 65,000 cords of dense hardwood. This also would have cut the wood surplus in the eastern Upper Peninsula.

- by expanding the use of wastepaper integrated woodpulp mills are in effect cutting their dependence on new pulpwood. Nationally, in 1965 the fibrous raw material blend needed to make paper or board was 76% wood fiber from new wood, 22% from recycled waste paper and board, and 2% from rags, straw and other fibers.[1] The Menasha Corporation used about 30% of recycled corrugated board in 1974. PCA used about 5% K2S clippings from corrugated box production in the early 1970s and in 1977 it is using about 8% to 10%. It has plans to increase its use of wastepaper to include post-consumer materials to about 25% in the future, making PCA even less dependent on new wood. At the present time the other integrated mills in Michigan are not heavy users of wastepaper.

- in assessing the expansion possibilities for forest industries, the Arthur D. Little Company suggested that expansion possibilities exist for particleboard and/or hardboard and integrated semi-chemical pulp

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[1]Michigan State University Agricultural Experiment Station and Cooperative Extension Service, Marketing Timber Production-Now and 1985, Op. Cit., p. 5.

for a bleached kraft plant. Since that "Little Report" PCA has shifted to a semichemical pulp process for machine 3 in order to make corrugated medium, a new particleboard plant was started in Gaylord, Michigan, by Champion International and the Mead Company in the Upper Peninsula expanded production by 700 tons. But the Upper Peninsula and the northern Lower Peninsula still have a large supply of untapped dense hardwoods.

TABLE 12

APPROXIMATE ANNUAL SURPLUS OF PULPWOOD SPECIES IN MICHIGAN, 1967-68 (THOUSANDS OF CORDS)

Location	Aspen	Other Hardwoods	Softwoods
Eastern Upper Peninsula	80	420	210
Western Upper Peninsula	70	350	200
Northern Lower Peninsula	50	410	180

SOURCE: Arthur D. Little, Incorporated, Overview of Pulp and Paper Expansion Possibilities in the Upper Great Lakes Region.

*Note: The southern Lower Peninsula is not included since no substantial levels of pulpwood product exist there and it was outside the boundaries of this study.

The percentage of federal-state forests in the northern Lower Peninsula plus industry holdings are much less than in the Upper Peninsula. Indeed the category of industrial holdings is very low and miscellaneous private holdings are very high. But better public timber sale policies and programs can foster a more efficient utilization of forest in production from private lands and public lands (see table 13 for the exact distribution of forest land ownership in Michigan). Also,

TABLE 13

DISTRIBUTION OF COMMERCIAL FOREST LAND OWNERSHIP IN MICHIGAN FOR 1966 (OWNERSHIP DISTRIBUTION IN PERCENT)

Location	Total Acreage (Thousands of Acres)	Ownership Distribution in Percent						
		Federal	Indian	State	County & Municipal	Industry	Farm	Misc. Private
Western Upper Peninsula	4,920,900	17.1	.3	13.5	1.4	27.8	6.7	33.2
Eastern Upper Peninsula	4,169,100	18.7	--	26.2	.1	18.8	11.6	24.6
Northern Lower Peninsula	6,994,000	12.0	--	27.5	.2	1.1	15.0	44.4

SOURCE: Arthur D. Little, Incorporated, Overview of Pulp and Paper Expansion Possibilities in the Upper Great Lakes Region.

since the combined total acreage is about 16.1 million acres, with the larger percentages in the Upper Peninsula for federal-state and industrial land holdings, and the total commercial forest lands are of greater consequence in the northern Lower Peninsula.

Both the Michigan State Forests managed by the Forestry Division of the Department of Natural Resources and the four federal forests managed by the U.S. Forest Service use multiple-use objectives in the professional management of Michigan forests. It is generally recognized that federal ownership pays more attention to the commodity production of timber. State forests, as do federal forests provide for the use of forest land for recreation, wildlife, mineral production, aesthetics, etc. The State of Michigan, for example, has an ambitious program for deer habitat management in cooperation with the Wildlife Division to locate areas and supervise projects directed toward improving deer habitat. Generally, wood production and the management of state forests for wood production are compatible. In some areas forest products are managed for deer habitat as a primary objective but overall they are part of a multiple-objective approach.

> As a general rule, the goal for the wildlife management units is to have a minimum of 35 percent in aspen and a total of 60 to 65 percent in intolerant types (aspen, oak, jack pine and upland bush). Grassy openings should make up 6 to 15 percent of the area. The higher percentage of open area will be in the deer priority townships. Note that, statewide, 35.9 percent is now in aspen, 62.2 percent in intolerant types or openings, some of the excess should be converted to species which will increase the timber potential for products in greatest demand by industry to meet public needs.[1]

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[1]Michigan Department of Natural Resources, State Forest Management Planning (Lansing, 1974), pp. 19-20.

Thus, an intolerant tree species is preferred for deer production since ground coverage of these species allows more vegetation to grow underneath. But all intolerant tree species are used for pulpwood production in Michigan, especially aspen. In Manistee County the Betsie River State Forest is in deer priority townships. The federally-owned Manistee National Forest in the southern part of the county also falls into a deer priority township which have similar guidelines but no funding from the state.

Management of private lands for timber production (a major problem in the northern Lower Peninsula) has been aided by the Tree Farming System which is a national program with more than 32,000 tree farms across the country sponsored by the American Forestry Institute. The tree farming program has been active in Michigan since 1949 and in 1976 there were 1,071 tree farms.[1] However, there is not any direct correlation between tree farms and pulpwood production. Tree farming can be for sawlogs (for a pallet mill) wildlife as well as pulpwood. Despite tree farming most small private landowners do not practice forest management because of indifference, lack of information on the benefits to be received or physical and economic limitations. Absentee owners often acquire forest land for recreation with no interest in harvesting forest products. Informational programs such as the Michigan Tree Farming Program need to be intensified if the economic and other benefits of proper forest management are to be realized. The impact of tree farming in Manistee County shows up in our economic

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[1]Michigan Forest Association, The Forest Flare, Vol. III, Issue No. 1 (Jan.-Feb., 1977), p. 1.

input-output model in the forestry sector and also in the lumber and furniture sector.

A third essential point concerning timber availability for integrated woodpulp mills in Michigan is the absence or occurrence of price competition over space. For Michigan there are two basic pricing situations which still prevail and have been described by Professor Manthy[1] in an earlier work and confirmed by informal discussion with the Department of Natural Resource's Forestry Division. The two timbersheds in Michigan for the supply of wood to Michigan pulp mills are the Upper Peninsula which is often divided into the western Upper Peninsula and the eastern Upper Peninsula and the Lower Peninsula (mostly the northern part since this is where almost all the pulpwood in this area is located).

Figure 1 shows the location of all the woodpulp mills in Michigan plus the single particle board plant. It is helpful to refer to when reading the analysis of Michigan timbersheds vis-a-vis woodpulp plants.

In the northern Lower Peninsula the timbersheds overlap. There are three plants in this zone (one particle board plant) and two outside this zone which still compete heavily for timber in this area. S. D. Warren in Muskegon and Menasha Corporation in Otsego, Allegan County buy large quantities of timber in the northern Lower Peninsula due to its relative abundance and the availability of needed tree species. The exact lines of the relative timbersheds for these five companies will vary from year to year depending on such facotrs as

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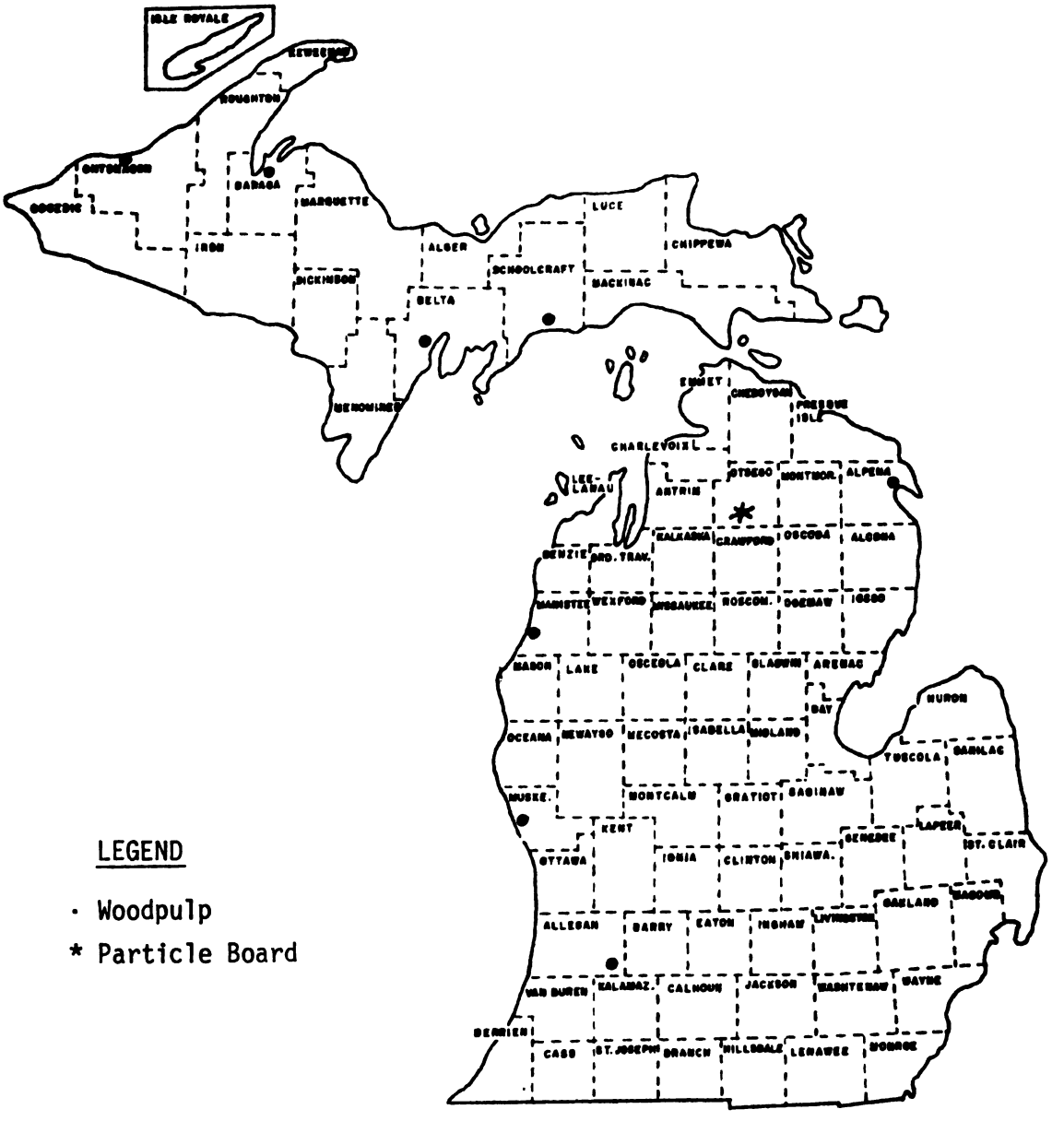
[1]Robert Manthy,"Marketing Pulpwood in the North Central Region," Michigan State University Ph.D. dissertation (East Lansing, 1963), pp. 148-149.



SOURCE: Michigan Department of Natural Resources, Forestry Division, Directory of Primary Woodusing Plants in Michigan, 1974.

FIGURE 1.--LOCATION OF MICHIGAN WOODPULP AND PARTICLE BOARD PLANTS IN 1974.

production levels, supplier relationships, availability of needed timber and the like. The timber supply situation is characterized by areas of monopoly for these five firms especially for the species close to their respective plants. PCA and Menasha Corporation both produce paperboard but are the only two companies with the same principal product in the Northern Lower Peninsula. There is a greater degree of overlap in the demand for similar tree species. For example, Abitibi, Champion International, S. D. Warren and PCA are heavily involved in buying aspen (especially PCA). Abitibi, Menasha and S. D. Warren are all competing for mixed hardwood chips.

The overall supply situation exhibits elements of price discrimination. Each plant is located along Lake Michigan or Lake Huron with good highway access and some distance from each other. Very little timber flows from the Upper Peninsula to the Lower Peninsula and virtually no imported pulp has come from Canada in recent years.[1] One would expect that in their home counties (location of woodpulp mills) prices would remain high and output somewhat restricted for stumpage they need. This along with transportation costs would discourage other firms from buying there. This would allow mills to use close sources of timber as a reserve. Further away from the plant pockets of competition exist subject to yearly changes. Prices vary over space beyond transportation costs. There seems to be evidence of this from the prices paid to sellers (owners of stumpage) from various distances

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[1]James E. Blyth, Allen H. Boetter, Carl W. Danielson, Forest Product Industry and Timber Use, (Michigan, 1972), p. 5. James Blyth and and Jerold T. Hahn, "Pulpwood Production in the North Central Region by County 1974," p. 4.

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for the mills. In fact, "bonuses are quite a common method of discriminating in price as mills seek wood supplies further and further from the plant site."[1]

Analysis of stumpage prices show the order in terms of price for Michigan is as follows for 1969*:

1.	Aspen	lowest price
2.	Dense hardwood	
3.	Balsam fir	
4.	Spruce	highest price[2]

The price differential for aspen and mixed hardwoods in 1969 was negligible but it was expected to be greater in 1970 due to a rise in demand. In 1970 aspen pulpwood production lead pine by almost 3 to 1 in the Lower Peninsula.[3]

Table 14 corroborates the relative price data listed previously. Aspen, the most common tree species, is also the cheapest in price with spruce being much less common in use and relatively the most expensive of the previous five tree species.

PCA and Abitibi use over 50% aspen for production purposes. Menasha uses some aspen, but not large amounts. Champion International and S. D. Warren use larger amounts of aspen than Menasha Corporation but exact figures on Champion's demand for aspen were not uncovered, but they would be expected to be substantial. Champion International

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[1]Manthy, p. 146.

[2]Arthur D. Little Report, p. 27.

[3]Michigan Department of Natural Resources, Michigan Pulpwood Production 1969, p. 2.

*1969 data were used since they were closest to 1970 which was the base year.

TABLE 14

MICHIGAN PULPWOOD PLANTS USING DIFFERENT SPECIES OF WOOD FOR PULPING IN 1974

Species and Kind of Material	Number of Plants
Aspen	8
Balsam fir	3
Birch	6
Hemlock	3
Pine	4
Spruce	3
Tamarack	1
Maple	7
Oak	5
Other hardwoods	5
Woodchips	5
Slabwood and other residue	2
TOTAL PLANTS	8

SOURCE: James B. Blyth and Jerold T. Hahn, Pulpwood Production in the North Central Region by County, 1974.

Note: 1970 data should be quite similar to this table, the only difference being that there were nine pulp mills in 1970 and eight in 1974.

used chips for around a quarter of its production in 1974.

The larger companies in the Lower Peninsula are very large buyers of aspen compared to smaller companies such as S.D. Warren or Hoerner Waldorf. S.D. Warren and Champion International use a lot of jack and red pine as well as mixed hardwood chips. The Menasha Corporation uses a lot of red oak and hardwood residue. The Department of Natural Resources in 1970 showed jack and red pine were more expensive than red oak, aspen and other wood residues. Other things being equal, the larger firms use cheaper pulpwood though the marginal firms (in terms of size) are larger users of wood residues which are relatively cheap. This generalization seems to hold true except for Champion International.*

The area for the timbersheds for the five plants in the Lower Peninsula are mostly concentrated in the northern Lower Peninsula. PCA has bought timber for some years in over 25 counties. PCA is almost a third bigger than the next largest woodpulp mill in the Lower Peninsula and for its size it does not own much land. Despite the fact that it is close to large pulpwood production counties such as Manistee and Lake, it is receiving competitive pressures from Champion International, S.D. Warren and Menasha Corporation. PCA's dependence on aspen and dense hardwood chips, mostly oak and maple, forces it to be selective in every county in which it buys.

A company letter (PCA) indicating the general buying pattern for state and federal timber is included in appendix 5. Most of its search

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*Note: The Department of Natural Resources has exact figures by county and tree species that each company buying pulpwood records, but because of disclosure problems the detailed information was not revealed.

for timber is concentrated in the mid-section of the Lower Peninsula. Naturally, being located close to the Manistee National Forest is a locational advantage.

Abitibi, also a large buyer of aspen, due to its somewhat smaller plant size than PCA and proximity to the largest number of high volume pulpwood producing counties in the Lower Peninsula (Alcon, Montgomery, Crawford, and Oscoda) only buys in a radius surrounding Alpena County. This covers a much smaller area than PCA's timbershed. Proximity to the Huron National Forest southwest of Alpena is a locational advantage and a major source for pulpwood.

Champion International at Gaylord, though it produces particle board, competes with the other woodpulp mills in the Lower Peninsula for pulpwood. It buys over a large market area and is mid-way between Abitibi and PCA so it undoubtly competes with both for timber. Nearness to major pulp producing counties such as Clare, Crawford, Oscoda, Roscommon and Montmorency provide a good source of timber. With one-quarter of the plant using chips it can be less selective in tree species selection.

S. D. Warren at Muskegon makes very large use, almost 90% of red oak which in 1970 was slightly more expensive than aspen when sold in state forests. Red oak was also considerably more expensive in the Huron-Manistee National Forest, $2.44 per cord as compared to 95¢ per cord for aspen. S. D. Warren is one of the smaller woodpulp plants along with Menasha Corporation. It nevertheless has to have a fairly large buying area for pulpwood due to the specificity of species and distance to large pulpwood producing counties. True, it is close to

the Manistee National Forest, but it is doubtful that it would be able to procure a large amount of oak from Manistee County because of PCA's presence. Possible areas for buying of large amounts of oak include Lake, Iosco and Crawford counties. S. D. Warren's timbershed area would seem to be moving in a northeast direction overlapping PCA, Menasha and Champion International at times.

Lastly, Menasha Corporation in Otsego produces corrugated medium as does PCA. However, due to its high use of recycled corrugated board (30% of total wood requirements) and 35% of hardwood chips only 35% of the stumpage is in the form of dense poplars. Possibly, Mecosta would be one county where Menasha would buy a lot of pulpwood and it does have a chipper at Paris, Michigan. But its basic timbershed region lies north by northeast. Since it buys mostly dense poplars and dense hardwoods it may buy in counties PCA and S. D. Warren use, but not necessarily competing heavily at all. It may compete with Champion International for dense hardwood to be chipped.

The Upper Peninsula has four woodpulp mills. As a timbershed, it is usually broken into two major areas, east and west. There were twenty-four woodpulp plants in Wisconsin in 1974 with about twice the overall woodpulp capacity as Michigan and about one-quarter of the Michigan pulpwood production (see appendix 4). Many of the twenty-four Wisconsin mills are on the northeast and northcentral portion of Wisconsin. However, the following tables show:

- almost one-third of the Michigan pulpwood goes to Wisconsin (see table 15).
-in 1974 the western Upper Peninsula had 60% of the total cut in the

Upper Peninsula and 63% of the Upper Peninsula to Wisconsin (see table 16).

- in 1969, all the Upper Peninsula counties furnished pulpwood for ten or more plants except Keweenaw. It was led by Menominee and Delta which recorded seventeen and eighteen plants respectively buying pulpwood in these counties. Obviously, a lot of Wisconsin woodpulp mills were buying pulp in Upper Peninsula counties (see table 17).

In Escanaba, Mead operates the largest mill in Michigan producing 750 tons per day, and while using a lot of aspen it also uses hard maple, hemlock, red pine and other hardwood residues. This plant controls 370,000 acres of forest,[1] owning 138,000 in the Upper Peninsula.[2] While buying all over the Upper Peninsula, its close proximity to the Hiawatha National Forest in Delta and Menominee, two of the largest pulpwood producing counties, and to Dickinson and Marquette counties which are also large pulpwood producing counties, would seem to indicate that it would favor procurement in the eastern Upper Peninsula close to its mill. Also, these counties have high production levels for the Upper Peninsula of aspen, balsam fir and spruce which is used by Mead.

The Manistique Pulp and Paper Company has the smallest mill in Michigan and uses an assortment of aspen, spruce, pine and balsam fir. It is half the size of the next largest mill in Michigan and one-ninth the size of the largest woodpulp mill in Michigan--Mead Company. It borders the Hiawatha National Forest on the west in Delta County and the east in Chippewa and Mackinac County. While it mostly buys pulpwood

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[1] Mead Annual Report, 1973, p. 7.

[2] Ibid, p. 15.

TABLE 15

MICHIGAN PULPWOOD PRODUCTION BY ORIGIN AND DESTINATION, 1970-1974 (THOUSANDS OF STANDARD CORDS)

Year	Total Cut	Destination of Pulpwood		Other
		Wisconsin	Michigan	
1970	1406	610	785	11
1971	1267	567	688	12
1972	1401	470	917	14
1973	1585	418	1131	36
1974	1843	534	1290	19
5-Year Average	1500	520	962	18

SOURCE: James B. Blyth and Jerold T. Hahn, Pulpwood Production in the North Central Region by County, 1974.

TABLE 16

MICHIGAN PULPWOOD PRODUCTION BY FOREST SURVEY UNIT AND DESTINATION BY STATE, 1974 (HUNDRED STANDARD CORDS, ROUGHWOOD BASIS)

Unit	Total Cut	Destination of Pulpwood		Other
		Wisconsin	Michigan	
Eastern Upper Peninsula	4666	1941	2725	0
Western Upper Peninsula	6917	3270	3534	113
Northern Upper Peninsula	6141	131	5966	44
Southern Lower Peninsula	700	0	672	28
TOTAL	18,424	5342	12,897	185

SOURCE: James B. Blyth and Jerold T. Hahn, Pulpwood Production in the North Central Region by County, 1974.

TABLE 17

NUMBER OF PLANTS RECEIVING PULPWOOD FROM UPPER MICHIGAN COUNTIES, 1969

County	Number of Plants
Alger	10
Baraga	13
Chippewa	13
Delta	18
Dickinson	14
Gogebic	14
Houghton	14
Iron	14
Keweenaw	3
Luce	15
Mackinac	11
Marquette	13
Menominee	17
Ontonogan	14
Schoolcraft	12

SOURCE: Michigan Department of Natural Resources, Directory of Primary Woodusing Plants in Michigan, 1970 and 1974.

throughout the eastern Upper Peninsula, it probably buys heavily in the strong pulp producing areas such as Delta, Schoolcraft and Luce.

Celotex in L'Anse and Hoerner Waldorf in Houghton are the two Michigan woodpulp mills in the western Upper Peninsula. Celotex produces insulation board and uses aspen as its major source of timber. With a 24 hour mill capacity of 270 tons per 24 hours (1974) it is one of the smaller Michigan integrated woodpulp mills. Its size and proximity to Baraga and Houghton counties would make additional purchases of pulpwood elsewhere unlikely.

Finally, Hoerner-Waldorf with a 24 hour capacity of 220 tons (1974) is one of the smaller integrated mills in Michigan. In producing paper it mostly uses aspen, chips, hard and soft maple. Hoerner-Waldorf's timbershed seems to lie in the western Upper Peninsula with emphasis on near counties such as Ontonogon and Gogebic with additional possibility of Houghton County. Close proximity to the Ottawa National Forest in Gogebic and Ontonogon County is a definite locational advantage. Mill expansion was planned to 565 tons[1] which may change Hoerner-Waldorf's timbershed area in volume and size.

Michigan Stumpage Prices and Pulpwood Volumes as an Indicator of PCA's Relative Locational Advantage Among Michigan Integrated Pulp Mills

Michigan stumpage prices and volumes within Michigan for pulpwood must be interpreted within certain definite guidelines:

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[1]See the U.S. Forest Service Handbook of Timber Appraisal and the Michigan Department of Natural Resources (Division of Forestry) Michigan State Forest Volumes and Stumpage Prices by Districts which are excellent sources for making yearly comparisons by geographic area for stumpage prices. They are in various log scales so conversion factors must be used.

- stumpage prices for pulpwood in Michigan, depending on tree species, can be higher or lower in the Upper Peninsula or Northern Michigan depending on the year.[1]

- from 1960-1975 Michigan pulpwood production has been higher in the Upper Peninsula than in the northern Lower Peninsula (see appendix 7).

- the future cut of aspen, the largest single tree species used in Michigan, is likely to fall by 1995 in the western Upper Peninsula and also by 1995 in the eastern Upper Peninsula and northern Lower Peninsula (see appendix 8).

The implications of these timber trends in Michigan need close inspection of stumpage prices over a reasonably long period of time in order to determine the advantages or disadvantages of the Upper Peninsula versus the northern Lower Peninsula (where PCA is operating). Secondly, while pulpwood production in the last 15 years has shown a definite trend toward greater production in the Upper Peninsula, almost half that production is exported to Wisconsin. Currently, the total pulpwood production from Michigan mills is running close to 50% from the Upper Peninsula, 50% from the northern Lower Peninsula, though this may easily change. But the northern Lower Peninsula is an important source of pulpwood and the second and third largest mills depend on the area to support their mills. Finally, in 20 years PCA, as well as other plants in Michigan, will need to find alternatives to aspen or costs will rise and future plant expansions will be aborted. (See appendix 8 for a fuller description of this trend and the implications for grouse

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[1] Hoerner-Waldorf Annual Report, 1973, p. 3.

and deer management.)

In order to fully assess locational advantages of PCA regardless of the model used or data source (primary or secondary data sources) certain additional factors must be considered. (Note the subsequent discussion of secondary data sources assumes use of the same basic information referred to in appendix 6 and 7). Stumpage prices and volumes must be looked at over a long period of time before some assessment of the future can be made. Secondly, transportation costs must be reflected fully and are the key to assessing relative locational advantages of integrated pulp mills. This approach poses no problem with a questionnaire or primary data as long as the disclosure problem is not violated. But secondary data sources, while providing accurate information, must be supplemented and/or reassembled to reflect a finer locational assessment of stumpage prices. For example, Michigan State forest prices are reported on a regional basis and the U.S. Forest Service efforts are recorded by forests. But information must often be broken down further by state forests or federal forests. as they overlap county or transportation zones delineated by the study. Similar efforts to obtain pulpwood production may mean giving county data a finer locational dimension.

With these qualifications let us take a glance at only 1970 pulpwood volumes and prices (as a benchmark) and make some tenative generalizations. The Upper Peninsula county production levels are much higher (table 18), but since they face competition from Wisconsin mills a lot of wood is exported. The largest woodpulp mills are PCA and Mead by an appreciable margin. Since the Upper Peninsula

TABLE 18

1970 MICHIGAN PULPWOOD PRODUCTION FOR COUNTIES WITH AN INTEGRATED PULP MILL OR PARTICLEBOARD PLANT BY SELECTED SPECIES STANDARD CORDS (ROUGH) ROUNDWOOD ONLY

County/Company	Selected Species					Total Pulpwood Production
	Aspen	Balsam Fir	Hemlock	Pine	Other Hardwood	
Baraga (Celotex)	23,909	849	16,301	6,645	4,225	53,757
Otsego (Champion International)	183	16	-	1,538	312	2,726
Allegan (Menasha Corporation)	11	-	-	12	11	171
Muskegon (S.D. Warren)	104	-	-	2,950	348	3,402
Schoolcraft (Manistique Pulp & Paper)	9,731	5,224	4,751	9,263	1,661	33,951
Manistee (PCA)	10,420	-	107	1,192	6,062	31,330
Alpena (Abitibi)	8,803	55	-	687	2,206	14,633
Delta (Mead Corporation)	31,355	17,954	3,856	10,472	3,812	79,274
Ontonagon (Hoerner-Waldorf)	14,618	557	5,114	318	1,169	22,139

SOURCE: Michigan Department of Natural Resources, Michigan Pulpwood Production, 1970.

represents another timbershed we really need not dwell on it. Of course, firms expand, contract and new plants are built based on relative profitability, but in this study we are mainly interested in existing plants since any change in output will most likely be made there because of high current costs of new plant construction.

It is beyond the scope of this study to gather profitability information and therefore we are focusing on plants and their relative locational advantages. In this case we are looking at the access to wood.

The Upper Peninsula has more growth potential and in recent years it has started to produce more but it faces heavy competition from Wisconsin mills and exports considerable amounts of pulpwood. The new Upper Peninsula production is about that or slightly more than the Lower Peninsula production. On the other hand several generalizations can be made about the northern Lower Peninsula. The smaller mills (see table 20) (Menasha Corporation in Allegan County and S.D. Warren in Muskegon County) are located in small pulpwood producing counties (see tables 18 and 19), farther from the larger pulpwood counties than any other mills and both use moderate quantities of aspen. Menasha Corporation relies heavily on hardwood residues and red oak, while S.D. Warren relies mostly on jack and red pine.

Therefore, both mills compete with PCA, Abitibi and Champion in only selected tree species and their smaller volumes pose competitive threats only in selected parts of the northern Lower Peninsula timbershed.

Essentially, PCA and Abitibi are the dominant firms in the

TABLE 19

RANKINGS FOR ASPEN AND PINE TOTAL PULPWOOD PRODUCTION FOR MICHIGAN COUNTIES WITH AN INTEGRATED PULP MILL OR A PARTICLEBOARD PLANT, 1970

County	Aspen	Pine	Total Production
Baraga	2	3	2
Otsego	7	5	8
Allegan	9	9	9
Muskegon	8	4	7
Schoolcraft	5	2	3
Manistee	4	6	4
Alpena	6	7	6
Delta	1	1	1
Ontonagon	3	8	5

Note: Rankings are listed from 1, the highest, to 9 which is the lowest.

SOURCE: Michigan Department of Natural Resources, Michigan Pulpwood Production, 1970.

TABLE 20

RELATIVE CAPACITY OF PULP MILLS IN MICHIGAN IN 1974*

County	Company	Relative Ranking**
Baraga	Celotex Corporation	4
Otsego	Champion International***	
Allegan	Menasha Corporation	5
Muskegon	S.D. Warren Company	6
Schoolcraft	Manistique Pulp & Paper Company	8
Manistee	PCA	2
Alpena	Abitibi Corporation	3
Delta	Escanaba Pulp & Paper-Mead Company	1
Ontonogan	Hoerner-Waldorf Corporation	7

SOURCE: Lockwood's Directory, 1974.

*Rankings are listed from 1, the highest, to 8, the lowest.

**Mill capacity in tons per 24 hours.

***Particleboard Plant.

northern Lower Peninsula. PCA does not own large tracts of land and the larger timber producing counties are in the central and eastern portion of the northern Lower Peninsula. Nevertheless, it can control counties close by such as Manistee and probably large parts of Lake and Mason counties though it may face some competition from S. D. Warren in these counties. As a general rule, we would expect PCA to undercut or buy less close to its plant site to keep prices down and have a reserve. Further from the mill it meets competition by discriminating in price in areas where its timbershed overlaps with other firms. The total production for close-by timber producing counties of high volumes is shown in table 21. Hence, PCA has close access to 16% of the northern Lower Peninsula's aspen and 22% of its total pulpwood production.

TABLE 21

PCA'S NEIGHBORING COUNTIES, ASPEN AND TOTAL PULPWOOD PRODUCTION IN 1970 STANDARD CORDS (ROUGH) ROUNDWOOD ONLY

County	Aspen	Total Pulpwood Production
Manistee	10,420	31,330
Mason	7,047	21,455
Lake	12,638	48,445
Wexford	15,556	33,667
TOTAL	45,661	134,897

SOURCE: Michigan Department of Natural Resources, Michigan Pulpwood Production, 1970.

The Champion International mill in Gaylord (Otsego County) is located slightly north of and mid-way between PCA and Abitibi. While a quarter of the wood is chipped, it competes with PCA and Abitibi for aspen and jack pine roundwood in a number of counties in the central Lower Peninsula. Though Otsego County is not a large producer of pulpwood it is located close to a number of high production counties (see table 22). Champion International is located closer to a larger percentage of aspen and total volume of pulpwood than PCA since it is within close range of 24% of the total aspen production and 29% of total pulpwood production in the northern Lower Peninsula. Compared to Abitibi, Champion has less access to aspen but the same percentage for total pulpwood production. Nevertheless, Champion International has two serious disadvantages: it is competing for similar types of wood with the two largest woodpulp mills located on either side of the northern Lower Peninsula; it is without a large pulpwood producing county in its immediate proximity. PCA's home county has a substantial amount of production but Abitibi home county production (Alpena) has less than half its volume though its production is seven times that of Otsego County (site of Champion International).

Abitibi, in Alpena County, is the second largest mill in the northern Lower Peninsula and has a lower relative ranking in aspen, pine and total pulpwood production than PCA in its home county (see table 19). It also is a larger buyer of aspen and has the highest total pulpwood production from counties in close proximity to the mill (see table 23).

Abitibi seems to have the best overall access to timber with better proximity to aspen and equal proximity to the total volume of pulpwood

TABLE 22

CHAMPION INTERNATIONAL'S NEIGHBORING COUNTIES' ASPEN AND TOTAL PULPWOOD PRODUCTION IN 1970 STANDARD CORD (ROUGH) ROUNDWOOD ONLY

County	Aspen	Total Pulpwood Production
Otsego	183	2,726
Cheboygan	8,204	14,148
Presque Isle	11,996	20,750
Montmorency	17,400	30,982
Oscoda	19,809	59,215
Crawford	4,724	30,387
Kalkaska	5,660	12,578
Antrim	862	1,334
TOTAL	68,838	172,120

SOURCE: Michigan Department of Natural Resources, Michigan Pulpwood Production, 1970.

TABLE 23

ABITIBI'S NEIGHBORING COUNTIES' ASPEN AND TOTAL PULPWOOD PRODUCTION IN 1970 STANDARD CORDS (ROUGH) ROUNDWOOD ONLY

County	Aspen	Total Pulpwood Production
Alpena	8,803	14,633
Presque Isle	11,996	20,750
Montmorency	17,400	30,982
Oscoda	19,809	59,215
Alcona	31,106	47,247
TOTAL	89,114	172,827

SOURCE: Michigan Department of Natural Resources, Michigan Pulpwood Production, 1970.

within adjacent counties compared to the total northern Lower Peninsula pulpwood production. Some disadvantages for Abitibi include: it controls a smaller supply of aspen and pulpwood in its home county than PCA; and, it is a smaller firm than PCA and size may provide advantages in buying pulpwood which are needed in the areas of competition between woodpulp firms. Some evidence of this is that PCA is able to enter into a fair number of long-term wood procurement contracts according to state forest officials.

This analysis was only for one year and could contain the following additional considerations for a more complete analysis of Michigan's timbersheds for integrated woodpulp mills: pulpwood production and prices within certain specified distances from the mills; data from a longer time span than one year; and, additional data on other tree species. Further analysis along these lines could provide greater depth to the question though not necessarily providing any different conclusions regarding locational advantages and disadvantages of woodpulp mills in Michigan.

In conclusion, PCA has a strong relative position in its proximity to pulpwood in neighboring counties though not as strong perhaps as Abitibi in Alpena. It does, however, reside in a strong pulpwood producing county which it can treat as its own reserve and can compete vigorously in overlapping supply areas with all other woodpulp mills in the Lower Peninsula because of its relative size.

Water Requirements for Integrated Pulp Mills and Pollution Impacts

Water requirements for pulp are quite high and this is a severe limiting factor in expanding industrial capacity. (See appendix 9 for an estimate of water requirements for different type of pulp mills.) A more recent and detailed estimate is included in table 24. Since PCA uses a semi-chemical process, its water requirements per ton will be lower than other pulping processes except the groundwood process as illustrated in table 25. Of course, having the second highest production volume of 700 tons means that it has very high water requirements and this is discussed in Chapter IV more at length but the total amount of water needed would be higher if the requirements per ton for the semi-chemical process were not so low.

Table 25 shows the total water available in each county in Michigan where a woodpulp mill is situated. In addition, almost all are located close to one of the Great Lakes. There is not tremendous variation in water availability among the counties except for Schoolcraft County which leads by quite a margin. This is where the smallest woodpulp mill, the Manistique Pulp and Paper Company is located. PCA is located in a county which has slightly below average water availability but the plant lies on Lake Manistee and is fed by the Little Manistee River, both of which are among the larger bodies of water within the county. Sufficient water is available for plant expansion of one-third of its capacity according to informal discussions with Department of Natural Resources officials in the Division of Forestry and PCA plant officials.

Many of the rivers capable of sustaining woodpulp operations in

TABLE 24

WATER REQUIREMENTS FOR SELECTED PULPING PROCESSES

Process	Gallons Fresh Water Per Ton of Pulp	
	Maximum	Minimum
Kraft and soda (unbleached)	88,500	33,000
Kraft and soda (bleached)	144,500	39,500
Sulfite (unbleached)	79,000	8,300
Sulfite (bleached)	126,300	8,300
Groundwood (unbleached)	69,000	1,000
Groundwood (bleached)	92,400	1,000
Semi-chemical (unbleached)	12,400	6,980
Semi-chemical (bleached)	30,000	12,960

*Figures are for integrated pulp mills with paper.

SOURCE: U.S. Department of Commerce, Technical and Economic Feasibility of Establishing a Hardwood Pulp and Paper Mill in an Eight-County Area of Western Kentucky.

TABLE 25

AREAS OF WATER FOR MICHIGAN COUNTIES WITH A PULP MILL

Firm	County	Inland Bodies of Water		Bodies of Water Over 200 Acres	Miles of Streams
		Total Number	Total Acreage		
Celotex	Baraga	1,147	10,152	9	696
Escanaba Pulp & Paper	Delta	561	5,977	2	514
Hoerner-Waldorf	Ontonagon	645	10,994	4	1,282
Abitibi Corporation	Alpena	67	13,373	8	301
Menasha Corporation	Allegan	569	8,522	11	517
S.D. Warren	Muskegon	262	11,453	7	394
Manistique Pulp & Paper	Schoolcraft	1,095	28,801	18	734
PCA	Manistee	301	8,248	6	276

SOURCE: Michigan State University, County and Regional Facts, 1972.

Michigan are being used and if further use of one of the Great Lakes were made the plant would have to meet very stringent federal regulations. Michigan does have a lot of water available and a tolerance for some unavoidable water pollution. With federal regulations being imposed and eventually enforced uniformly, Michigan is not at any real disadvantage for a new plant expansion or expansion of an existing plant.

Pollution control for integrated woodpulp mills requires large volumes of water for the purification process which can be quite costly. The basic pollutants of woodpulp mill water are suspended solids such as bark and fiber and solubles entering the material and production process.

> Suspended matter deposits on the bottom of receiveing streams which discolor the water and during decomposition can place a great demand upon the oxygen content of the water. The solubles also deplete dissolved oxygen and stimulate the growth of slime organism. Purification processes such as screening, settling, and floatation are effective in preventing suspended materials from entering streams, but the solubles require either reaeration or activated-sludge treatment which are more costly.[1]

The regional water quality supervisor for Michigan in 1969, Mr. Thomas L. Kamppinen, stated that "abatement of pollution in the interstate waters of Michigan is to be accomplished by June 1, 1972."[2] He lists the Menominee River as having pollution problems attributable to the paper companies. Also the Kalamazoo River biochemical oxygen demand (BOD) loadings are another of Michigan's problem areas. Only one

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[1]Battelle Memorial Institute, Industries Suited for the Upper Great Lakes Region, pp. 5-12.

[2]Alfred J. Tassel, Environmental Side Effects of Rising Industrial Output, p. 33.

Michigan woodpulp plant is in the Kalamazoo Basin, the Menasha Corporation. Certainly PCA's pollution control efforts have been extensive and costly and they are described at more length in Chapter IV.

Table 26 and appendix 9 can be used in calculating comparative waste discharges for wastewater, BOD and suspended solids in woodpulp mills. Using table 25 or part of appendix 9 as a guide (with the 1974 capacities of Michigan mills except PCA where 700 tons per 24 hours is used) multiplying discharges times appropriate mill volume yields the levels of discharge. Similarly, table 27 can be used to calculate estimated pollution abatement costs given type of mill and mill volume. PCA has had a primary treatment plant since 1957 and has completed a new $4.5 million secondary treatment plant putting it in a relatively good position for controlling pollution. The purpose of the facility is to remove biochemical oxygen demanding materials (such as wood sugars and lignin upon which bacteria feed) from the wastewater generated in the production of corrugating medium. The Filer mill secondary treatment plant along with a nutrient addition system and collecting and pumping facilities adjacent to the mill are financed under Michigan Industrial Development Revenue Bond Act. Revenue bonds to cover the cost of the treatment facilities were issued by Manistee County. PCA will repay the bonds from lease rental fees. The principal and interest on the bonds are not a general obligation of the county and are not payable from any tax revenues or other general funds of the county. Most existing Michigan woodpulp mills are making substantial investments in pollution control in order to comply with Federal Water Pollution Standards.

TABLE 26

COMPARATIVE WASTE DISCHARGE

Process	Unit of Input or Output	Waste Water (gals. per unit)	BOD (parts per million)	Suspended Solids (parts per million)
Groundwood pulp	1 ton dry pulp	12,000	645	---
Soda pulp	1 ton dry pulp	58,000	110	1,720
Sulfate (kraft) pulp	1 ton dry pulp	64,000	123	---
Sulfite pulp	1 ton dry pulp	48,000	443	---
Paper mill	1 ton paper	40,000	19	452
Paperboard	1 ton paperboard	14,000	121	660

SOURCE: E.A. Ackerman and G.O.G. Lof, Technology in American Water Development.

TABLE 27

ANTICIPATED POLLUTION ABATEMENT COSTS

Product	Operating Costs ($/Ton)			Capital Costs ($000/Daily Capacity Ton)		
	Water	Air	Total	Water	Air	Total
News & uncoated groundwood	13.20	1.00	14.20	23	3	26
Printing & writing	10.50	1.00	11.50	16	1	17
Tissue	12.20	1.00	13.20	18	1	19
Unbleached industrial & converting	8.30	2.50	10.80	20	1	21
Unbleached kraft board	6.50	2.50	9.00	13	3	16
Semi-chemical medium						
with cross recovery	3.80	2.00	5.80	13	2	15
without recovery	11.50	2.00	13.50	20	2	22
Bleached packaging & board	9.70	2.50	12.20	22	3	25
Combination board	6.20	1.00	7.20	10	1	11
Construction paper	5.90	1.00	6.90	9	1	10
Insulation board	7.10	1.00	8.10	9	1	10
Hardboard	8.70	1.00	9.70	8	1	9
Bleached kraft pulp	7.70	2.50	10.20	16	2	18
Bleached sulfite pulp	8.17	2.00	10.19	8-43	2	10-45
Groundwood pulp	2.90	1.00	3.90	4	-	4
De-inked waste paper	13.80	1.00	14.80	20	-	20

SOURCE: Council on Environmental Quality, Department of Commerce, and Environmental Protection Agency, The Economic Impact of Pollution Control.

[1]All estimates based on minimum sized mills with 1971 dollars.

[2]Water costs are based on extended aeration.

[3]Not integrated to pulping.

[4]Assumes the paper industry will remove 95% of the suspended solids through primary treatment systems and reduce BOD by 90% through secondary systems.

Table 28 shows the anticipated impact of pollution control equipment on prices for the U.S. All woodpulp plants in Michigan can be assumed efficient. PCA, which produces semichemical medium, would (if these national guidelines are used) then register a 5.5% price increase in 1972-76. Similar calculations could be made for other woodpulp mills in Michigan.

Marketing Advantages and Disadvantages of PCA Compared to Other Woodpulp Mills in Michigan

It is often quite difficult to estimate distances to markets from plants for a variety of reasons but mainly because individual plants or firms may not disclose information about the exact markets they serve. Also reciprocal trade agreements exist probably because of freight rates which vary over space. Therefore, companies may not actually sell their goods in the markets they hope to serve.

Nevertheless, access to markets is a very important locational advantage and some general calculations were made. Table 29 shows that the northern Lower Peninsula and the Upper Peninsula are different subregions and though the Upper Peninsula distances to the markets are higher its results might best be interpreted separately. As a general rule, woodpulp mills locate close to raw materials and paper mills closer to markets, given equal transportation rates. However, all mills are integrated though producing a different variety of paper and allied products. PCA, a large producer of coarse paper, is in a relatively good market location in the northern Lower Peninsula ranking only slightly behind Menasha Corporation and S. D. Warren which produce fine quality paper and are very market oriented.

TABLE 28

ANTICIPATED POLLUTION ABATEMENT COST IMPACT ON PRICES 1972-76

Key Grades	Approximate Current Average Price ($/ton)	Estimated Abatement Cost for Efficient Mills ($/ton)	Percent Increase Over Current Price
Unbleached kraft liner	120	8.50	7.0
Bleached paperboard	210	12.00	6.0
Semi-chemical medium	104	5.50	5.5
Combination board	110	5.50	5.0
Unbleached bag and wrapping	160	8.50	5.5
Bleached packaging paper	200	11.00	5.5
Newsprint	160	12.50	8.5
Uncoated groundwood	180	12.50	7.0
Coated publication	220	8.50	4.0
Tissue paper (converted)	400	8.50	2.0
Special industrial paper	600	9.50	1.5
Construction paper (shingles)	65	1.00	1.5
Insulation board	135	6.00	4.5
Hardboard	80	7.50	10.0
Bleached kraft pulp hardwood	120	10.00	8.5
Bleached kraft pulp softwood	140	10.00	7.0
Dissolving pulp	220	7.05	3.5

SOURCE: Council on Environmental Quality, Department of Commerce and Environmental Protection Agency, The Economic Impact of Pollution Control.

TABLE 29

DISTANCES TO MAJOR MARKETS FOR MICHIGAN PULP MILLS

Firm	Location	Markets[1]	Total Mileage	Relative[2] Ranking
Lower Peninsula				
Abitibi Corporation	Alpena	Detroit & Chicago	647	5
Champion International	Gaylord	Detroit & Chicago	569	4
S.D. Warren Company	Muskegon	Detroit & Chicago	365	2
Packaging Corporation of America	Manistee	Detroit & Chicago	401	3
Menasha Corporation	Otsego	Detroit & Chicago	288	1
Upper Peninsula				
Hoerner-Waldorf Corporation	Ontonagon	Chicago & St. Paul	826	3
Manistique Pulp & Paper Company[3]	Manistique	Chicago & St. Paul	844[4]	4
Mead Corporation	Escanaba	Chicago & St. Paul	690	1
Celotex Corporation	L'Anse	Chicago & St. Paul	714	2

SOURCE: Wisconsin and Michigan State Highway Maps.

[1]Location of wholesale markets.
[2]Upper Peninsula and northern Lower Peninsula ranked separately but all Upper Peninsula is higher. Highest ranking 1 to lowest 5.
[3]It only sells to the Chicago market.
[4]It is only 406 miles to Chicago.

Finally, distances to two major market in the Upper Peninsula are fairly close. The exception is the Manistique Pulp and Paper Company which now only sells in one market, Chicago, and would of course have lower total mileage figures.

In the summary, PCA holds a good relative position in the northern Lower Peninsula for access to major markets. It exercises reciprocal trade agreements with other companies in the Midwest so while it may be serving a designated market area, it may not actually deliver to it. Reciprocal selling usually indicates an oligopolistic market structure where members of the industry compete through nonprice rivalry rather than price competition.

Tables 30 and 31 list marketing considerations for integrated woodpulp mills in Michigan. All mills are well related to their product lines and very often part of a larger diversified company. Many are subsidiaries of larger companies (such as PCA which is a part of Tenneco). As for PCA, it is in an enviable position from a marketing standpoint since its corrugated plant in Filer City is part of a large corrugated box production effort.

PCA appears to hold a strong overall position in type of production process, access to pulpwood, access to markets and marketing capability, water availability and water pollution efforts. It is by no means a marginal company and the prospects for future viability, largely related to the market for corrugated medium which is expected to be good, seem to be very promising.

TABLE 30

MICHIGAN PULP MILLS, PRODUCT PRODUCED AND STANDARD INDUSTRIAL CLASSIFICATION NUMBER FOR 1970

Firm	Product	SIC No.
Abitibi Corporation	Insulation board and hardboard	2661
Champion International	Particleboard	2661
S.D. Warren* (Scott Paper Company)	Coated printing paper (fine papers)	2641
PCA	Paperboard (corrugated medium)	2631
Menasha Corporation	Paperboard (corrugated medium)	2631
Hoerner-Waldorf	Paper - makes a variety of carton stocks, corrugated medium, kraft liner board and other paper products	2621
Manistique Pulp & Paper Company	Paper (newsprint and other specialty papers)	2621
Mead Company	Paper (bleached kraft pulp printing paper)	2621
Celotex (Jim Walter Corporation)	Insulation board	2661

SOURCE: Michigan Department of Natural Resources, Directory of Primary Woodusing Plants, 1970 and 1974.

*Produces bleached kraft pulp.

TABLE 31

MARKETING CONSIDERATIONS FOR MICHIGAN PULP MILLS FOR 1970

Firm	Marketing Factors
Abitibi Corporation	Requires distribution channels to the construction industry. Market dominated by five companies in hardboard.
Champion International	Requires distribution channels to construction, cabinet and furniture industries.
S.D. Warren (Scott Paper Company)	Ideally should be integrated into a firm producing book and fine papers, publication paper, sanitary tissue or footboard.
Packaging Corporation of America	Firms should be integrated to corrugated box production.
Menasha Corporation	Firm should be integrated to corrugated box production.
Hoerner-Waldorf	
Manistique Pulp and Paper Company	Supply reliability and quality image with newspaper publishers.
Mead Company	Strong price-performance, competition in selling to key magazine and catalog publishers.
Celotex (Jim Walter Corporation)	Requires distribution channels to construction industry.

SOURCE: Arthur D. Little, Overview of Pulp and Paper Exapnsion Possibilities in the Upper Great Lakes Region.

TABLE 32

COMMENTS ON INTEGRATED MICHIGAN PULP MILLS FOR 1970

Firm	Comments
Abitibi Corporation	Abitibi is one of the five major hardboard companies and it has distribution channels to the construction industry through the Abitibi Corporation Building Products Division and the Abitibi Building Products Division.
Champion International	Champion International has distribution channels to the construction industry through its subsidiary of U.S. Plywood and Weldwood of Canada and to the furniture industry through Drexel Heritage.
S.D. Warren	Scott Paper Company has divisions which make sanitary tissue and book and fine paper through its division, S.D. Warren.
PCA	PCA is integrated into Tenneco which produces chemicals and natural gas. PCA makes corrugated containers, folding cartons, molded pulp as well as paper. It merged with Tenneco in 1965. It has a plant in Grand Rapids which makes high grade box boards.
Menasha Corporation	Menasha has corrugated container divisions with seven plants, one of which is at Colorna, Michigan.
Hoerner-Waldorf	Hoerner-Waldorf is involved in a variety of paper-making activities which makes it difficult to assess major marketing factors. It also has a large container division and several consumer packaging and bag plants.
Manistique Pulp and Paper Company	Since 1959 the Manistique Pulp and Paper Company has been a subsidiary of Field Enterprises of Chicago, Illinois. Field Enterprises publishes The Chicago Sun-Times, The Chicago Daily News and World Book Encyclopedia.

TABLE 32--Continued.

Firm	Comments
Mead Company	The backbone of Mead's merchant business is in printing papers such as bond, writing and carbonless papers for business forms and copy/duplicator markets, coated and uncoated book papers for offset printing (catalogs, etc.).
Celotex (Jim Walter Corporation)	The parent company, Jim Walter Corporation is a major home builder through its division of Jim Walter Homes and Mid-States Homes. It also produces building supplies through its Dixie Building Supplies and its array of companies in its wood products group.

SOURCE: Annual Reports for Scott Paper, Tenneco, Abitibi Corporation, Champion International, Menasha Corporation, Hoerner-Waldorf, Field Enterprises, Mead Company, and Jim Walter Corporation, 1974.

CHAPTER III

SOCIO-ECONOMIC DESCRIPTION OF MANISTEE COUNTY

Location

In the northwest portion of Michigan's Lower Peninsula lies Manistee County. It borders on Lake Michigan and is almost square in shape. Directly north of Manistee County is Benzie County, east lies Wexford County and to the south is Muskegon County. "Within the boundaries of Manistee County are 357,120 acres or 558 square miles."[1] The county lies within the Michigan Planning and Development Region 9 which includes the ten northwest Lower Peninsula counties of Antrim, Benzie, Charlevois, Emmet, Grand Traverse, Kalkaska, Leelanau, Manistee, Missaukee and Wexford. The regional center is Traverse City though Manistee County lies much closer to the "pull" of Muskegon.

Economic History

Prior to 1850 Manistee County was the frontier. But during the post-Civil War period until about 1915 the logging industry exploited the virgin forests of prime white pine. These were years of great prosperity and today the city of Manistee has a great number of artifacts ranging from timber barons' homes to a sizeable number of churches of many varied denominations. When the high quality white pine

[1]U.S. Bureau of the Census, Census of the Population: 1960, Number of Inhabitants, Michigan, Final Report PC(1)-24A (Washington: U.S. Government Printing Office, 1962), p. 14.

was stripped the economic activity of the county fell. The major timber companies moved to the west coast. The pulpmill in Filer City began in 1917 as a kraft-pulp mill using low grade woods such as aspen, oak and other hardwoods. It has grown into one of the largest corrugating medium production mills. In 1977 all three machines were producing corrugating medium. Other mineral based industries such as chemicals and the production of salt have attempted to rejuvinate the economic base of the county but it has been a slow process.

The growth of a year-round recreational business in the 1940's and farmers turning to the production of specialty crops have further diversified the county's economy. Two developments in the area of recreation loom as possible future benefits for Manistee County. Since the coho salmon were introduced into Lake Michigan in 1965 many sport fishermen will be coming to Manistee County since many good fishing spots include Manistee County. In 1970 Sleeping Bear Dunes National Lakeshore was established 25 miles north of Manistee County in Benzie and Leelanau Counties. Many people that visit this area may visit or stop off in Manistee County. "It has been estimated that three million persons will be drawn annually to Sleeping Bear Dunes National Lakeshore."[1] The exact impact of the two new developments of the economy of Manistee have not been fully analyzed at this time.

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[1]Donald A. Blome, The Proposed Sleeping Bear Dunes National Lakeshore: An Assessment of the Economic Impact (East Lansing: Michigan State University, 1967), p. 42.

Human Resources

Population

Table 33 shows Manistee County with a growth rate of moderate proportions. The City of Manistee is having the opposite trend. Indeed from 1960-1970 Manistee County's population rose 5.5% while the City of Manistee's population fell 7.2%.

TABLE 33

POPULATION IN MANISTEE COUNTY AND THE CITY OF MANISTEE FROM 1940 TO 1970

	POPULATION			
	1940	1950	1960	1970
City of Manistee	8,694	8,642	8,324	7,723
Manistee County	18,450	18,524	19,042	20,094

SOURCES: U.S. Bureau of the Census, U.S. Census of the Population: 1960, General Social and Economic Characteristics, Michigan. U.S. Department of Commerce, Bureau of the Census, United States Census of Population: 1970, Number of Inhabitants.

"For 1970 in Manistee County, 38.4% of the population was classified as urban and 61.6% as rural."[1] "This compares to Michigan and the entire U.S. where the urban-rural breakdown is approximately 75% urban and 25% rural. In 1970 98.8% of the population was white."[2]

[1]U.S. Bureau of the Census, United States Census of Population: 1970, Number of Inhabitants, Michigan, PC(1)-AP4 (Washington: U.S. Government Printing Office, 1970), pp. 19-20.

[2]U.S. Bureau of the Census, United States Census of Population: 1970, General Population Characteristics, Michigan, PC(1)-B24, pp. 178-180.

When looking at total population figures the statistic net migration is often left out. The term means the number of persons moving out of the county exceeding those moving in. "In 1970 for Manistee County there was a net migration of -289 but an excess of births over deaths of 1,341."[1]

Miscellaneous Information

"As expected for a rural area, Manistee County has a lower percentage of males and females in the 20-44 age group and more males and females in the over 65 group than the State of Michigan."[2] This is due to the less than satisfactory job opportunities which cause a negative net migration.

Income and Employment

"Manistee County has a mean family income of $9,121 compared to $12,296 for the State of Michigan (1969). It has 11.8% of its families which lie below the poverty level compared to 7.3% for the state."[3]

Table 34 shows the per capita income in the county increasing over the past few years. In 1959 the per capita income was $1,648 and in 1968 it was $2,956.

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[1]Michigan State University, Michigan Department of Commerce, Executive Office of the Governor, County and Regional Facts (Region 10) (East Lansing, Michigan, 1970), p. 8.

[2]Ibid, p. 10.

[3]Ibid, pp. 35-36.

TABLE 34

PERSONAL INCOME IN MANISTEE COUNTY 1959, 1965, AND 1968

Personal Income	1959	1965	1968
Total (millions of dollars)	31.2	47.3	57.6
Per Capita (dollars)	1,648	2,377	2,956

SOURCE: Michigan State University, Michigan Statistical Abstract, 1970.

From Table 35 Manistee County's percentage of earnings by the industrial sector look very close to the State of Michigan for Government; Manufacturing; Transportation, Communication and Public Utilities; Wholesale and Retail Trade; and, Service. A heavy natural resource based industry in pulp and chemical accounts for the higher than normal (for a rural county) percentage earnings by the manufacturing sector. Farm earnings are higher than the state on a percentage basis but below other rural counties in the same region.

Looking at employment by activity (Table 36), similar conclusions can be made as in income by activity (see previous discussion). The manufacturing sector plays a dominant role by employing 2,842 workers from the 6,945 workers which comprise about 39.4% of the total labor force. Retail trade at 18.2% and professional and related services at 15.3% of the labor force are also important sectors.

The American Box Board Corporation (later PCA) had 303 workers in 1953. PCA has 632 workers in 1962. In 1972 after the conversion of

TABLE 35

TOTAL EARNINGS BY MAJOR SOURCE - 1969.

Item	Michigan	Manistee
Total Earnings ($000)	29,607,631	47,211
Distribution of Total Earnings by Percent		
Farm	1.1	4.3
Government	12.0	14.8
Manufacturing	45.4	43.4
Mining	0.1	0.0
Contract Construction	5.7	4.0
Transportation, Communication and Public Utilities	4.9	5.4
Wholesale and Retail Trade	13.9	14.0
Finance, Insurance and Real Estate	3.2	2.4
Services	12.2	11.3
Other	0.2	0.4

SOURCE: Michigan State University, County and Regional Facts, 1973.

TABLE 36

EMPLOYMENT BY ACTIVITY IN MANISTEE COUNTY - 1970

Item	No.	Total %	Male %
Total Number Employed	6,945	100.0	64.8
Agriculture, Forestry & Fisheries	244	3.5	77.9
Mining	16	.2	68.8
Construction	294	4.2	95.9
Manufacturing:			
Durable Goods	1,105	15.9	85.3
Non-Durable Goods	1,637	23.5	70.5
		39.4	
Utilities	348	4.0	84.5
Trade	1,265	18.2	55.3
Finance, Insurance & Real Estate	199	2.8	50.3
Business & Repair Service	77	1.1	75.3
Personal Services	333	4.7	37.5
Entertainment & Recreation Services	20	0.2	75.0
Professional & Related Services	1,067	15.3	33.8
Public Administration	340	4.8	78.5

SOURCE: Michigan State University, County and Regional Facts, 1973.

the third machine from the production of solid bleached-draft paperboard to the production of more corrugated medium, the employment was down to 467. Table 37 shows the relationship between PCA's woodpulp output and employment. By 1974 employment rose to 489 but potential production was 700 tons per 24 hours. It shows increasing production with fewer workers. See also table 38 which shows the higher levels of unemployment in 1972 of 15.9% in Manistee probably in part due to introduction of a third machine as a labor saving investment.

Table 39's major point is that though production of woodpulp, paper and paperboard have been increasing in Michigan, the rate of growth nationwide is four times the growth rate in Michigan from 1960 to 1971.

Two separate studies indicate that the potential employment effects of pollution abatement might have a significant impact on employment in the woodpulp industry. Firstly, in a joint publication effort by the Council on Environmental Quality, Department of Commerce and the Environmental Protection Agency it was found that "of the 752 pulp and paper mills over 15% of the U.S. production is marginal."[1] Price increases to cover pollution abatement costs will reduce already low profit margins. It was estimated that in the time frame 1972-76 "60-65 mills would be forced to close (nationwide) resulting in a loss of 16,000 jobs by 1976."[2] While a larger number of jobs will be expected by way of plant expansion, many jobs created may not be in communities

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[1]Council on Environmental Quality, Department of Commerce and the Environmental Protection Agency, The Economic Impact of Pollution Control (Washington: U.S. Government Printing Office, 1970) p. 41.

[2]Ibid, p. 41.

TABLE 37

PACKAGING CORPORATION OF AMERICA PRODUCTION
AND EMPLOYMENT - 1953 TO 1973

Manistee Woodpulp Production (mill capacity in tons per 24 hours)		Manistee Woodpulp Employment	
(1) 1953	280	(3) 1953 (Feb.)	303
(1) 1961 (June)	565	(4) 1962	632
(2) 1972	625	(6) 1972	467
(5) 1974	700	(6) 1974	489

SOURCES: (1) United States Pulp Producers Association, Incorporated, Woodpulp Statistics, 1960.

(2) PCA's Headlines, 1972.

(3) Comsumers Power Company, Data on Plant Location at Manistee, Michigan, 1953.

(4) Consumers Power Company, Data on Manistee, Michigan, 1966.

(5) James E. Blyth and Jerold T. Hahn, Pulpwood Production in the North Central Region by County, 1974.

(6) PCA company data transmitted by letter.

TABLE 38

MANISTEE CIVILIAN LABOR FORCE, UNEMPLOYMENT AND
EMPLOYMENT IN MICHIGAN, BY BROAD INDUSTRIAL CATEGORY
AND COUNTY OR AREA: 1969 TO 1972
(AVERAGE OF 12 MONTHLY FIGURES)

Year	Civilian Labor Force	Unemployment	
		Number	Rate
1969	7,400	725	9.8
1970	7,450	925	12.4
1971	7,500	875	11.7
1972	7,725	1,225	15.9

SOURCE: Michigan Department of Commerce, Employment by Selected Industrial Sectors, January 1975.

TABLE 39

PRODUCTION OF WOODPULP, PAPER AND PAPERBOARD IN MICHIGAN AND THE UNITED STATES: 1960-1971

Year	Michigan* (in thousands of short tons)	United States**
1960	515.3	25,315.6
1961	476.8	26,522.8
1962	499.5	27,908.3
1963	548.5	30,121.2
1964	570.1	32,428.9
1965	605.6	33,993.1
1966	590.3	36,640.0
1967	575.9	36,660.0
1968	496.0	39,399.7
1969	588.9	43,416.1
1970	587.3	43,662.6
1971	572.6	43,932.7

SOURCE: Michigan State University, Michigan Statistical Abstract, 1974.

*Greater than 10% increase in 11 years.

**Greater than 42.4% increase in 11 years.

experiencing job loss. Furthermore, many plant closings are expected in rural areas much like Manistee County where they would have a significant community impact. The study concludes that semi-chemical pulp plants (like PCA) have a definite potential for plant shutdowns.

Vertrees concludes in his dissertation that within region II B (this includes an area larger than just Manistee County) there is

> the widespread dispersal of diverse employment effects among the industries. Within this region, however, the relatively small paper and chemical industries would have contributed substantially to the number of jobs lost due to the worst-possible employment effects. Of the 1,330 workers in status list plants with 'E' rated discharges (the highest level of pollution) in region II B, 775 workers or about 58 percent found employment in either a paper mill in Filer City or a salt work in Manistee.[1]

The employment impact of pollution abatement needed to bring PCA into compliance with the new environmental water pollution direct controls would: have a sizeable employment impact in Region II B and Manistee County since it employs 600 of the 775 in a paper mill or a salt works; require substantial investments since it was classified as a major pollutor since it was related "E" in discharges (the highest level of pollution). Since we do not know the individual firms cost/price relationship and hence its profitability (which will ultimately indicate its ability to absorb the pollution abatement costs or pass them on to consumers) we are left only with an assessment of potential employment effects of direct pollution controls which indeed Professor Vertrees recognizes.

Despite the potential for serious employment impacts as a result

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[1]Robert L. Vertrees, The Incidence of Certain Beneficial and Adverse Effects of Public Water Pollution Control Measures Upon Manufacturing in Michigan, Michigan State University Dissertation, p. 182.

of new pollution control regulations, PCA built a new secondary treatment plant for wastewater at a cost of over $4,000,000. This is in addition to the primary treatment plant which has been in existence since 1957. The new facility removes biochemical oxygen demanding materials from wastewater (organic materials such as wood, sugar and lignin upon which bacteria feed). Only a non-marginal firm could absorb this expense and still retain its normal levels of profitability and therefore its work force.

Table 40 shows 30 years of employment data for various industries in the county. As mentioned in other sections, manufacturing and wholesale and retail trade and services show large employment gains while agriculture shows a sharp drop. Paper and allied products show a gain but as we know from table 37 employment levels dropped after 1970 but then increased again when the new machine was installed and employment registered 487 workers in 1974. Incidentally, the Manistee Chamber of Commerce reports that the county is the labor market area.

Sectorial Analysis

Manufacturing

Manistee County has a very diverse economy for Michigan consisting of an active wood products, primary metals, machinery, food processing, apparel and chemical industry. From table 41 it appears that the expansion of output and increased employment has come from existing firms over this time period.

Trade

Retail and wholesale trade has been steadily increasing over the past years. For example, "retail total sales jumped from $18.9 million

TABLE 40

TOTAL EMPLOYMENT IN MANISTEE, MICHIGAN FROM 1940-1970

	1940	1950	1960	1970
Total Employment	5,894	6,362	6,433	7,037
Agriculture, Forestry and Fisheries	1,484	1,106	452	244
Agriculture	1,452	1,070	429	209
Forestry and Fisheries	32	36	23	35
Mining	12	15	16	16
Contract Construction	253	364	436	294
Manufacturing	1,793	2,232	2,420	2,768
Food and Kindred Products	55	68	109	172
Textiles Mill Products	--	3	8	11
Apparel and Other Fabricated Textile Products	359	261	399	223
Printing, Publishing and Allied Industries	48	54	65	73
Chemical and Allied Products	525	614	470	557
Lumber and Furniture	94	178	216	239
Machinery, All	31	137	239	340
Machinery Except Electrical	--	136	227	340
Electrical Machinery	--	1	12	--
Transportation Equipment	94	186	186	169
Motor Vehicles and Motor Vehicle Equipment	3	41	12	61
Transportation Excluding Motor Vehicles	91	145	172	108
Other Manufacturing	587	731	730	985
Paper and Allied Products	--	290	433	609
Petroleum Refining and Related Products	--	2	--	--
Primary Metals Industries	--	145	107	160
Fabricated Metals - Ordnance	--	11	3	51
Miscellaneous Manufacturing	--	283	187	165
Transportation, Community Public Utilities	410	453	454	352

TABLE 40--Continued.

	1940	1950	1960	1970
Transportation	264	247	270	189
Railroad Transportation	107	108	115	75
Motor Freight Transportation and Warehousing	49	50	70	64
Other Transportation Services	108	89	85	50
Communications	26	70	79	61
Electric, Gas and Sanitary Services	120	136	105	102
Wholesale and Retail Trade	825	989	1,148	1,284
Wholesale Trade	75	109	115	94
Retail Trade	750	880	1,033	1,190
Eating and Drinking Places	119	171	189	285
Food, Dairy Stores	187	180	184	207
Other Retail Stores	444	529	660	698
Finance, Insurance and Real Estate	73	91	166	205
Services	882	900	1,156	1,520
Business Services	492	462	416	440
Lodging Places and Personal Services	162	190	139	262
Business and Repair Services	110	126	160	77
Amusements and Recreation Services	34	38	18	20
Private Households	186	110	99	81
Professional Services	390	438	740	1,080
Total Government	162	212	195	353
Public Administration	152	206	195	340
Federal Military	10	8	--	13
Industry Not Reported	83	88	88	489

SOURCE: Michigan Department of Commerce, Employment by Selected Industrial Sectors, January 1975.

TABLE 41

SOME MANUFACTURING DATA FOR 1958, 1963 AND 1967

Year	Manistee County	Michigan
All Employees Annual Average		
1958	1,871	880,014
1963	2,533	961,090
1967	2,700	1,137,600
Total Number of Establishments		
1958	55	13,429
1963	55	14,220
1967	46	14,370
Establishments with 1-19 Employees		
1958	37	N.A.
1963	38	N.A.
1967	N.A.	N.A.
Establishments with 20-99 Employees		
1958	12	2,837
1963	11	3,229
1967	N.A.	N.A.
Establishments with 100 or More Employees		
1958	6	1,153
1963	6	1,308
1967	N.A.	N.A.
Value Added by Manufacturing (million dollars in current terms)		
1958	21.1	8,363.6
1963	36.3	13,090.3
1967	41.9	12,243.7

SOURCE: U.S. Bureau of the Census, 1967 Census of Manufacturing, Michigan, Preliminary Report MC 67 (P)-S23 (Washington: U.S. Department of Commerce, 1970), p. 3.

Note: N.A. - Not available.

in 1958 to $25.0 million in 1967 with food accounting for 30%, 25% for automobiles and 16.4% for general merchandise."[1]

Figures in table 42 show in summary form those establishments in retail and wholesale trading activities. Higher payroll and sales volumes in 1967 were obtained without a large increase in firms and employees than in previous years (that is, 1963).

The data in table 43 shows selected statistics for Manistee County's manufacturing. It shows that with slightly fewer establishments from 1963 to 1967 gains were made in employment, payroll and value added by manufacturing. Employment per establishment increased from 45.45 to 58.70 employees from 1963 to 1967.

Financial Institutions

There are two main banks in Manistee County--Manistee Bank and Trust Company, and Security National Bank. For 1969, "both banks reported total resources of $45,470,000."[2] The Manistee Bank and Trust Company is the larger of the two institutions.

Housing

"The 1970 Census showed Manistee County with 9,346 housing units."[3] In 1960 the total was 8,642. Housing stock built prior to 1940 was 5,921. From 1940-49, 1,189 units were constructed. Then from 1950-59,

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[1]Michigan State University, Michigan Statistical Abstract, 1970, pp. 294-95 and pp. 306-307.

[2]Ibid, p. 374.

[3]Michigan State University, Michigan Department of Commerce and Executive Office of the Governor, op. cit., p. 23.

TABLE 42

SELECTED MANISTEE COUNTY TRADING STATISTICS FOR 1963 AND 1967

Type of Trade	Year	Number of Establish-ments	Sales	Yearly Payroll	(Nov. 15) Number of Paid Employees	Number of Active Proprietors
Retail	1963[a]	220	$23,040,000	$1,942,000	742	281
	1967[b]	231	$25,570,000	$2,414,000	735	216
Wholesale	1963[c]	36	$10,718,000	$ 781,000	275	21
	1967[d]	32	$14,648,000	$ 974,000	168	16

[a]U.S. Bureau of the Census, Census of Business: 1967 Retail Trade: Michigan BC 67-RA 2Y (Washington: U.S. Government Printing Office, 1969), p. 70.

[b]Ibid, p. 12.

[c]U.S. Bureau of the Census, Census of Business: 1967 Wholesale Trade: Michigan BC 67-WA 24 (Washington: U.S. Government Printing Office, 1969), p. 24.

[d]Ibid, p. 9.

1,532 homes were built and from 1960-69 a decline was registered with 704 housing units added. Based on year round housing figures, in 1970 67.6% of all homes were owner-occupied, 15.0% rented, and vacant homes accounted for the other 17.4%. Seasonal and migrational homes accounted for 16.2%

Transportation

A well-developed transportation network services Manistee County. While highways are not the four lane variety, the roads are functional. U.S. 31 is the major north-south route and M-55 is the primary east-west connector. "The Michigan State Highway Department pays for the cost of maintaining the federal and state roads in the county, but Manistee County Road Commission also maintains the other primary and secondary roads."[1]

Air traffic is handled by the Manistee Blacken Airport with North Central Airlines providing passenger and freight service. Figures for commercial trucking are not available on the county level. Railroad service is provided by the C & O Railroad. The line is in the "black" and no rail closings along this connection are foreseen in the near future. Finally, port facilities at Manistee Harbor are available up to large freight vessels with some freight storage space available. "A depth of 25.0 feet is maintained over the entrance bar, with 23.0

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[1]Provisional League of Women Voters at Manistee County, A Citizen's Guide to Manistee County, p. 54.

TABLE 43

MANISTEE MANUFACTURING--1963 AND 1967

Item	Manistee
Number of Establishments	
1963	55
1967	46
Employment	
1963	2,500
1967	2,700
Payroll($000)	
1963	13,200
1967	16,600
Value Added by Manufacturing ($000)	
1963	36,300
1967	41,900
Value of Shipments ($000)[1]	
1967	72,400

SOURCE: Michigan Department of Commerce, Office of Economic Expansion, Economic Profile of Manistee County, November 1971.

[1]Data not recorded in 1963.

feet in the river channel."[1] Navigation dates are from March 30 to December 14. Table 44 shows the period 1958-1967 when freight tonnage grew 46.3%. Most of the traffic is freight, not passenger traffic.

A large part of the incoming freight is coal and lignite which in 1967 accounted for 86% of the tonnage of incoming materials. From outgoing cargo sand, gravel and crushed rock amounted to 77% of the outgoing weight. See table 45 for a more detailed description of 1967 traffic data.

Communication

Michigan Bell (one of the four telephone companies servicing Manistee County) serviced 80.2% of the households in the county in 1970. Local radio is provided by Station WMTE. Finally, there are two newspapers, "The Manistee News-Advocate in Manistee (the largest paper) is a daily paper having a circulation of 5,301."[2]

Energy Availability

PCA makes its own steam and electricity. Natural gas is the main fuel, but bark from the pulpwood debarking system and electricity and heat generated by the pulping chemical recovery system also generate steam. According to Michigan Consolidated Gas Company, the supplier of natural gas to PCA, there is no danger of PCA being cut off or

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[1]U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1967, Part 3: Waterways and Harbors, Great Lakes (Washington: U.S. Government Printing Office), p. 68.

[2]Michigan State University, Michigan Statistical Abstract, op.cit., p. 399.

TABLE 44

STATEMENT OF TRAFFIC AT MANISTEE HARBOR, MICHIGAN

Year	Tons	Passengers
1958	430,601	354
1959	571,569	0
1960	590,522	334
1961	508,736	0
1962	502,637	282
1963	602,896	0
1964	634,022	0
1965	582,928	392
1966	628,795	0
1967	629,976	0

SOURCE: U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1967, Part 3: Waterways and Harbors, Great Lakes, 1967.

TABLE 45

FREIGHT TRAFFIC, 1967, MANISTEE HARBOR, MICHIGAN (SHORT TONS)

Commodity	Lakewise		Local	Total
	Receipts	Shipments		
Fresh fish, except shellfish	0	0	10	10
Iron ore and concentrates	0	15,076	0	15,076
Coal and lignite	221,622	0	0	221,622
Limestone	14,927	0	0	14,927
Sand, gravel, crushed rock	15,705	286,698	0	302,403
Other nonmetallic minerals	6,000	69,938	0	75,938
TOTAL	258,254	371,712	10	629,976

SOURCE: U.S. Department of the Army, Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 1967, Part 3: Waterways and Harbors, Great Lakes, 1967.

cutback, barring a Federal or State mandate. About 17% of this company's natural gas is obtained from Canada, their only foreign supplier as of 1975.

Land Use by Resource

Agriculture

Agricultural development in Manistee County has paralleled those trends evident in Michigan and the U.S. at the macro-level. Table 46 shows that the average size of farms is increasing at the same time the total percentage of land in farms is decreasing. Both the average value of products sold and the value of land and improvements including buildings per farm are increasing (in current dollars).

Farming in Manistee over the last twenty or so years has been a shift from generalized farming to more specialized crops. Over two-thirds of the value of agricultural production (in 1964) of the $3,719,000 value of products sold in Manistee County $3,020,000 was for crops of which $2,482,000 was for fruits and nuts.[1]

In 1967 the Overall Economic Development Program (OEDP) of Manistee County, Michigan classified the county agricultural land uses into four broad sections (which are shown in Figure 2)--the fruit belt, the specialized fruit and vegetable crop area, a combination area and of interest to this study, a pine-oak forest area located south of the Manistee River along the southern 6 to 10 miles of the county.

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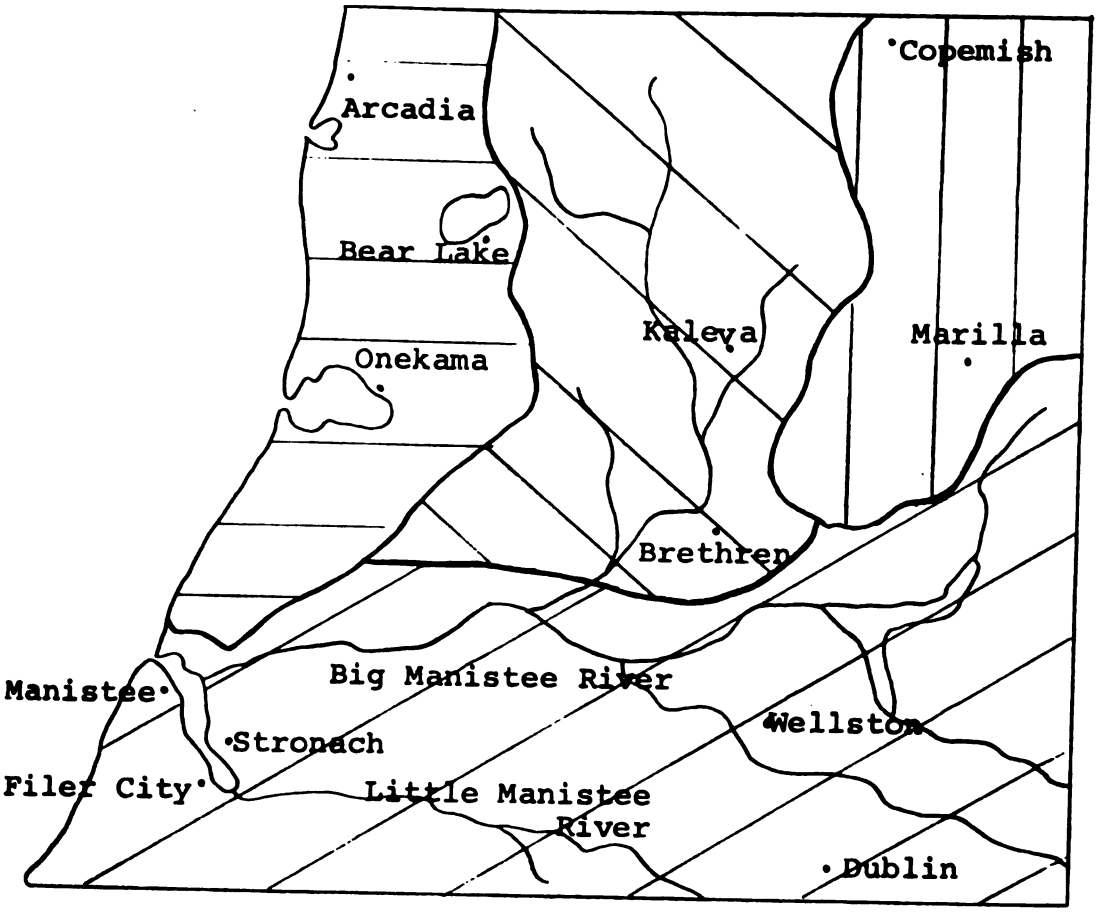
[1]U.S. Bureau of the Census, Census of Agriculture: 1964, Statistics for the State and County, Michigan, Vol. 1, Part 13 (Washington: U.S. Government Printing Office, 1967), p. 298.

TABLE 46

AGRICULTURE ECONOMIC PROFILE, 1959 and 1964

Item	Year	Manistee County	Michigan	United States
Percent of all land in farms	1959	22.5	40.5	49.5
	1964	22.2	37.3	48.7
Percent of all farms tenant operated	1964	1.3	6.0	17.1
Number of farms	1964	524	93,504	3,157,014
Ratio of commercial farms to all farms	1964	54.0	64.4	68.6
Average size of farms (acres)	1959	140	132	303
	1964	151	145	352
Farm products sold ($000)	1959	2,579	622,960	30.5 Bil.
	1964	3,719	767,188	35.3 Bil.
Ratio of farm products sold - 1964 to 1959		144.2	123.2	115.8
Percent of commercial farms with under $2,500 in products sold	1964	24.4	10.4	20.6
Percent of commercial farms with over $10,000 in products sold	1964	31.1	37.9	40.2
Average value of land and buildings per farm ($000)	1959	12.8	25.6	34.8
	1964	19.0	34.0	51.0
1964 average value of land and buildings per farm as a percent of 1959		148.6	133.2	146.4

SOURCE: "Overall Economic Development Program, Manistee County, Michigan," 1959 and 1964.



Fruit tree area

Specialized fruit and vegetable crop area

Combination area

Pine-Oak forest area

Scale: 1 inch= 5 miles

SOURCE: Robert A. Harrell, The Development of Foundational Materials and a Study Plan for a Combined Economic-Environmental Quality Study of Manistee County, Michigan.

FIGURE 2.--AGRICULTURAL LAND USE AREAS OF MANISTEE COUNTY FOR 1970.

Forestry

"Virgin forests covered 353,000 of the 357,120 acres of the county or 98.8% of the land. In the virgin stands it has been calculated that there were about 117,000 acres of hardwoods, 159,000 acres of softwoods and 77,000 acres of mixed pine and hardwood."[1] Currently, nearly half of the county is in second growth trees, mostly of hardwoods used for pulpwood production. Table 47 shows that in Manistee County 27.7% of all government owned land is in the hands of the state, and 27.3% is in federal hands. Manistee County's 357,120 acres include 86,165 acres under government ownership or 24.1%.

TABLE 47

ACRES OF LAND OWNED BY THE MICHIGAN DEPARTMENT OF NATURAL RESOURCES AND THE U.S. FOREST SERVICE IN MICHIGAN, BY COUNTY: JUNE 30, 1971

	State Owned	Federally Owned
Manistee County	23,904.10	62,261

SOURCE: Michigan State University, Michigan Statistical Abstract, 1974.

Pulpwood statistics for 1973 show a much larger cutting of hardwoods than softwoods. "In Manistee over 30,702 standard cords of all species were cut, the largest species being aspen--16,918 and oak 8,727."[2] "Prices of pulpwood vary by species and region but as of

[1] Land-Use Planning Report, Manistee County, 1947, p. 10.

[2] Michigan Department of Natural Resources, Forestry Division, Michigan Pulpwood Production, 1973, p. 4.

January 1, 1973 aspen sold as pulpwood for about $17 per standard cord with bark at the mill and oak around $18.50."[1] This would have amounted to $552,536 in 1973 assuming a standard $18.00 a cord price.

Minerals

Mineral production is quite important economically in Manistee County. The year 1966 saw salt production as the most valuable mining activity followed in order by salines, sand and gravel. "For the year 1966 some $20.5 million of the products were extracted and refined. In 1967 and 1960 the value of minerals produced was $22,105,000 and $20,795,000."[2]

Eco-System Impacts

The ecologic impact of PCA could be localized in Manistee County or in the other areas outside the county. The plant is located in Filer City which is just outside of the City of Manistee. It lies on Manistee Lake which is fed by the Little Manistee River. PCA draws and discharges water into Manistee Lake which eventually empties into Lake Michigan. There are two larger lakes in the western portion of the county: Bear Lake and Portage Lake. To the north of the county is the Betsie River State Forest which has a deer priority management status. To the south and east lies the Manistee National Forest. PCA buys pulpwood from both forest areas. Also both the State and Federal Forest land include recreational activities such as camping, boating,

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[1]Michigan Department of Natural Resources, Forestry Division, Timber Price and Market Report, 1973, p. 1.

[2]U.S. Bureau of Mines, Mineral Yearbook: 1968, Vol. III: Area Reports Domestic (Washington: U.S. Government Printing Office, 1970), pp. 375-394.

fishing, etc. The Manistee State Game Area is in the southwestern portion of the county close to Filer City. The coho and chinook were transplanted from west coast salmon eggs in 1964 as an attempt to import sport fishing in Lake Michigan. This program has been successful and salmon is now plentiful along the Lake Michigan shore which includes the shore line west of the city of Manistee.

CHAPTER IV

A CASE STUDY: MANISTEE COUNTY AND PACKAGING CORPORATION OF AMERICA'S IMPACT ON RESOURCE USE

Formation of an Input-Output Model for Manistee County Using Secondary Data Methods

Why Use an Input-Output Model

The input-output technique is a tool of economic analysis which can be utilized to show the economic impact of changes in final demand given a full and complete quantitative input-output table showing interindustrial trading. Hence, out interest is in showing the economic effects of a private decision for the growth or contraction of a dominant industry and the implications for regional development. Furthermore, input-output can show the distributional or equity impacts of an economic change which is often neglected in policy analysis.

The input-output model can aid in the construction of a regional growth plan by showing regional growth trends and information concerning interdependencies between regional economic sectors. For example, information can be compiled from 1940 to 1980 for Manistee County which can track various components of economic growth. Then predictions in possible changes in final demand can be made and their economic impacts delineated which can aid in the formation of a regional economic plan.

The Basic Input-Output Model Utilized

An Input-Output model shows the economic interdependencies of a region when the date are organized into sectors representing the important economic enterprised of the region. This study utilizes a 15-sector model which was derived from a 87-sector state model of Michigan. The Paper and Allied Products Industry sector represents the integrated woodpulp mills in Michigan.

The basic function of input-output analysis is to show the interdependencies of sectors as goods and services flow from primary to final use. That is, it describes the buying and selling of goods and services as inputs are transferred to intermediate and final products. Hence, the "double counting" of national income accounting is included in input-output. That is, the total sales price of all interindustry transactions are recorded in input-output and not just the value added as in national income analysis.

Input-Output analysis rests on the following basic assumptions:
- the level of technology is assumed stable over time. Therefore, the normal changes which occur in a dynamic economy through a changing pattern of demands for goods and services are not considered part of an input-out model. Where a relatively stable economy exists, the assumption of "constant technology" is not assumed to be unrealistic. Also predictions in the short-run can be assumed reasonably accurate when no significant changes occur in the economic structure. Therefore, short-run predictions can be used. However, when an economy has large economic changes the direct requirements can be adjusted from one time frame to the next so that the model can become a "comparative static"

one.

- fixed rates of substitution between inputs over time imply that the use of resources over time in an input-output model does not change. That is, since resources are considered free, they are not substituted for each other. Therefore, interindustry transactions between industries are taken to remain the same over time. Given the essentially static framework within which input-output works, private and public sector changes can be evaluated and forecast when a specified change in an autonomous variable affects the endogenous sector or exogenous inputs.

The State Input-Output Model for Michigan

The first essential step in arriving at an input-output table for Manistee County was to obtain the data of Karen Polenske's 1963 U.S. Multiregional Input-Output Model.[1] This study yielded an 87-sector model. It contrasts with Robert Harrell's 37-sector listing for Manistee County.[2] The final regional model consisted of 15 sectors which were aggregated from the State of Michigan's 87-sector model. Mostly the automotive sector of the manufacturing industry was removed since it does not function in the study region. The assumptions underlying the use of the aggregation process were: the technical coefficients developed at the state level hold at the regional level; the industries represented in the consolidated sectors utilize a similar

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[1]Karen Polenske, Multiregional Input-Output Analysis, Op. Cit.

[2]Harrel, Op. Cit.

level of technology (i.e., there are the same rates of substitution between factors of production and therefore inter-industrial linkages).

SIC classifications were used in 87 rows and columns of Polenske's Michigan data and can also describe the aggregated sectors:

1. Agriculture
2. Forestry
3. Mining
4. Construction
5. Lumber and Furniture
6. Paper and Allied Products/Integrated Woodpulp Mills
7. Manufacturing
8. Transportation
9. Communication, Public Utilities
10. Wholesale, Retail Trade
11. Finance, Insurance and Real Estate
12. Lodging Services
13. Amusements
14. Other Services
15. Government: Federal, State and Local

The transaction table for the State of Michigan reduced from national input-output tables from 1963 appears as table 48.

The Reduction Process to the County Level

A county matrix was developed from the 15-sector row and column consolidation of the 87-sector Polenske model which produced a new set of technical coefficients. The procedures utilized to reduce the state matrix in an adjusted form to a county matrix followed the Stipe-Miley

TABLE 48

1963 STATE OF MICHIGAN TRANSACTION TABLE IN ($000)

	Agriculture	Forest, Fish.	Mining	Construction	Lumber & Lumber Products	Paper & Allied Products
Agriculture	497,382	802	15	12,707	77	60
Forestry & Fish.	1,489	365	0	24	3	3
Mining	3,356	0	2,597	23,779	24	3,211
Construction	20,834	0	2,607	802	1,805	1,616
Lumber & Lumber Prod.	5,403	98	1	172,781	119,620	53,387
Paper & Allied Prod.	172	4	214	8,873	102,578	116,616
Manufacturing	136,009	2,466	11,428	849,335	122,144	67,241
Transportation	25,391	3,366	45,862	90,090	41,409	31,283
Comm., Pub. Utilities	8,393	2	4,199	17,957	9,482	14,844
Wholesale, Retail Trade	51,911	1,304	10,171	226,915	34,557	23,821
Fin., Ins., Real Estate	27,923	269	17,650	32,287	17,688	9,273
Lodging Services	137	22	108	2,181	1,166	1,293
Amusement	23	3	17	351	78	68
Other Services	34,517	69	2,661	117,994	15,644	11,041
Government	284	6	213	2,055	978	799
Imports	17,227	38,314	201,596	542	380,157	104
Value Added	400,258	5,920	93,585	1,469,651	320,296	242,517
MVPA = VA/TP (1963)	.32	.11	.24	.49	.27	.42
Total Outlay	1,230,709	53,010	392,924	3,028,324	1,167,698	577,177

TABLE 48--Continued.

	Manufacturing	Transportation	Communications, Public Utilities	Wholesale, Retail Trade	Fin., Ins., Real Estate
Agriculture	615,551	202	219	6,886	2,048
Forestry & Fish.	12,414	5	11	568	35
Mining	223,850	172	89,643	0	24
Construction	77,421	40,794	61,654	16,812	280,294
Lumber & Lumber Prod.	203,982	485	5	26,122	7
Paper & Allied Prod.	160,608	705	1,776	33,652	9,608
Manufacturing	9,102,595	79,741	35,893	107,345	44,736
Transportation	664,181	94,685	33,403	53,554	10,000
Comm., Pub. Utilities	360,207	18,590	292,275	139,298	48,685
Wholesale, Retail Trade	873,488	31,239	15,499	89,450	23,537
Fin., Ins., Real Estate	316,546	46,989	38,305	348,151	364,593
Lodging Services	44,166	1,005	1,743	17,295	1,975
Amusement	3,333	110	20,572	4,739	328
Other Services	735,034	43,363	46,374	277,462	117,621
Government	40,975	3,569	7,808	25,461	32,346
Imports	366,828	90,318	2,270	2,503	4,974
Value Added	10,496,836	726,331	1,255,470	3,680,958	2,967,446
MVPA = VA/TP (1963)	.44	.62	.66	.76	.76
Total Outlay	24,798,015	1,178,303	1,902,920	4,830,236	3,908,257

TABLE 48--Continued.

	Lodging Services	Amusement Services	Other Services	Government	Final Demand	Total Output
Agriculture	150	595	2,265	142	492,593	1,558,694
Forestry & Fish.	8	5	56	7	19,776	34,769
Mining	55	0	0	1,971	7,802	356,484
Construction	5,601	2,243	21,284	65,080	2,488,526	3,067,323
Lumber & Lumber Prod.	914	2	676	20	306,458	889,961
Paper & Allied Prod.	2,024	96	7,229	1,618	9,884	455,637
Manufacturing	80,861	9,783	203,355	13,812	6,957,703	17,824,447
Transportation	7,076	1,755	34,314	22,305	600,091	1,759,765
Comm., Pub. Utilities	13,180	3,828	83,635	37,798	854,278	1,906,651
Wholesale, Retail Trade	16,570	3,979	108,494	3,096	3,883,232	5,397,263
Fin., Ins., Real Estate	40,438	22,904	174,151	11,574	3,166,057	4,634,798
Lodging Services	15,845	902	12,097	456	485,077	585,468
Amusement	245	41,186	2,080	54	199,586	272,765
Other Services	21,816	10,603	111,860	16,504	1,909,896	3,472,459
Government	1,914	365	40,964	574	81,245	237,557
Imports	262	3,876	1,871	6,621	308,254	391,217
Value Added	367,629	109,827	1,766,612	323,559	1,831,932	26,558,827
MVPA = VA/TP (1963)	.64	.52	.69	.64		
Total Outlay	574,588	212,949	2,570,943	505,141		

SOURCE: Karen Polenske, Multiregional Input-Output Model.

approach. Stipe used the "modified and unmodified supply-demand pool techniques discussed by Schaffer and Chu with demands calculated from data outside the model. They differ in that final demands are not calculated within the models but taken from other available data."[1] My approach uses a similar technique for the reduction of the state model to a region but with imports and exports treated as residuals. This allows some final demands to be met from imports and not generated all by internal production as mentioned in the first reduction model. It is reasonable to assume that some final demand is satisfied by imports since numerous survey-based studies verify this premise. A study by Philip J. Bourque for the State of Washington showed that about 15% of the total final demand was imported.[2] Another study done for the State of New Mexico shows "24% of the final demands being purchased by the import sector."[3]

Given the choice of date reduction techniques, the following steps were followed:

- calculation of employment ratios and population and income ratios from county and state data.
- calculation of county final demands from secondary sources and the use of regional to state income and employment ratios for county final gross output.
- calculation of a county transaction table from regional gross outputs.

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[1]Stipe, Op. Cit., p. 58.

[2]Philip J. Bourque, The Washington Economy: An Input-Output Study, p. 39.

[3]University of New Mexico, A Review of the Input-Output Study.

County Gross Output Calculations Outlined

Starting with state gross outputs (this was derived by multiplying the inverse of the processing sectors times state final demand) for the year which the input-output table is to be constructed, "state and county employment was obtained by each sector."[1] A productivity ratio for the state by sector is obtained by dividing state gross output for the state by sector by the number of workers. This productivity ratio will be assumed to hold for the county as well. Then, the productivity ratio multiplied by the employment within the county by sector yields gross county output by sector. This was done for each sector to obtain a column sector for a region.

Area Final Demands

In order to arrive at county final demands for a chosen year, state final demands were disaggregated into three areas:

- personal consumption expenditures.
- non-export final demand which includes the sum of gross private capital formation plus net inventory change plus federal, state and local expenditures.
- net exports.[2]

All figures were changed to 1963 dollars by the use of a commodity

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[1]Michigan Department of Commerce, Bureau of Economic Analysis, Regional Economics Information System (Lansing, Michigan, 1975).

[2]Karen R. Polenske, State Estimates of the Gross National Product, pp. 224-225, 260-261, 296-297, 332-333, 380-381, 416-417. These data were aggregated to the 15-sector model.

price index and a service price index.[1]

Assuming consumption is a function of income, a ratio of income for the county to the state is developed. The income for personal consumption of the county divided by the income for personal consumption by the state was multiplied by the state personal consumption for each of the 15 sectors which yielded personal consumption expenditures for Manistee County.[2]

Area non-export final demand by sector was derived from state non-export final demand by another allocation technique. Here the ratio of county gross output by sector divided by state gross output by sector multiplied by state non-export final demand by sector yielded non-export final demand by sector.

The Area Transaction Table

In order to derive the processing sector for Manistee County the area gross output was multiplied by the state table of direct coefficients by sector. It was assumed that the state direct coefficients are similar to the county. Also, all sectors in the state table are in the county table. Here, the automotive industry was factored out of both the state and county input-output tables. The original State of Michigan table did include the automotive industry. Furthermore, the 1963 direct requirements were used with other years of gross output. This assumes the same direct requirements are used with other

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[1] Economic Report of the President, Feb. 1974, p. 301.

[2] Michigan Department of Commerce. Economic Profile of Manistee County, Nov. 1971, p. 2.

years of gross output, i.e., small changes in technology and a stability of industry with an unchanging capital-labor ratio make this approach reasonable.

Treatment of Exports and Imports as a Residual

Gross output, summing across each of the rows for the processing sectors, equals the sum of the rows for the processing sectors, personal consumption expenditures, non-export final demand and net exports. Since we know all the figures except net exports, we can calculate this as a residual.

Imports are also derived as residuals. Gross input for each row equals (this lies at the bottom row of the transaction table) the gross output of each row. Value added was assumed to be an average figure based on 1963 transaction table data. This figure, average value added for the state, was obtained by dividing value added by gross input or total outlays for each sector. Since in each column sector we lack only one figure, imports, it is derived as a residual just as with exports. That is, gross input equals value added, imports and the sum of the column of the processing sector. Subtracting the known figures of value added, and the sum of each column of the processing sector from gross input for each column leaves imports.

Results of the County Input-Output Model: A Brief Description of the Multiplier Analysis Used

There are three basic types of multipliers which are used in this study. Without input-output multipliers, local and regional impacts would not be as easily or sharply assessed. Some of the techniques are direct descendants of Keynesian multiplier analysis.

An output multiplier for a column or industry can be computed by adding up the entries of a column of the inverted Leontief matrix. The household sector is excluded. They show, for a given industry, the unit requirements of an input per dollar of sales. Higher output multipliers show higher amounts of interdependence among industries.

Income multipliers, the core of an impact study, come in two varities. The type I multiplier shows the direct and indirect changes in income given a dollar change in output from all of the industries making the product. Type II income multipliers also take into account the induced changes in income which were a result of additional consumer spending. The type II multiplier is always larger than the type I multiplier. Here, the household sector is endogenous or within the processing sector.

Employment multipliers are often included in regional analysis in order to see what the effects on employment would be from industrial expansion. The approach taken here parallels the Moore and Petersen method.[1] Employment-production functions for the county by sector were calculated and type I and type II employment multipliers similar to type I and type II income multipliers were calculated. They were arrived at by multiplying the state productivity ratio times employment in Manistee County. Employment then is a function of income since changes in employment reflect changes in final demand.

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[1]F. T. Moore and J. W. Peterson, "Regional Analysis: An Interindustry Model of Utah," Review of Economics and Statistics, pp. 363-383.

The Output, Income and Employment Multipliers for Manistee County

1970 total sales for Manistee County including internally and externally generated income appear in table 49. The table is read by going down a column to find the expenditures of the purchasing sector and across the rows for sales to producers. The table is easily read and shows the importance of sector 6 which is the Paper and Allied Products Industry or PCA. It has the third largest gross outlays.

The technical coefficients (or direct requirements) in table 32 was formed from the transaction table. One reads the table down a column. Each column adds up to 1 showing the input expenditure used to produce a product or service. Sector 6, paper and allied products, purchases 42% from external sources (excluding households) and 20% from itself.

Income multipliers, described earlier, were arrived at on a type I and type II basis. They range from 2.9 to 1.5 for type I and 6.1 to 3.2 for type II multipliers. Sector 6, the woodpulp industry in Manistee County, has a multiplier for type I of 1.7 and type II of 3.6. See table 51 which lists all the type I and type II income multipliers and their relative rankings.

As noted above, output multipliers can be derived from the Leontief inverse matrix as shown in table 52 (the matrix of direct and indirect coefficients). Output multipliers, while not as useful as income and employment multipliers for impact studies, do show the direct and indirect requirements per unit of final demand. Table 53 summarizes the data from table 52 to show only output multipliers for Manistee County by ranking in size. Sector 6, Paper and Allied Products, has a relative

TABLE 49

TRANSACTIONS MATRIX FOR MANISTEE COUNTY IN 1970

Sector Producing	Sector Purchasing Agriculture	Forestry, Fish.	Mining	Construction	Lumber, Furniture	Paper, Woodpulp
Agriculture	1,891.0000	11.0000	0.0000	26.0000	0.0000	1.0000
Forestry, Fish.	6.0000	5.0000	0.0000	0.0000	0.0000	0.0000
Mining	13.0000	0.0000	3.0000	49.0000	0.0000	44.0000
Construction	79.0000	0.0000	3.0000	1.0000	9.0000	23.0000
Lumber, Furniture	20.0000	1.0000	0.0000	357.0000	637.0000	746.0000
Paper, Woodpulp	1.0000	0.0000	0.0000	18.0000	546.0000	1,630.0000
Manufacturing	517.0000	34.0000	12.0000	1,757.0000	651.0000	940.0000
Transportation	96.0000	47.0000	47.0000	186.0000	220.0000	437.0000
Comm., Pub. Utilities	31.0000	0.0000	4.0000	37.0000	50.0000	207.0000
Wholesale, Retail	197.0000	18.0000	10.0000	469.0000	183.0000	332.0000
Finance, Ins., Real Estate	105.0000	4.0000	18.0000	66.0000	94.0000	129.0000
Lodging	1.0000	0.0000	0.0000	4.0000	6.0000	18.0000
Amusements	1.0000	0.0000	0.0000	1.0000	0.0000	1.0000
Other Services	131.0000	1.0000	3.0000	244.0000	83.0000	154.0000
Government	1.0000	0.0000	0.0000	4.0000	5.0000	11.0000
Households	1,050.0000	102.0000	77.0000	1,983.0000	1,512.0000	3,819.0000
Payments	542.0000	512.0000	233.0000	1,060.0000	2,223.0000	-422.0000
Total Internal	3,090.0000	121.0000	100.0000	3,219.0000	2,484.0000	4,673.0000
Total External	1,592.0000	604.0000	310.0000	3,043.0000	3,735.0000	3,397.0000
Total Outlay	4,682.0000	725.0000	410.0000	6,262.0000	6,219.0000	8,070.0000

TABLE 49--Continued.

Sector Producing	Sector Purchasing Manufacturing	Transportation	Communications, Public Utilities	Wholesale, Retail	Finance, Ins., Real Estate
Agriculture	1,414.0000	0.0000	0.0000	18.0000	5.0000
Forestry, Fish.	29.0000	0.0000	0.0000	1.0000	0.0000
Mining	513.0000	0.0000	234.0000	0.0000	0.0000
Construction	177.0000	143.0000	161.0000	44.0000	713.0000
Lumber, Furniture	468.0000	2.0000	0.0000	69.0000	17.0000
Paper, Woodpulp	365.0000	2.0000	4.0000	88.0000	24.0000
Manufacturing	20,944.0000	278.0000	93.0000	283.0000	113.0000
Transportation	1,593.0000	331.0000	87.0000	140.0000	25.0000
Comm., Pub. Utilities	827.0000	65.0000	763.0000	366.0000	123.0000
Wholesale, Retail	2,008.0000	110.0000	40.0000	235.0000	60.0000
Finance, Ins., Real Estate	724.0000	164.0000	100.0000	915.0000	927.0000
Lodging	97.0000	3.0000	4.0000	44.0000	5.0000
Amusements	6.0000	0.0000	53.0000	11.0000	1.0000
Other Services	1,688.0000	151.0000	120.0000	730.0000	299.0000
Government	91.0000	12.0000	20.0000	66.0000	82.0000
Households	16,494.0000	1,089.0000	1,882.0000	2,760.0000	2,225.0000
Payments	9,616.0000	1,770.0000	1,411.0000	2,942.0000	5,324.0000
Total Internal	30,944.0000	1,261.0000	1,679.0000	3,010.0000	2,394.0000
Total External	26,110.0000	2,859.0000	3,293.0000	5,702.0000	7,549.0000
Total Outlay	57.054.0000	4,120.0000	4,972.0000	8,712.0000	9,943.0000

TABLE 49--Continued.

Sector Producing	Sector Purchasing: Lodging Services	Amusements	Other Services	Government	Households	Final Demand
Agriculture	0.0000	1.0000	5.0000	0.0000	360.0000	950.0000
Forestry, Fish.	0.0000	0.0000	0.0000	0.0000	28.0000	666.0000
Mining	0.0000	0.0000	0.0000	3.0000	2.0000	-461.0000
Construction	21.0000	3.0000	55.0000	95.0000	0.0000	-345.0000
Lumber, Furniture	3.0000	0.0000	1.0000	0.0000	319.0000	3,579.0000
Paper, Woodpulp	8.0000	0.0000	19.0000	2.0000	101.0000	5,262.0000
Manufacturing	310.0000	11.0000	534.0000	20.0000	10,736.0000	19,821.0000
Transportation	27.0000	3.0000	90.0000	33.0000	1,031.0000	-273.0000
Comm., Pub. Utilities	50.0000	4.0000	220.0000	55.0000	1,937.0000	233.0000
Wholesale, Retail	50.0000	4.0000	285.0000	5.0000	7,909.0000	797.0000
Finance, Ins., Real Estate	155.0000	26.0000	459.0000	17.0000	7,679.0000	-1,639.0000
Lodging	61.0000	1.0000	32.0000	1.0000	1,005.0000	919.0000
Amusements	1.0000	47.0000	5.0000	0.0000	303.0000	-186.0000
Other Services	83.0000	12.0000	293.0000	24.0000	3,919.0000	-1,178.0000
Government	7.0000	0.0000	107.0000	1.0000	123.0000	211.0000
Households	826.0000	65.0000	1,324.0000	213.0000	218.0000	0.0000
Payments	599.0000	67.0000	3,328.0000	272.0000	0.0000	0.0000
Total Internal	776.0000	112.0000	2,105.0000	256.0000	0.0000	0.0000
Total External	1,425.0000	132.0000	4,652.0000	485.0000	34,670.0000	28,536.0000
Total Outlay	2,221.0000	244.0000	6,757.0000	741.0000	35,670.0000	28,536.0000

TABLE 50

MATRIX OF TECHNICAL COEFFICIENTS FOR MANISTEE COUNTY IN 1970

Sector Producing	Sector Purchasing Agriculture	Forestry, Fish.	Mining	Construction	Lumber, Furniture	Paper, Woodpulp
Agriculture	.403887	.014966	0.000000	.021997	0.000000	.000124
Forestry, Fish.	.001282	.006803	0.000000	0.000000	0.000000	0.000000
Mining	.002777	0.000000	.007500	.041455	0.000000	.005452
Construction	.016873	0.000000	.007500	.000846	.001447	.002850
Lumber, Furniture	.004272	.001361	0.000000	.302030	.102428	.093441
Paper, Woodpulp	.000214	0.000000	0.000000	.015228	.087795	.201983
Manufacturing	.110423	.046259	.030000	1.486464	.104679	.116481
Transportation	.020504	.063946	.117500	.157360	.035375	.054151
Comm., Pub. Utilities	.006621	0.000000	.010000	.031303	.008040	.025651
Wholesale, Retail	.042076	.024490	.025000	.396785	.029536	.041140
Finance, Ins., Real Estate	.022426	.005442	.045000	.055838	.015115	.015985
Lodging	.000214	0.000000	0.000000	.003384	.000965	.002230
Amusements	.000214	0.000000	0.000000	.000846	0.000000	.000124
Other Services	.027973	.001361	.007500	.206430	.013346	.019083
Government	.000214	0.000000	0.000000	.003384	.000804	.001363
Households	.224263	.138776	.192500	1.677665	.243126	.473234
Payments	.115762	.696599	.557500	-3.401015	.357453	-.052292
Total Internal	.659974	.164636	.250000	2.723350	.399421	.579058
Total External	.340025	.835374	.750000	-1.723350	.600579	.420942
Total	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000

TABLE 50--Continued.

Sector Producing	Sector Purchasing: Manufacturing	Transportation	Communications, Public Utilities	Wholesale, Retail	Finance, Ins., Real Estate
Agriculture	.024784	0.000000	0.000000	.001416	.000503
Forestry, Fish.	.000508	0.000000	0.000000	.000079	0.000000
Mining	.008991	0.000000	.047064	0.000000	0.000000
Construction	.003102	.034709	.032381	.003461	.071709
Lumber, Furniture	.008203	.000485	.000805	.005428	.001710
Paper, Woodpulp	.006397	.000485	.000805	.006923	.002414
Manufacturing	.367091	.067476	.018705	.022262	.011365
Transportation	.027921	.080340	.017498	.011013	.002514
Comm. Pub. Utilities	.014495	.015777	.153459	.028792	.012371
Wholesale, Retail	.035195	.026699	.008045	.018486	.006034
Finance, Ins., Real Estate	.012690	.039806	.020113	.071979	.093231
Lodging	.001700	.000728	.000805	.003461	.000503
Amusements	.000105	0.000000	.010660	.000865	.000101
Other Services	.029586	.036650	.024135	.057426	.030071
Government	.001595	.002913	.004023	.005192	.008247
Households	.289095	.264320	.378520	.217118	.223776
Payments	.168542	.429612	.283789	.546098	.535452
Total Internal	.542363	.306068	.337691	.236784	.240772
Total External	.457637	.693932	.662309	.763216	.759228
Total	1.000000	1.000000	1.000000	1.000000	1.000000

TABLE 50--Continued.

Sector Producing	Sector Purchasing Lodging	Amusements	Other Services	Government	Households	Final Demand
Agriculture	0.000000	.004098	.000740	0.000000	.010093	.033503
Forestry, Fish.	0.000000	0.000000	0.000000	0.000000	.000785	.023487
Mining	0.000000	0.000000	0.000000	.004049	.000056	-.016258
Construction	.009541	.012295	.008140	.128205	0.000000	-.012167
Lumber, Furniture	.001363	0.000000	.000148	0.000000	.008943	.126217
Paper, Woodpulp	.003635	0.000000	.002812	.002699	.002832	.185569
Manufacturing	.140845	.045082	.079029	.026991	.300981	.699006
Transportation	.012267	.012295	.013320	.044534	.028904	-.009628
Comm., Pub. Utilities	.022717	.016393	.032559	.074224	.054303	.008217
Wholesale, Retail	.022717	.016393	.042178	.006748	.221727	.028107
Finance, Ins., Real Estate	.070423	.106557	.067930	.022942	.215279	-.057801
Lodging	.027715	.004098	.004736	.001350	.028175	.032409
Amusements	.000454	.192623	.000740	0.000000	.008495	-.006559
Other Services	.037710	.049180	.043362	.032389	.109868	-.041543
Government	.003180	0.000000	.015835	.001350	.003448	.007441
Households	.375284	.266393	.195945	.287449	.006112	0.000000
Payments	.272149	.274590	.492526	.367072	0.000000	0.000000
Total Internal	.352567	.459016	.311529	.345479	0.000000	0.000000
Total External	.647433	.540984	.688471	.654521	1.000000	1.000000
Total	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000

TABLE 51

TYPE I AND TYPE II INCOME MULTIPLIERS FOR MANISTEE COUNTY, 1970

Sector	Type I Income Multiplier	Relative Rank	Type II Income Multiplier	Relative Rank
Agriculture	2.9	1	6.1	1
Forestry, Fisheries	1.6	9	3.3	11
Mining	1.7	8	3.6	9
Construction	1.8	7	3.8	8
Lumber, Furniture	1.9	6	4.0	6
Paper, Woodpulp	1.7	8	3.6	9
Manufacturing	2.1	4	4.3	4
Transportation	1.9	6	3.9	7
Communication, Public Utilities	1.7	8	3.5	10
Wholesale, Retail	1.6	9	3.2	12
Finance, Insurance, Real Estate	2.4	3	4.9	3
Lodging	1.5	10	3.2	12
Amusements	2.0	5	4.1	5
Other Services	1.9	6	4.0	6
Government	2.8	2	5.7	2

TABLE 52

MATRIX OF INTERDEPENDENCY COEFFICIENTS FOR MANISTEE COUNTY IN 1970

Sector Producing	Sector Purchasing Agriculture	Forestry, Fish.	Mining	Construction	Lumber, Furniture
Agriculture	1.697042	.029898	.005748	.152968	.011023
Forestry, Fish.	.002414	1.006944	.000071	.001622	.000147
Mining	.011844	.001527	1.010443	.075953	.004590
Construction	.040113	.005181	.018868	1.051628	.009532
Lumber, Furniture	.027238	.004846	.008220	.392869	1.133275
Paper, Woodpulp	.009173	.001927	.002988	.092357	.127689
Manufacturing	.421549	.103729	.116774	2.695352	.250814
Transportation	.064380	.076023	.138095	.312391	.063157
Comm., Pub. Utilities	.032374	.005754	.021081	.138977	.024787
Wholesale, Retail	.111826	.035255	.043681	.573779	.056559
Finance, Ins., Real Estate	.070724	.016022	.065413	.211152	.036591
Lodging	.002229	.000474	.000730	.013411	.002363
Amusements	.001183	.000155	.000395	.000340	.000492
Other Services	.084492	.012487	.026563	.380687	.036340
Government	.004037	.000956	.001941	.020620	.002986
Total	2.580617	1.301179	1.461011	6.118108	1.760347

TABLE 52--Continued.

Sector Producing	Sector Purchasing: Paper, Woodpulp	Manufacturing	Transportation	Communications, Public Utilities	Wholesale, Retail
Agriculture	.014420	.069639	.012407	.009055	.007036
Forestry, Fish.	.000189	.000942	.000149	.000101	.000138
Mining	.013139	.017689	.005914	.060131	.003624
Construction	.015100	.014402	.047057	.046496	.014615
Lumber, Furniture	.139783	.022651	.020002	.018249	.013511
Paper, Woodpulp	1.272528	.017172	.006833	.006205	.012129
Manufacturing	.319550	1.654288	.249397	.168879	.092610
Transportation	.097806	.061448	1.108091	.046711	.022177
Comm., Pub. Utilities	.054065	.037778	.033580	1.193016	.043364
Wholesale, Retail	.081871	.075238	.063403	.041572	1.034280
Finance, Ins., Real Estate	.047717	.042341	.067368	.046860	.093335
Lodging	.004375	.003722	.002100	.002022	.004418
Amusements	.001115	.000899	.000670	.015926	.001794
Other Services	.052912	.066619	.068234	.053358	.074178
Government	.004590	.004888	.005928	.006850	.007804
Total	2.119158	2.089717	1.691131	1.715431	1.425013

TABLE 52--Continued.

Sector Producing	Sector Purchasing Finance, Ins., Real Estate	Lodging	Amusements	Other Services	Government
Agriculture	.014754	.013761	.018018	.010722	.023561
Forestry, Fish.	.000151	.000177	.000125	.000122	.000257
Mining	.007497	.005743	.004932	.005332	.019471
Construction	.086333	.022079	.031811	.021743	.143884
Lumber, Furniture	.035138	.013392	.013699	.010799	.054974
Paper, Woodpulp	.011764	.010065	.004978	.007986	.017163
Manufacturing	.249803	.304262	.019143	.200699	.429031
Transportation	.031653	.031806	.032962	.030120	.097373
Comm., Pub. Utilities	.031092	.031028	.037471	.051769	.112004
Wholesale, Retail	.057368	.049861	.048114	.065222	.092499
Finance, Ins., Real Estate	1.125499	.098005	.164562	.093748	.064793
Lodging	.001993	1.029766	.006444	.006036	.003744
Amusements	.000805	.001314	1.239294	.001800	.001890
Other Services	.068905	.064208	.088001	1.067180	.094714
Government	.011648	.006212	.003707	.018767	1.005862
Total	1.734405	1.691680	1.885521	1.592042	2.161220

TABLE 53

OUTPUT MULTIPLIERS FOR MANISTEE COUNTY IN 1970

Sector	Output Multiplier	Rank
Agriculture	2.5	2
Forestry, Fisheries	1.3	10
Mining	1.4	9
Construction	6.1	1
Lumber, Furniture	1.7	6
Paper, Woodpulp	2.1	3
Manufacturing	2.0	4
Transportation	1.6	7
Communication, Public Utilities	1.7	6
Wholesale, Retail	1.4	9
Finance, Insurance, Real Estate	1.7	6
Lodging	1.7	6
Amusements	1.8	5
Other Services	1.5	8
Government	2.1	3

rank of 3 but seems to be somewhere in the middle in terms of structural interdependence between this sector and the rest of the economy.

Employment multipliers were calculated on a type I and type II basis just as the income multipliers were. The employment multiplier analogous to the type I income multiplier is the ratio of this direct plus indirect employment change to the direct employment change. Similarly, there is an employment multiplier parallel to the type II income multiplier which measures the ratio of the direct, indirect and induced employment change to the direct employment change.[1] Table 54 shows type I and type II employment multipliers. Table 55 show their relative rankings. Sector 6 has an EMI of 2.8 and EMII of 8.6. This means that changes in employment result from a change in final demand.

The employment multipliers are higher than the income multipliers for sector 6 despite PCA being a capital-intensive firm. Type I and type II employment multipliers are 2.8 and 8.6 compared to type I and type II income multipliers which run 1.7 and 3.0. This contradiction is explained by the employment multipliers linkage to more labor-intensive industries as a result of direct, indirect and induced linkages.

Some Hypothetical Multiplier Impacts in Manistee County

Changes in the Level of Output

Two case studies can illustrate how some of the income and employment multipliers could be used to forecast expected impacts on Manistee

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[1]Harry W. Richardson, Input-Output and Regional Economics, p. 35.

TABLE 54

TYPE I AND TYPE II EMPLOYMENT MULTIPLIERS FOR MANISTEE COUNTY IN 1970

Sector	Type I Multiplier	Type II Multiplier
Agriculture	2.5	5.1
Forestry, Fisheries	1.3	2.2
Mining	1.6	2.5
Construction	6.7	20.3
Lumber, Furniture	1.6	3.2
Paper, Woodpulp	2.8	8.6
Manufacturing	1.8	3.7
Transportation	1.7	3.8
Communication, Pub. Utilities	1.5	3.5
Wholesale, Retail	2.0	5.2
Finance, Ins., Real Estate	1.3	2.3
Lodging	3.1	9.4
Amusements	2.6	6.6
Other Services	3.4	9.3
Government	14.1	49.3

TABLE 55

RANKINGS OF TYPE I AND TYPE II EMPLOYMENT MULTIPLIERS
FOR MANISTEE COUNTY IN 1970

Sector	EMI	Ranking	EMII	Ranking
Agriculture	2.5	7	5.1	8
Forestry, Fisheries	1.3	13	2.2	15
Mining	1.6	11	2.5	13
Construction	6.7	2	20.3	2
Lumber, Furniture	1.6	11	3.2	12
Paper, Woodpulp	2.8	5	8.6	5
Manufacturing	1.8	9	3.7	10
Transportation	1.7	10	3.8	9
Communication, Pub. Utilities	1.5	12	3.5	11
Wholesale, Retail	2.0	8	5.2	7
Finance, Insurance, Real Estate	1.3	13	2.3	14
Lodging	3.1	4	9.4	3
Amusements	2.6	6	6.6	6
Other Services	3.4	3	9.3	4
Government	14.1	1	49.3	1

County. Neither case is contemplated in PCA's future planning. Sector 6, Paper and Allied Products or PCA has a total annual income of $8,000,000 in 1970. This is 6.4% of the total county gross output ($8,000,000/125,112,000) and 8% (609/7,603) of the total employment. Unemployment was 12.4% in Manistee County or 567 persons in the year 1970. For sector 6, type II income multiplier is 3.6 and the type II employment multiplier is 8.6.

Case I Plant Closing

Total annual income lost by a plant closing is estimated to be $8,000,000 x 3.6 or $28,800,000. This would be cushioned by welfare, unemployment compensation, savings, severance pay and other income support programs which would reduce the impact on consumption within the county. The employment impact would be expected to be 609 jobs lost x 8.6 (type II employment multiplier) which equals 5237 unemployment workers. This high total would be reduced to the extent that government transfers income to unemployed workers to maintain consumption and retain workers for other jobs.

Case II Plant Expansion

The present plant (PCA) produces 700 tons per 24 hours at full capacity and is presently adding $8,000,000 of income per year or $13,136 per worker. Assuming we expand output by 233 tons or 1/3 of existing production to 933 tons, this would mean an estimated 200 additional workers using an average production per worker ratio. Two hundred workers times $13,136 (average dollar per worker) yields $2,627,200 per year of additional income from the plant.

Income Effect

The total income change is: $2,627,200 x 3.6 = $9,457,920. This would mean that for sector 6, total gross income would be $10,627,200 (8,000,000 annual income plus $2,627,200 additional income), or 8% instead of 6.4% of total county gross income.

Employment Effect

The total employment effect is: 200 workers x 8.6 = 1720 new jobs.

Total Labor Force Before Expansion = 7603

New Jobs Created = 1720

Total Labor Force = 9323

After this change, sector 6 row represents 8.6% of the total labor force instead of 7%. Unemployment is 6.5% instead of 12.4%. This assumes all new workers came from the "not in the labor force" category in Manistee County or from the outside. If the unemployment within the county are absorbed then the unemployment rate will fall depending on amounts involved. The skill levels may not be high enough to allow large numbers of unemployed and "not in the labor force" to be absorbed.

Environmental Impacts

What would be the environmental, labor force and other resource considerations in the previous two hypothetical cases of a plant closing and a plant expansion by a third? Firstly, input-output analysis assumes that labor is available and mobile. But with an expansion additional workers would be needed. They must come from outside the local labor market, the unemployed or from people not currently in the labor

force in Manistee County. The model would assume these assumptions as facts but further investigation needs to be done by company planners and the county officials if such a move were contemplated. A second consideration is that at current levels of production there is no problem in obtaining sufficient natural gas but is there a sufficient amount for expansion (of course this varies by the volume considered) and if not is another energy source available? In short, are energy resources available at reasonable prices. Thirdly, the existing water supply will be enough but can it be processed by the present secondary treatment plant or will additional facilities have to be built?

> Currently, with three machines capable of producing 700 tons of corrugated medium per day, 4 to 5 million gallons of water are used from the Little Manistee River along with 15 million gallons per day from Manistee Lake for cooling purposes. Seven to eight million gallons of water per day are treated in its secondary wastewater treatment plant.[1]

This puts the overall use of water at 28,571 gallons per ton of output of which 11,428 gallons per ton of output are treated in a secondary wastewater treatment plant. (See appendix 9 for guidelines for pulpmills water usage.) Now if output were expanded at the rate stated in our earlier example, 233 tons, 6,463,063 gallons of water would be needed and 2,662,724 gallons of additional water would be treated by a secondary treatment plant.

Timber availability for a 233-ton plant expansion would require a mix of woods probably similar to existing ratios. (This assumes the same process and product is being produced.) However, it has been estimated that from the period 1965 to 1980 "the average amount of

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[1]The Manistee News Advocate, Jan. 18, 1975, p. 5.

pulpwood required for a ton of wood pulp was 1,5 cords."[1] Consequently, a more accurate estimate of cords of pulpwood needed for a 233 ton expansion of capacity may be around 350 additional cords per day.

Construction of An Economic-Ecologic Model As An Aid for Environmental Planning

It is my purpose here only to sketch the barest outlines of how an ecologic matrix can be combined with the economic input-output model of Manistee County.[2] Only sector 6, paper and allied products, will be looked at for environmental impacts. In order to fully analyze the economic-ecologic relationships all or a large number of sectors must be included in this analysis and direct and indirect environmental linkages must be shown. Direct linkages occur when an economic sector draws resources straight from the environment. Indirect linkages occur when one sector in supplying inputs to another draws on the environment to provide this economic linkage. Only one sector's direct linkages to other sectors will be sketched out here. The only environmental goods considered at this point are 5-day BOD discharge in pounds and total amounts of water. For pulp mill pollution of water, it is the dissolved oxygen content of the receiving water for the mill's organic wastes (BOD), the biochemical oxygen demand, which is the major or crucial pollution factor. The analytical process will be sketched out and discussed and compared to the Charlestown, South Carolina study by

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[1]Michigan State University, Michigan Timber Production--Now and in 1985, p. 5.

[2]This discussion follows closely the work of Eugene A. Laurent and James C. Hite.

Laurent and Hite where applicable.

Sludge disposal is another important environmental emission especially for a plant the size of PCA. Currently, PCA is spending about 1/2 million dollars in fuel costs to burn the sludge. To a certain extent there are some beneficial effects of the sludge. A small part of it is being used as a soil conditioner and nutrient on forest lands but the land has to be specially prepared for this type of treatment which aids tree growth in dry weather.

Table 56 shows only total water intake and 5-day-BOD for sector 6, Paper and Allied Products. The Charlestown study equivalent of our sector 6 is Lumber, Pulp and Paper Products which is not directly comparable. Table 57 multiplies the inverse matrix times the environmental matrix. This shows the direct changes for water and BOD resulting in a dollar increase in sales from sector 6. If the entire matrix was complete we would have a better understanding of economic-ecologic interdependence (see appendix 13).

In order to assess the trade-offs between income growth and environmental quality, environmental-income multipliers can be calculated. The summation of each column of a value-added matrix (the Leontief matrix times the value added coefficient) divided by the income multiplier gives us the environmental-income multiplier. This shows the environmental impact per dollar of income generated within Manistee County for sector 6, Paper and Allied Products. The environmental-income multipliers, then, show the trade-offs between economic growth and environmental quality. Table 59 shows the environmental emissions per dollar of local income for Manistee County in 1970 for

TABLE 56

THE DIRECT ENVIRONMENTAL IMPACT OF A DOLLAR INCREASE IN OUTPUT BY SECTORS FOR MANISTEE COUNTY, 1970*

Sector	Total Water Intake (Gallons)	5-Day BOD (lbs.)
6. Paper & Allied Products	2.47	.002 to .012

*Other environmental linkages could include hydrocarbons (lbs.), sulfur dioxides (lbs.) and solid wastes (cu. yards) to name just a few.

TABLE 57

DIRECT ENVIRONMENTAL IMPACTS FOR A DOLLAR INCREASE BY SECTOR FOR MANISTEE COUNTY, 1970*

Sector	Total Water Intake (Gallons)	5-Day BOD (lbs.)
6. Paper & Allied Products	(2.47 x 2.1) = 5.1	(.002 or .012 x 2.1 = .004 or .025)

*Environmental Matrix x Inverse.

TABLE 58

MANISTEE COUNTY VALUE-ADDED MATRIX FOR 1970*

Sector	
6. Paper & Allied Products	.71

*Each sector x the inverse of that sector summed equals the value-added for that sector.

TABLE 59

DIRECT ENVIRONMENTAL IMPACTS PER DOLLAR OF LOCAL INCOME FOR MANISTEE COUNTY, 1970*

Sector	Total Water Intake	5-Day BOD
6. Paper & Allied Products	.71 x 5.1 = 3.6	.71 x .004 or .025 x .017

*Value-Added Matrix x Table 39 = Direct Environmental Impact per Dollar.

only sector 6. Additional information for other sectors would be needed before trade-offs could be assessed. See appendices 12, 13 and 15. The information in tables 56 to 59 is incomplete but if additional information for environmental indices for other sectors were compiled then the economic-ecologic trade-off could be assessed.

This type of analysis is useful to view as part of the overall Leontief model (see appendix 11). Generally, the model has two key limitations. Firstly, the model is linear and subject to the limitations associated with such a system. Secondly, costs are calculated in terms of estimates of opportunity costs of diverting environmental resources from primary uses to environmental goods but these values do not have the same meaning as a direct estimate that consumers place on environmental goods. In short, it only places a minimum price on the economic value of common-property environmental resources.

This sort of economic-ecologic model can provide a useful input to decisions made by planners and public officials in regional planning. It can show the trade-offs between generation of local income and loss of environmental goods.

Examples of Some Distributional Impacts from a Hypothetical Plant Expansion in Manistee County

Assuming an additional $2,627,200 per year were generated by an investment in a single new machine and other associated fixed costs for sector 6, what would the on-going distributional impact of this incremental income be? Using table 50, the direct coefficients for Manistee County, times the amount of annual income generated by sector 6, the distributional results appear in table 60. Since 42% of the

TABLE 60

DISTRIBUTIONAL IMPACTS WITHIN MANISTEE COUNTY GIVEN A CHANGE IN SECTOR 6, PAPER AND ALLIED PRODUCTS INDUSTRY'S ANNUAL TRANSACTIONS

Sector	Total Dollars
1. Agriculture	315
2. Forest & Fisheries	--
3. Mining	14,186
4. Construction	7,356
5. Lumber & Lumber Products	241,702
6. Paper & Allied Products	528,067
7. Manufacturing	304,755
8. Transportation	141,868
9. Communications & Public Utilities	65,680
10. Wholesale, Retail Trade	107,977
11. Finance, Insurance & Real Estate	42,035
12. Lodging Services	5,779
13. Amusement	262
14. Other Services	49,536
15. Government, Federal, State & Local	2,627

*Of $2,627,200, 57.6% of this amount ($1,513,267) is distributed internally and 42.4% is exported or for external use.

**Figures are approximations due to round-off error.

***Household internal sales are omitted.

gross output is exported only $1,512,145 of this is initially distributed within Manistee County. Note the large flow of monies to the paper and allied products industry, manufacturing, and lumber and lumber products industries. A type II multiplier of 3.6 yields a net effect (for inside Manistee County) of only $5,443,722.

Table 61 shows the distributional impact on sector 2, forestry and fisheries, for the same amount--$2,627,200. However, in this case the external sector is 84% of gross output. This leaves $422,506 to be distributed within Manistee County. By contrast with the earlier example, most of the monies are distributed to the government, manufacturing and transportation sectors. Using the sector 2 type II income multiplier which is 3.3, the impact on income inside Manistee County is $1,394,269.

Local planners in evaluating promotional activities or even subsidies to local industries must weigh not only the income and employment multipliers but county distributional impacts and total amount of dollars to be spent inside the county. This example shows that industries which spend a large portion of their incomes locally should be encouraged because of the multiplier impact, assuming that our bias is to promote spending as much income as possible inside Manistee County.

Distributional Impacts of a Change in Timber Stumpage Sales: A Hypothetical Example

It was estimated that PCA uses 700 cords per day or 252,000 cords per year. In 1970 Michigan produced 1,406,000 cords.[1] Using 1970 data

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[1]Blyth and Danielson, Op. Cit., p. 16.

TABLE 61

DISTRIBUTIONAL IMPACTS WITHIN MANISTEE COUNTY GIVEN A CHANGE IN SECTOR 2--FORESTRY AND FISHERIES INDUSTRY'S ANNUAL TRANSACTIONS

Sector	Dollars
1. Agriculture	39,318
2. Forestry & Fisheries	17,872
3, Mining	--
4. Construction	--
5. Lumber & Lumber Products	3,575
6. Paper & Allied Products	--
7. Manufacturing	121,531
8. Transportation	167,998
9. Communication & Public Utilities	--
10. Wholesale & Retail Trade	64,340
11. Finance, Insurance & Real Estate	4,297
12. Lodging Services	--
13. Amusement	--
14. Other Services	3,575
15. Government, Federal, State & Local	--

*Of $2,627,200, 16% of this amount ($422,506) is distributed internally and 84% is within the external sector.

**The figures differ slightly due to round-off error.

with the three semi-chemical machines currently in place plus a fourth (assuming an expansion of 33% in capacity) which would use a similar mix of 65% aspen and 35% oak or maple, an additional 83,880 cords would be used. "Manistee County has averaged around 5.5% of the total pulpwood production from 1965-1975 with production ranging from 30,000 to almost 40,000 cords per year."[1] It was estimated for Michigan "there was an excess of 760 thousand cords of pulpwood in the northern Lower Peninsula."[2] By 1970 it was projected to be 859,000 cords. We assumed that 5.5% of the 83,880 cords needed for plant expansion would be bought in Manistee County from state and federal forests (especially since data on stumpage prices are readily available). The increased cut at a given set of volumes and prices looks like this:

Aspen	2,998 cords	x $2.88 =	$ 8,634
Maple	1,385 cords	x $3.16 =	$ 4,376
Mixed Hardwoods	230 cords	x $1.11 =	$ 255
	4,613 cords		$13,265

The impact of $13,265 in stumpage sales in Manistee County would be distributed as shown in table 62 given that 42% is estimated to be exported.

We can conclude with the aid of this table and other pertinent analysis that:

- three out of five dollars in timber stumpage sales flow outside the county.

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[1]Michigan Department of Natural Resources, Michigan State Forest Volumes and Stumpage Prices by Districts 1965-1975.

[2]Arthur D. Little Report, Op. Cit., p. 22.

TABLE 62

DISTRIBUTIONAL IMPACTS OF AN INCREASE IN TIMBER SALES FOR MANISTEE COUNTY IN SECTOR 6, PAPER AND ALLIED PRODUCTS INDUSTRY'S ANNUAL TRANSACTIONS

	Internal Sector*	Dollars
1.	Agriculture	1.64
2.	Forestry & Fisheries	---
3.	Mining	72.3
4.	Construction	37.8
5.	Lumber & Lumber Products	1226.2
6.	Paper & Allied Products	2679.0
7.	Manufacturing	1545.0
8.	Transportation	718.3
9.	Communication & Public Utilities	340.0
10.	Wholesale & Retail Trade	545.7
11.	Finance, Insurance & Real Estate	212.0
12.	Lodging Services	29.5
13.	Amusement	1.6
14.	Other Services	253.1
15.	Government, Federal, State & Local	18.0
	Total Internal**	7680.0
	External	571.0

*Household internal sales are omitted.

**43% is external and 57% is internal of the $13,265 of timber stumpage sales.

Numbers are not exact due to round-off errors.

- internal distributional impacts favor the manufacturing, lumber and paper products and paper and allied products sectors.
- $13,265 increase in stumpage sales with a multiplier of 3.6 (type II) yields $47,754 for Manistee County. However, the total impact internally to Manistee County is $27,697.
- a larger volume of timber stumpage sales (if available) would naturally produce a greater income impact. However, it would place a greater burden on other input requirements such as labor, power and water. Input-output models assume these inputs are available but this need not be the case.

Analysis of Potential Land Use Changes

The percentage of land devoted to forestry has not shifted significantly over the last 35 years. In 1941 "there were 216,867 acres of wooded land in Manistee County or 61.79%."[1] By 1966 Manistee County had "221,000 acres in forest land or 62% of the total county land."[2] Certainly land-use changes have occurred in Manistee County despite the fact that the overall percentage of land devoted to forestry has not changed. The type of tree species, the intensity of forestation and even individual parcels of acreage may be significantly different over this time span.

Planners can influence land-use changes by taxation, zoning or public projects. In addition, shifts in demand for various sectors

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[1] Land-Use Planning Report, Manistee County, 1941, p. 77.

[2] Michigan State University Extension Service, Michigan Department of Commerce, Office of the Governor, County and Regional Facts Region 10, 1972, p. 71.

notably recreation and second-home communities are the most notable causes of land-use shifts in Manistee County. For example, increased timber sales may be compared to shifting land to agriculture (see table 63 which outlines the procedure for the expansion of the agricultural sector). If $100,000 were invested, $65,000 would be spent internally and $35,000 externally. The net impact internally would be $106,001 and these distribution effects are also shown by sector as in table 62 with sector 1, agriculture, having the largest impact.

Conclusion: Multiplier Analysis is a Result of Demand Shifts in Input-Output Analysis

The economic impact analysis described in this chapter has illustrated estimated income and employment multipliers for Manistee County and the potential distributional impacts within the county. These impacts were a result of a change in sales. Incremental changes, increases or decreases of sales by sector, trigger economic impacts. It thus becomes necessary to have a good handle on the local economy and final demands by sector in order to use the input-output model. Or putting it another way, if resources exist such as water, minerals, timber stumpage and the like, then you must first question whether sales exist to prompt an investment or disinvestment when using input-output analysis. Comparisons of two or more industries (sectors) can then be made utilizing income and employment multipliers and distributional impacts when sales change as a result of a shift in demand.

TABLE 63

DISTRIBUTIONAL IMPACT AND TYPE I MULTIPLIER IMPACTS OF AN EXPANSION IN THE AGRICULTURAL INDUSTRY FOR MANISTEE COUNTY

Sector of Expenditure	Technical Coefficients	Amount of Respending	Income Multiplier	Total Impact
1. Agriculture	.40	26,000	2.9	75,400
2. Forestry & Fisheries	.001	65	1.6	104
3. Mining	.002	130	1.7	221
4. Construction	.016	221	1.8	397
5. Lumber & Lumber Products	.004	260	1.9	494
6. Paper & Allied Products	.0002	13	1.7	22
7. Manufacturing	.110	7,150	2.1	15,015
8. Transportation	.02	1,300	1.9	2,470
9. Communication & Public Utilities	.006	390	1.7	663
10. Wholesale & Retail Trade	.042	2,730	1.6	4,368
11. Finance, Insurance & Real Estate	.022	1,430	2.4	3,432
12. Lodging Services	.0002	13	1.5	19.5
13. Amusements	.0002	13	2.0	26
14. Other Services	.027	1,755	1.9	3,334
15. Government, Federal, State & Local	.0002	13	2.8	36.4
Total Internal	.65	65,000		$106,001
Total External	.35			
Total	1.0			

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

The basic thrust of this study was to develop a county input-output model using secondary sources. Special attention was then focused on the impacts of a particular sector, Paper and Allied Products, in a county which has a strong natural resource base. The impact analysis was done after locational advantages and disadvantages, and ecologic impacts of the Paper and Allied Products Industry (really integrated woodpulp mills) were evaluated for the State of Michigan in order to estimate the possibilities for expansion or contraction of this industry.

Major Conclusions

Two major conclusions stand out in this study. Firstly, PCA, one of the eight integrated woodpulp mills in Michigan, was used as a test case to evaluate economic-ecologic impacts in Mansitee County. It proved to provide potential decision-makers with a solid company from a locational perspective. The locational advantages of PCA are that its production process uses 65% aspen which is the cheapest wood for pulping in Michigan. It is located in a strong pulpwood producing county. Finally, PCA is able to compete more easily with companies in the northern Upper Peninsula since it is the largest company by a good margin in this timbershed. Though it buys over the entire central region of the Lower Peninsula, it has very good access to timber producing counties. There are sufficient quantities of water available for plant

expansion and a new $4.5 million secondary water treatment plant has been in existence several years.

Finally, PCA is a subsidiary of Tenneco, a solid company in the top twenty in Fortune's list of industrial companies. It produces corrugated medium which has a steadily growing market and is integrated into carton box production through other PCA plants and is in a good relative position to midwestern markets vis-a-vis other integrated woodpulp firms in the northern Lower Peninsula. This is a very solid company which has a strong economic and ecologic presence in Manistee County and its potential impacts make it ideal for a county input-output study.

Secondly, a reduction technique was developed which allowed the input-output model for the State of Michigan to be reduced to Manistee County. A transaction table, technical coefficients, and output, income and employment mulitpliers were developed. Although the focus of the Manistee County Study was the Paper and Allied Products sector, represented by PCA, 14 other sectors were included and could be used if the study objectives were different. The output, income multipliers were within reasonable ranges. When compared to other regional impact studies, the Paper and Allied Products output and income multipliers have yielded results similar to studies using primary data collection techniques. For example, one regional study yielded a type I income multiplier of 1.7 which is the same as in Manistee County and 3.4 for a type II income multiplier compared to 3.0.[1] Users of the input-output

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[1]Jay Hughes, Forestry in Itasca County's Economy (St. Paul: The University of Minnesota, 1966), p. 23.

model for Manistee County should take care in using the results of the export and import for each sector since they were derived as residuals. Errors exist for other entries of the row and column summations. Since net exports and imports are computed as row and column balancing entries, they would then include all the errors from the other data. It may be an inaccurate figure which does not represent true export and import values. Primary collection is needed when considering more accurate values for imports and exports. Similarly because of the size and importance of the household sector primary data collection should be considered. Finally, the input-output model for Manistee County can easily be extended in scope by collecting more environmental impacts for a variety of sectors to show the economic-ecologic trade-offs. The economic input-output model for Manistee County can be used as input for a linear programming land allocation model. It can be used to predict possible land-use shifts which have important policy implications.

The Advantages of Using Secondary Data for Regional Input-Output Analysis

The input-output analysis developed for Manistee County is a value-free tool of economic analysis which was utilized to:

- measure the income and employment impacts of changes in the volume of economic activity of PCA. It showed the distributional impacts of changes in final demand for Forestry and Fisheries and Paper and Allied Products. Also it showed how to schedule output for a given change in demand for corrugated medium.
- project probable levels of economic activity which then can be used by private or public decision-makers.

- develop economic-ecologic relationships through a matrix.

For the businessman, it facilitates an appraisal of their own expansion possibilities and an estimation of marketing potential by looking at the appropriate row. He can use the total sales to each sector to:

- see how its operation differs from the average firm.
- know the specific portion of his sales to total sales for the industry sold to each sector.

It can also be used as a method of appraising alternative development plans or decisions for regional industrial development.

This economic impact study of Manistee County utilized all five possible benefits of an input-output study. Recommendation 1: When making use of data generated from this study public and private decision-makers must spell out their objectives if the "best" choices are to be made. For example, trade-offs may occur between alternative courses or action which may have a high income impact, a low environmental multiplier but a low employment multiplier compared to low income impact, a low environmental multiplier but a high employment multiplier. If maximizing employment is our major objective then there is no problem in selecting the alternative having a high employment multiplier. But choosing which of the conflicting multiple objectives is more difficult and conflicts arise requiring trade-offs. With scarce capital, a project that has a low capital requirement but also a low employment multiplier is difficult to assess. Another factor may be whether to favor one sector or another by expanding an existing sector or developing new industries. The decision to promote a sector may really be a function of whether one objective is to promote growth or

stability, to save on scarce capital or whether one favors large employment or income impacts. Only after priorities have been set for decision-makers can one use an input-output model designed to show economic impacts and find the appropriate solutions. After setting forth priorities, input-output models can only pose questions as to possible trade-offs required.

In short, the input-output model is an odd form of economic model. It does not address itself to the traditional economic questions of maximizing profit, consumers welfare or social welfare. By itself an input-output model is not a choice mechanism which can make public policy decisions. It requires values or objectives which should be set within the planning process but exogenous to the model. Then alternatives can be evaluated and discussed and decisions made.

Recommendation 2: Greater regional economic definition for Manistee County may be needed, but for our purposes we only wanted to look at the impact of the Paper and Allied Products Industry (The Woodpulp Industry) on the designated sectors. Since only a single integrated woodpulp mill existed in sector 6 (SIC 26), further definition was not necessary. If other industries such as recreation or salmon fishing are important to the objectives of the study, then further definition of the economy would be necessary. Therefore, with greater detail one must always ask to what extent this additional information will assist the decision-maker as compared to extra expected costs.

A closely related issue is the data precision requirements of input-output studies and the Manistee County Input-Output Study in particular. The precision level required from an input-output study is a

function of the goals of the project, its benefits and a given cost framework centering on data collection and analysis costs. Whether primary data collected using a sample design or secondary data are required relates to the precision level stipulated by the decision-makers. Each decision-maker or group will place his own assessment of what the benefits are of the information compared to the costs. Similarly there are different assessments of risk and uncertainty made by individuals and groups. The value of the information depends then on who is receiving the information and how they assess the benefits.[1] This must be set given the probability of expected losses (in costs) due to wrong decisions from incorrect information.[2] Thus, once the loss function is specified continual trade-offs between the cost of information processing (which has declined due to high-speed data processing) and requirements of the decision-maker to set an adequate level of data precision must be made. If multiple objectives confront the decision-maker, this vastly complicates the entire process. Input-output models for regional analysis using secondary data provide decision-makers with a very powerful tool at a very low cost. If an acceptable loss function can be found and put in terms of costs then a vast array of benefits accrues to the users due to the vast array of potential uses.

Recommendation 3: Input-output models can have important uses

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[1]See D. E. Chappelle, "How Much Is Information Worth" (West Lafayette, Indiana, 1976).

[2]See D. E. Chappelle, Precision in Allowable Cut Determinations on the National Forests: An Inquiry into the Nature of an Appropriate Loss Function (East Lansing, Michigan, 1975), pp. 14-17.

since they provide planners with guidelines for economic-ecologic interdependencies in community planning. Often in community development studies public decision-makers merely collect more data in the hope that this will provide better solutions. "More and better data are needed if we are to have better planning, but an appropriate analytic framework is needed first so that data will be collected that are relevant to the planning function."[1]

Recommendation 4: Use of secondary data for regional input-output analysis provides answers quickly at low cost and can be used when precision levels are not so high that only a primary data input-output study could meet the study objectives. Furthermore, use of secondary data collection techniques for input-output to view policy alternatives is useful when the planner's budget may require such an approach. It avoids errors due to faulty sample design, inaccurate preparation of interviews and data processing errors which occur in primary data collection of input-output data. So if a powerful tool of economic analysis is available now in a rapidly changing world why not use it rather than waiting when the time lag may be quite long in the preparation of input-output analysis from primary data and the results may not be that different.

Disadvantages of Regional Input-Output Analysis Using Secondary Data

Critics of secondary data techniques point toward the greater inaccuracies of relying on secondary data. This is a moot point at best.

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[1]Daniel E. Chappelle, Regional Models of Economic Activity Involving Natural Resources (East Lansing, Michigan, 1970), p. 31.

Many studies using secondary data use national coefficients which may not be adjusted for regional studies. The pitfalls of this approach are the differences in sector mix, prices, imports and exports, and level of technology between the region and nation. However, as in the Manistee Study, data reduction methods are available to make adjustments.[1] Of course, if the region is a reasonable approximation of the nation then this is not a problem. But regardless of the adjustments made, many observers rightly feel that primary data utilizing sample techniques provides a higher level of precision.

Limitations of Input-Output Analysis in Its Application to Regional Impact Studies

While some claim that input-output analysis is value-free, critics claim that it does contain value judgments. It assumes constant costs which implies a specific institutional framework. Of course, input-output analysis has been adapted to alternative economic societies but perhaps its best use would be in a command society and/or a highly centralized society where resources can be presumed to be directed to specific uses. The major implicit assumptions of input-output models are that prices are outside of the model and assumed constant, constant returns to scale or no substitution effects and the technical mix of inputs does not change which means the multipliers do not change (the multipliers to every scale of every operation remain the same despite the scale of operation). Furthermore, input-output is essentially value-free and does not help government planners introduce a stronger goal-oriented content to the planning process. Also, if economics is finding

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[1]Stipe, Op. Cit., pp. 16-76.

efficient means to achieve given ends with scarce resources, input-output models do not deal with economic choice. However, when resources have serious capital, labor and land-environmental, management and energy constraints, the use of the model becomes much more limited. The input-output model assumes slack resources. In short, an input-output model assumes excess resources of every type to meet exogenously projected final demands. Demand always equals supply, equilibrium always exists and there are no shortages or surpluses. Furthermore, input-output models do not optimize any objective function since it does not have any specific restraints. However, there is an implicit objective function of exactly meeting the final demands which are exogenous. However, the input-output information can be used for linear programming to optimize a specific objective function given a set of constraints. Finally, input-output analysis is essentially static though it can be aided by forecasting techniques in projecting future demand and assessing the structural impacts since the technical coefficients often do not change rapidly. The replacement of a new technique or material takes time to have its impact felt through the entire economic system. It is too costly to perform anything like national or large regional input-output studies yearly from primary data, hence there is a need to adjust the basic input-output matrix. The woodpulp industry is not undergoing any radical changes in the short-run (except the installment of pollution control equipment) and therefore a regional input-output impact study for Manistee County seems reasonable.

There are a large number of social questions left unanswered. The locational dimension of such social costs as transportation costs for

workers and consumers, and immigration patterns of workers are left out of input-output models. For example, in the regional input-output model of Manistee County one cannot answer when there is a change in final demand, what the impact may be on the social costs of alternative transportation patterns or where the additional workers hired or layed off (as the case may be) come from. Another example of the limitations of an input-output model in explaining social impacts is the somewhat rigid assumption of its linkage to the ecologic sectors. Often ecologic impacts are not adequately represented by shadow pricing. There may be intangible impacts which may be left out or underestimated environmental resources (in social terms) when use is made of shadow or minimum pricing. Furthermore, the assumption that ecologic resources have a linear dimension can obscure the real costs of environmental resources.

Alternatives to Regional Input-Output Analysis

The key problem for regional input-output analysis is lack of specific quantitative and qualitative data. This then translates into a cost-time-accuracy dimension. One approach to simplifying data needs is to streamline the form of input-output tables. Richardson lists several general methods which can accomplish this objective:

- obtaining information about sales or purchases, but not both.
- using a rectangular input-output matrix with the number of columns not equal to rows (this is called a hybrid model). This suggests looking at fewer rows when one is not concerned with a detailed breakdown of inputs.
- combining less important sectors together so that only major inter-sectoral flows are traced from primary data.

- aggregation in the size of the table. This approach can be used in avoiding disclosure problems but it also aids in reducing cost and data requirements.[1]

Another approach could be to construct indexes of "internal purchases" and "internal sales" as an alternative to the standard input-output format. Knowing the flow of internal purchases and sales can provide quite a lot of information about a local economy in rural areas that lack the money to do sophisticated research.[2]

In this study we were able to aggregate the input-output table but still retain the detail for sector 6, Paper and Allied Products. Also, a simplified input-output format as outlined previously or just indexes of total sales or purchases for our objectives was not chosen since we wanted to retain the full power of an input-output analysis at a very low cost.

The Future Use of Similar Input-Output Analysis for Regional Studies

Our study of Manistee County has utilized an input-output model which can be applied to a specific industry to assess various environmental impacts, inter-industry relationships or for use in river basin studies which are often of a multi-county nature. The computational simplicity of an input-output model along with the power of its impact analysis utilizing type I and type II income and employment multipliers make this approach highly useful in its applications.

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[1] Richardson, Op. Cit., p. 131.

[2] See Daniel W. Bromley, "An Alternative to Input-Output Models: A Methodological Hypothesis," Land Economics, Vol. 48, No. 2 (May 1972), p. 126.

Using secondary data sources made this investigation very inexpensive. Various tests of secondary data sources have been made. Some researchers have concluded that the advantages of cost-saving and the potential to look at a single sector and its relationships to other sectors and the environment outweigh the advantages of primary data collection in terms of greater precision. In summary, this analysis has shown the potential of tracing county impacts from a single sector using secondary data sources.[1]

It has been observed that "the differences in various input-output studies are primarily in the choice of the economic sectors to be studied and the estimation procedures to be used when secondary data are

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[1]See the following articles for a partial discussion on the advantages of primary versus secondary techniques:

Jerald R. Barnard and Harold K. Charlesworth, "The Kentucky Secondary Data Approach and Its Potential," Growth and Change, Vol. I, No. 2 (April 1970), pp. 33-38.

Karen R. Polenske, "A Commentary on Both Models and Their Uses," Growth and Change, Vol. I, No. 2 (April 1970), pp. 39-40.

Ronald S. Boster and William E. Martin, "The Value of Primary Versus Secondary Data in Interindustry Analysis: A Study in the Economics of Economic Models," Annals of Regional Science, Vol. 6, No. 2 (December 1972), pp. 35-44.

David G. McMenamin and Joseph E. Haring, "An Appraisal of Non-Survey Techniques for Estimating Regional Input-Output Models," Journal of Regional Science, Vol. 14, No. 2 (August 1974), pp. 191-205.

William A. Schaffer, "Estimating Regional Input-Output Coefficients," Review of Regional Studies, Vol. 2, No. 3 (Spring 1972), pp. 51-71.

William A. Schaffer and Kong Chu, "Nonsurvey Techniques for Constructing Regional Interindustry Models," Regional Science Association, Vol. 23 (1969), pp. 83-101.

unavailable."[1] The availability and timing of secondary data is very often of a crucial nature. Recommendation 5: When secondary data or resources are not available or of poor quality in a county or multi-county study, the mixing of primary and secondary data should be used. Therefore, special studies for the household, retail, export and import sectors would be desirable when necessary to increase the accuracy of studies similar to the Manistee County input-output study. All multipliers generated should be checked against other studies (regional and national) to see if they fall within reasonable ranges.

Along with county employment, sales and population data, secondary data was used in the development of an input-output model for Manistee County. It was felt that

> the important aspect of interindustry relations is perhaps not the accuracy of the input-output table--with the possible exception of data such as employment, households, retail, etc., but the ability to experiment with various structural and developmental alternatives and see the effects of changes in one sector on the rest of the region's economy.[2]

We are interested in the direction of change and its potential impacts rather than being overly concerned that the input-output tables be perfectly accurate. That is our justification for using only secondary data for the regional input-output study of Manistee County.

It is always a problem in research to decide how much additional data is needed. Recommendation 6: For research that is concerned with

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[1]Cyrus K. Motlagh, Evaluation of Input-Output Analysis as a Tool for the Study of Economic Structure of the Grand Traverse Bay Area, University of Michigan Bureau of Business Research, Graduate School of Business Administration Working Paper No. 36, p. 14.

[2]Ibid, p. 15.

more than the direction of change and potential impacts but not the levels of accuracy that primary data can give, an intermediate approach as suggested earlier, is recommended for regional input-output analysis. The household sector and import and export sectors plus the sector or sectors to be studied may require primary data. All these sectors are of importance because of their size (the household sector), the high degree of possible error (import and export sectors) and because various sectors are crucial to the regional input-output study. Hence, a hybred approach is recommended.

Estimation procedures are either the bottom-up (the pure) approach or the top-down (the balanced) approach. The top-down approach was utilized here with the starting point being the model of a state (Michigan) via the MRIO (Multiregional Input-Output Model constructed by the Harvard Economic Research Project and available through the National Technical Information Service).[1] This approach was thought to be accurate in disaggregating national tables. Projections of final demands to 1980 are also available from the Harvard work. Some additional advantages are that a state table for each state was developed. The MRIO puts each state model in a consistent framework. That is, all the fifty states add up to a balanced national input-output table using standardized allocation techniques. If changes are made in regional models they will not be additive. The consistency of this approach is very important since one region or state could have an undue comparative advantage if the approach was not derived this way. The Polenske

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[1]Karen Polenske, The Implementation of a Multiregional Input-Output Model for the United States (1972), pp. 171-189.

approach then represents a top-down approach since the state input-output tables are derived from national input-output tables. However, there are several disadvantages of the MRIO approach. The estimates for the state input-output tables are done by allocation techniques which are necessarily arbitrary. It is not an inter-regional model but a multi-regional model. By that we mean that the input-output table does not have trade coefficients. Finally, it has all the disadvantages of using secondary data for an input-output model such as pricing problems over space and variations of industrial mix over space.

The bottom-up approach will perhaps in the long-run yield valuable research results. Yet unless counties and other sub-state regional institutions, state and Title II and Title V Commissions find ways of increasing their independent source of revenues, bottom-up input-output studies will not materialize. As population and rising demand press against scarce resources the externalities will spill over county and state boundaries. Hence, sub-state and multi-state regionalism can be a potent force in providing data from a grass-roots level as these institutions are upgraded. The overall effect of this will be greater citizen involvement at the local level in decision-making on economic-ecologic problems. The institutional level at which this approach will receive its major thrust, if at all, cannot be predicted, but efforts along these lines must be consistent with each other. For example, will counties develop models which are additive so that sub-state regions, states, multi-state regional bodies and national planners can use them in assessing larger regional models? This study has shown the resources are available now to use the top-down approach to county

input-output models but the future may see increased use of a hybrid approach of both secondary and primary data or the possible development of the bottom-up approach as the decentralization process becomes stronger in American institutions. Certainly, county, multi-regional and river basin studies can make good practical use of a hybrid approach.

APPENDICES

APPENDIX 1

CLASSIFICATION OF PAPER AND ALLIED PRODUCTS INDUSTRY[1]

This report shows 1958 Census of Manufactures statistics for establishments classified in each of the following industries:

S.I.C. Code and Title (1957 Edition)

2611--Pulp Mills

2621--Paper Mills, Except Building Paper Mills

2631--Paperboard Mills

2661--Building Paper and Building Board Mills

While there is some overlap in the shipments of products primary to each of the industries in this group, the specialization for this group of industries collectively is very high. In 1958, shipments by mills in this group of industries consisted of 99 percent pulp, paper and board, and only 1 percent of other products (chiefly converted paper and board products and basic chemicals produced as a by-product of the pulp operations). These establishments also accounted for approximately 100 percent of the pulp, paper and board produced in all manufacturing industries.

Although some duplication occurs where the wood pulp and other products produced by mills classified in industry 2611 are shipped to paper and board mills for incorporation into the products of

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[1]U.S. Bureau of The Census, 1958 Census of Manufacturing, Vol. 1.

establishments classified in industries 2621 and 2631, this situation does not exist for paper, board and converted products.

2611--Pulp Mills

This industry comprises establishments primarily engaged in Manufacturing pulp from wood or from other materials such as rags, linters, wastepaper, and straw. Logging camps operated by pulp mills, and not separately reported, are also included in this industry. Establishments primarily engaged in cutting pulpwood are classified in Industry 2411; and pulp mills combined with paper mills or paperboard mills, and not separately reported, are classified with the latter in Industries 2621 and 2631, respectively. For a detailed list of products of Industry 2611, refer to table 6A, product codes 2611111 to 2611289.

The code number for this industry in the 1957 revision of the Standard Industrial Classification Manual is unchanged, but the content of the industry has been significantly changed from the previous classification system. In the 1958 Census of Manufactures, pulp mills operated in conjunction with a paper and board mill at the same location were permitted to file a combined report for such integrated operations. However, in 1954 all pulp mill activity was separately reported whether or not such pulpmill operations were conducted at the same physical location as an associated paper or board mill. This change in treatment has the effect of restricting the reporting of a "pulp mill" for classification in Industry 2611 in the 1958 Census to the following situations:

(a) Those pulp mills which are not affiliated with any paper and board mills and ship all their products to the market;

(b) Pulp mills affiliated or associated with a primary paper or board mill but which are separately located from the pulp mill; and

(c) A few pulp mills affiliated or associated with a primary paper or board mill at the same physical location, where separate departmental records of employment, materials, and fuel costs, shipments, etc., are maintained for the pulp mill from those covering the paper or board mill at that location and the company elected to file such a separate report.

The above-described change in the concept for treating Industry 2611 was made effective in 1955, and as a result comparable figures for previous Censuses are not available for this industry. To provide historical comparison, table 1 has been prepared to show the old SIC Group 261, Pulp, Paper, and Board, for 1957 and earlier years.

In addition, tall oil, formerly classified in this industry, is now considered primary to Industry 2861, Gum and Wood Chemicals, and tall oil fatty acids, also formerly classified in this industry, are now considered primary to Industry 2894, Fatty Acids.

Value of shipments and other receipts of the Pulp Mill industry in 1958 totaled $428 million. This included shipments of wood pulp and other pulp mill products, except tall oil (primary products), valued at $417 million, shipments of other products (secondary products) valued at $10 million, and miscellaneous receipts (all resales) of $1 million.

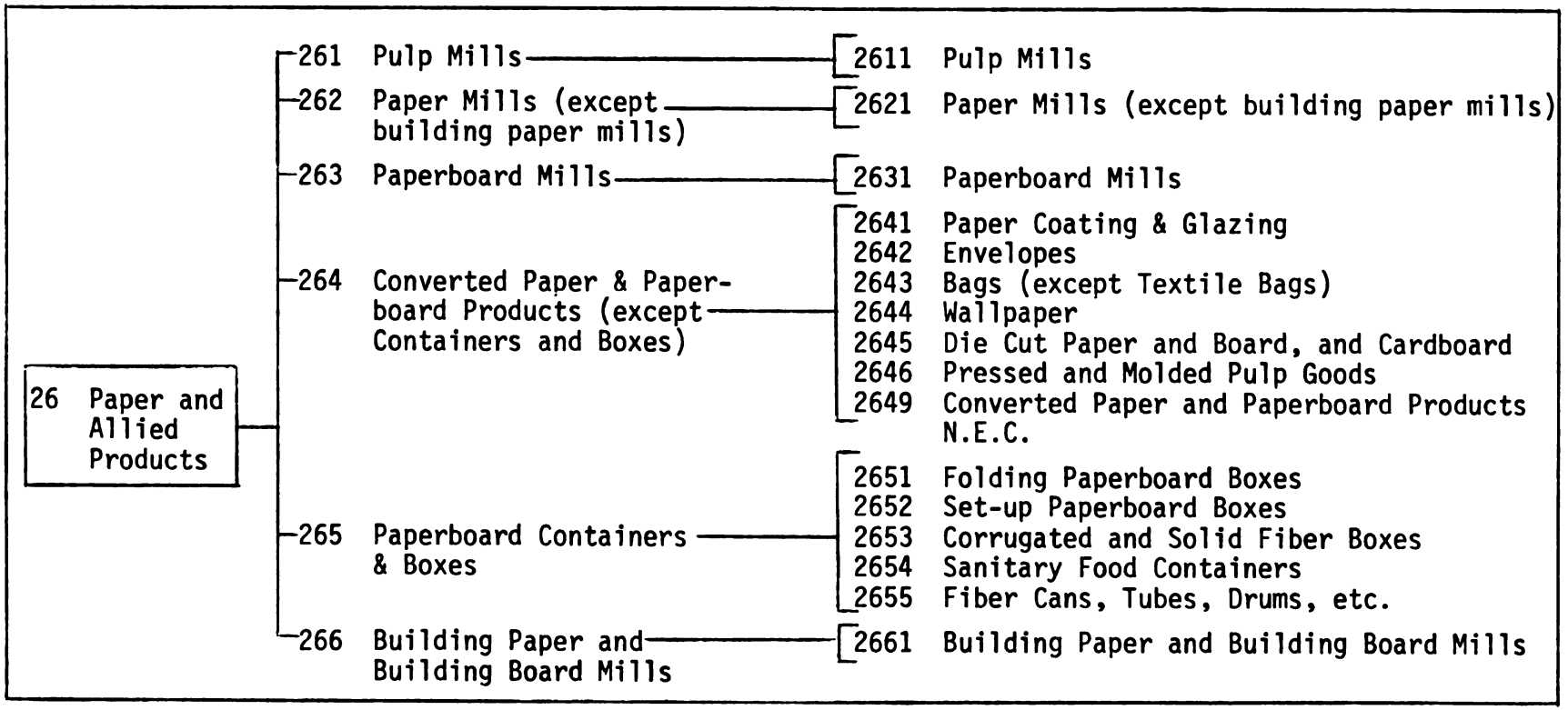
This industry's shipments of wood pulp and other pulp mill products (primary products) in 1958 represented 98 percent (specialization ratio) of its total product shipments (primary and secondary).

Secondary products shipped by this industry in 1958 consisted almost entirely of paperboard, alkalies and chlorine, and tall oil.

Industry 2611 shipments of wood pulp and other pulp mill products (primary products) in 1958 represented 73 percent (coverage ratio) of these products valued at $568 million shipped by all industries. Other industries shipping wood pulp (primary products) consisted mainly of Industry 2621, Paper Mills, Except Building, $124 million; and Industry 2631, Paperboard Mills, $25 million.

APPENDIX 2

STRUCTURE OF PAPER AND ALLIED PRODUCTS INDUSTRY GROUP #26



SOURCE: United States Bureau of the Budget, 1957 Standard Industrial Classification Manual.

APPENDIX 3

THE MAJOR ECONOMIC CHARACTERISTICS OF PAPER MANUFACTURING[1]

Paper manufacture and distribution is distinguished by ten major characteristics which are of paramount importance in understanding both historical and current price movements.

1. High Capital Intensity

The process of paper manufacture is highly capital invensive. Approximately 5.6 percent of current dollar shipments volume is devoted to new investment, which is second only to the chemical industry which spends approximately seven percent of each sales dollar on new investment. A major corollary of very high capital intensity is that operating rates in paper manufacturing must be maintained at comparatively elevated levels to keep the sector in a viable financial position. Typically, only at rates well above 90 percent can an acceptable return on investment be earned on relatively new higher-cost facilities. Old or fully depreciated facilities can operate with apparent profitability at lower rates.

2. Production-Oriented

Because of the heavy burden of fixed charges, and large additions of productive capacity, paper manufacturing has historically tended to

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[1] J. Sanford Smith, "The Economics of Papermaking," May 1976.

be production oriented at the expense of short-term profitability.

3. High Energy User

The production process requires substantial energy inputs. The production of one ton of paper requires the energy equivalent of six barrels of oil, which is more than is required to produce one ton of steel.

4. Heavy Chemical Consumer

The manufacture of every ton of paper consumes approximately a quarter of ton of chemicals. The production of pulp and paper accounts for about 90 percent of the North American consumption of saltcake, 75 percent of the alum, and 16 percent of the chlorine.

5. Heavy Environmental Investments

Because of the industry's strong commitment to environmental cleanliness, it devotes a large portion of capital resources to pollution abatement equipment, a process which will continue for many years under increasingly stringent environmental standards.

6. Relatively Low Concentration

Concentration is low, especially when compared to other capital-intensive industries such as chemicals, petroleum refining, rubber, iron and steel, and aluminum. Approximately 18 companies account for 50 percent of primary paper and paperboard tonnage. The top ten companies account for only 35 percent of total tonnage.

7. Heavy Debt Structure

The capacity to acquire debt has effectively been exhausted in

recent years. The long-term debt/equity ratio for the industry segment as a whole has risen from a modest .23 in 1958 to .58 in 1975. Over the same period, the long-term debt/equity ratio in total manufacturing has risen from .20 to .43 which indicates the relative deterioration in the financial position of the paper business.

8. Highly-Depreciated Asset Base

The paper business is mature in the sense of its years in existence, and this fact is reflected in the age distribution of mill facilities. A considerable block of productive facilities has been in operation for many years, and despite periodic modernization programs, is largely depreciated. For example, in the case of IP, the average age of our mills is 36 years.

9. Relatively Stable Demand Growth

Historically, consumption of paper and paperboard in the United States has closely tracked growth in real Gross National Product. Indeed, each billion dollar improvement in real GNP has rather consistently generated an additional 80,000 tons of paper and paperboard consumption.

10. Relative Instability in Earnings

One of the major contradictions of the paper business has been the marked cyclical variability of earnings in spite of a stable final demand profile. This historic pattern can be attributed to "binges" in new capacity additions, as well as to wide swings in inventory accumulation in the distribution and utilization chain. The paper and pulp segment of the forest products industry has been characterized

by additions to new capacity in large, discrete blocks which drive returns on invested capital to unsatisfactory levels. Such a process has always meant an excess of capacity in advance of society's needs, but economic conditions in recent years indicate that such overbuilding of capacity will no longer be financially feasible.

APPENDIX 4

TABLE 64

ACTIVE WOODPULP MILLS IN THE LAKE STATES BY LOCATION, TYPE OF PULP PRODUCED, AND CAPACITY, 1974

Company	Location	Mill Capacity in Tons Per 24 Hours				
		Total	Sulfite	Sulfate	Groundwood and Other Mechanical	Semi-Chemical
Michigan:						
Abitibi Corp.	Alpena	430	0	0	430	0
Celotex Corp.	L'Anse	270	0	0	270	0
Hoerner-Waldorf Corp.	Ontonagon	220	0	0	0	220
Manistique Pulp & Paper	Manistique	90	0	0	90	0
Mead Corp.	Escanaba	750	0	600	150	0
Menasha Corp.	Otsego	225	0	0	0	225
Packaging Corp. of Am.	Filer City	400	0	0	0	400
Warren Co., S.D.	Muskegon	240	0	240	0	0
Total	8 Plants	2,625	0	840	940	845
Minnesota:						
Blandin Paper Co.	Grand Rapids	250	0	0	170	80
Hennepin Paper Co.	Little Falls	75	0	0	75	0
Boise Cascade Corp.	International Falls	770	0	320	450	0
Potlatch Corp.	Cloquet	520	120	400	0	0
Superwood Corp.	Bemioji	90	0	0	90	0
St. Regis Paper Co.	Sariell	125	0	0	125	0
Superwood Corp.	Duluth	350	0	0	350	0
Hoerner-Waldorf Corp.	St. Paul	300	0	0	0	300

TABLE 64--Continued.

Company	Location	Mill Capacity in Tons Per 24 Hours				
		Total	Sulfite	Sulfate	Groundwood and Other Mechanical	Semi-Chemical
Minnesota: (continued)						
Conwed Corp.	Cloquet	350	0	0	350	0
Total	9 Plants	2,830	120	720	1,610	380
Wisconsin:						
American Can Co.	Green Bay	210	150	0	60	0
Weyerhauser Co.	Rothschild	200	200	0	60	0
Badger Paper Mills	Peshtigo	110	110	0	0	0
Appleton Papers, Inc.	Combined Locks	200	0	0	200	0
Consolidated Papers, Inc.	Appleton	175	175	0	0	0
Consolidated Papers, Inc.	Stevens Point	100	0	0	100	0
Consolidated Papers, Inc.	Wisconsin Rapids	625	0	400	225	0
Green Bay Packaging, Inc.	Green Bay	200	0	0	0	200
Flambeau Paper Co.	Park Falls	115	115	0	0	0
Kimberly-Clark, Corp.	Kimberly	115	0	0	115	0
Pentair Industries	Niagara	170	0	0	170	0
Mosinee Paper Mills Co.	Mosinee	200	0	200	0	0
Nekoosa-Edwards Paper Co.	Nekoosa	310	0	310	0	0
Nekoosa-Edwards Paper Co.	Port Edwards	215	215	0	0	0
Owens-Illinois	Tomahawk	620	0	0	0	620
Charmin Paper Products	Green Bay	1/	1/	1/	1/	1/
Scott Paper Co.	Oconto Falls	110	110	0	0	0
St. Regis Paper Co.	Rhinelander	120	120	0	0	0
Flinkote Company	Cornell	50	0	0	50	0
Superior Fibre Products	Superior	180	0	0	180	0
Thilmany Pulp and Paper	Kaukauna	400	0	400	0	0

TABLE 64--Continued.

Company	Location	Mill Capacity in Tons Per 24 Hours				
		Total	Sulfite	Sulfate	Groundwood and Others Mechanical	Semi-Chemical
Wisconsin: (continued)						
Tomahawk Pulp Co. Inc.	Tomahawk	50	0	0	50	0
Wausau Paper Mills Co.	Brokaw	185	185	0	0	0
Evans Products Co.	Phillips	100	0	0	100	0
Total	24 Plants	4,760	1,380	1,310	1,250	820
All States	41 Plants	10,215	1,500	2,870	3,800	2,045

1/ Capacity not available.

SOURCE: James E. Blyth and Jerold T. Hahn, Pulpwood Production in the North Central Region by County, 1974.

APPENDIX 5

PACKAGING CORPORATION OF AMERICA LETTER

TO SELLERS OF PULPWOOD

This PCA organizational letter shows that its prospective buyers, state and federal forests and competing companies, are located mainly in the entire central region of the northern Lower Peninsula.

Organization letter of March 13, 1974 from R.A.Y. to the following:

Ranger Districts: U.S.F.S. Manistee, Baldwin, White Cloud, Mio, Tawas, Harrisville, Cadillac

Nels Johnson, Roscommon 48653 (Reg. Game Mgr., MDNR)

Daniel F. Bonner, Traverse City 49684 (Fife Lake State Forest, Area Forester)

Lee Sherwood, Area Forester, Ogemaw State Forest, West Branch, Mich. 48661

William H. Tarr, Area Forester, Au Sable State Forest, Grayling, Mich. 49738

Lynn B. Mohr, Area Forester, Tittabawasee River State Forest, 801 N. Silverleaf Street, Gladwin, Mich. 48624

Robert J. Slater, Area Forester, Kalkaska State Forest, Court House, Kalkaska, Mich. 49646

Eugene C. Phillips, Area Forester, Thunder Bay River State Forest, MDNR, Atlanta, Mich. 49709

Jerry L. Lawrence, Area Forester, Pigeon River State Forest, Gaylord, Michigan

Robert E. Leeson, Area Forester, Pere Marquette State Forest, Baldwin, Michigan

Ted M. Reuschel, Area Forester, Betsie River State Forest, Box 158, Beulah, Mich. 49617

Donald L. Torchia, Area Forester, Houghton Lake State Forest, Box 158, H. Lake Heights, Mich.

J. Doyle Voice, Area Forester, Missaukee State Forest, H. Lake Heights, Mich.

Leon E. Erbe, Area Forester, Oscoda State Forest, Mio, Mich. 48747

Rodney J. Rugg, Area Forester, Chippewa River State Forest, Paris, Mich.

Jack P. Lockwood, Area Forester, Jorday River State Forest, P.O. Box 120, Boyne City, Mich.

Horace H. LaBumbard, Timber Management & Wildlife Staff Officer, USFS, Cadillac, Mich.

Robert A. Borak, Regional Forest Supervisor, MDNR, Regional Headquarters, Roscommon, Mich.

Craig J. Taggart, Timberlands Manager, Champion International, Gaylord, Mich.

James C. Lamy, Woods Manager, Abitibi Corporation, 416 Ford Ave., Alpena, Mich.

John Hanson, Woodlands Manager, Menasha Corporation, Otsego, Mich.

John N. Fields, Woodlands Manager, S.D. Warren Company, 2400 Lakeshore Drive, Muskegon, Mich.

APPENDIX 6

ALTERNATIVE SOURCES OF MICHIGAN STUMPAGE VALUES

The U.S. Forest Service Handbook of Timber Appraisal and The Michigan DNR's (Division of Forestry) Michigan State Forest Volumnes And Stumpage Prices By Districts are excellent sources for making yearly comparisons by geographic area for stumpage prices. They are in various log scales so conversion factors must be used.

APPENDIX 7

TABLE 65

TOTAL PULPWOOD PRODUCTION FOR MICHIGAN FOR THE UPPER AND LOWER PENINSULA 1960 TO 1974, STANDARD CORDS (ROUGH)

Year	Upper Peninsula	Percent	Lower Peninsula	Percent	State Total
1974	1,165,773	61	744,360	39	1,910,133
1973	969,757	58	750,217	42	1,719,947
1972	805,073	53	703,359	47	1,508,432
1971	699,046	51	662,557	49	1,361,603
1970	735,586	52	670,604	48	1,406,190
1969	679,178	52	622,725	48	1,301,903
1968	575,226	49	592,370	51	1,167,598
1967	803,496	60	539,461	40	1,343,957
1966	837,339	53	698,938	47	1,570,639
1965	771,365	57	593,775	43	1,365,140
1964	750,492	57	570,963	43	1,321,455
1963	779,887	60	517,128	40	1,297,015
1962	704,280	58	419,014	42	1,223,294
1961	602,880	55	489,157	45	1,092,037
1960	689,976	55	566,452	45	1,256,428

SOURCE: Michigan Department of Natural Resources, Forestry Division, Michigan Pulpwood Production 1960-1974.

Note: Total pulpwood includes residues. Very little pulpwood production comes from the southern half of the Lower Peninsula. This data may be further broken down for volumes of timber from Michigan State Forests and U.S. Federal Forests (see: Department of Natural Resources, Forestry Division, Michigan State Forest Volumes and Stumpage Prices by District, 1975-1960. U.S.D.A. Forest Service, Timber Cut and Sold (Region 9), FY 1975-1960).

APPENDIX 8

IMPLICATIONS OF USING ASPEN IN PULPING OPERATIONS

Aspen is the dominant tree species in Michigan (see table 66). It has a short growing cycle and can be regenerated by clear-cutting. The implications of table 66 are:

- pulp mills will have to shift their wood procurement to other areas or plan on using less aspen. This means increased costs due to higher transportation costs or shifts to high cost timber. However, without change in procurement, aspen prices would rise.
- plants planning expansion or new mills should not use capital equipment favoring aspen but should seek an alternative species.
- deer and grouse management will suffer with declining growth of aspen. All these conclusions will especially affect PCA in the future as their current operation is 65% dependent on aspen. Further expansion may require a different capital investment for machinery which needs species other than aspen.

TABLE 66

MICHIGAN ASPEN CUT AND GROWING STOCK, ALL COVER TYPES, BY SURVEY UNIT, YEAR, AND 5-YEAR AVERAGE

Year	Cut Million Cubic Feet	Growing Stock Billion Cubic Feet
Eastern Upper Peninsula		
1970	15.2	.35
1975	17.4	.37
1980	19.5	.38
1985	21.6	.37
1990	26.9	.34
1995	29.5	.27
2000	24.6	.24
Western Upper Peninsula		
1970	22.9	.63
1975	26.1	.59
1980	29.3	.53
1985	32.5	.46
1990	40.3	.35
1995	41.5	.26
2000	27.7	.14
Northern Lower Peninsula		
1970	38.1	1.08
1975	43.4	1.00
1980	48.8	.88
1985	54.1	.73
1990	59.5	.55
1995	64.8	.33
2000	57.3	.20

SOURCE: William A. Leuschner, Projecting the Aspen Resource in the Lake States.

Note: Projections assume recent timber practices continue into the future.

APPENDIX 9

WOODPULPING WATER REQUIREMENTS AND 5-DAY BOD DISCHARGES

Pulping requires relatively large quantities of process water, although it is essentially nonconsumptive insofar as water volumes are concerned. Even larger quantities of water than needed for processing must be flowing in the stream, however, simply to dilute the wastes discharged from the pulpmill. Approximate water-volume requirements for pulp and paper processing are as follows:

	Groundwood	Semichemical	Sulfate
	(Gallons per ton of pulp)		
Pulpmill	1,000	3,000-20,000	20,000-40,000
Bleaching	1,000		
Partial		20,000	20,000
Full		40,000	40,000
Papermill	7,000-10,000	10,000-25,000	10,000-20,000

Water for debarking will vary from 0 to 7,500 gallons per ton of pulp, depending on pulping technique, process used, and equipment.

Pollution is a technically complex subject; however, with regard to pulpmill pollution of water, the most important factor is the demand of organic mill wastes upon the dissolved oxygen content of the receiving water. This oxygen-depletion characteristic is called Biochemical Oxygen Demand (BOD). Because Colorado River water is used as a

domestic supply by two adjacent towns, Colorado State Health Department regulations state that waste loads discharged to the river must not exceed a 5-day 20°C. BOD of 30 parts per million (p.p.m.). BOD characteristics of various pulping processes assumed applicable in the Colorado River study area follow:

	5-day 20°C. BOD[1] (Pounds per ton of pulp)
Sulfate	50
Groundwood	3-10
Semichemical:	
No chemical recovery	275
Chemical recovery	25-140

[1]Jay Hughes, Pulp and Papermaking Opportunities in West Central Colorado.

APPENDIX 10

TABLE 67

VALUE-ADDED PER DOLLAR OF GROSS OUTPUT AND VALUE-ADDED PER EMPLOYEE, CHARLESTON, SOUTH CAROLINA STUDY AREA, 1968

	Value-Added Per Dollar Gross Output[a]	Value-Added Per Employee
1. Ag., Forestry and Fisheries	.4126[c]	2,822
2. Food and Kindred Products	.2655[c]	2,947
3. Construction and Mining	.4130[b]	8,425
4. Textiles and Apparel Mfg.	.3804	1,316
5. Lumber, Pulp & Paper Prods.	.3430	8,913
6. Furniture & Fixtures Mfg.	.4315	4,248
7. Printers & Publishers	.4700	4,781
8. Chemical Manufacturing	.4680	2,625
9. Petroleum & Coal Mfg.	.2505	392
10. Rubber, Plastic & Related Prods.	.4454	1,483
11. Stone, Clay & Glass Prods.	.4902	1,293
12. Machinery & Metal Shops	.4181	3,063
13. Miscellaneous Manufacturing	.4029[b]	2,455
14. Transportation	.6071[b]	4,074
15. Communications	.5141	1,455
16. Utilities	.5606	12,154
17. Eating & Drinking Places	.6175[b]	7,049
18. Hotels & Lodging Places	.6745[b]	2,854
19. Gasoline Service Stations	.4680	21,881
20. Other Wholesale & Retail Trade	.7245[b]	26,263
21. Finance and Insurance	.5602[b]	7,217
22. Real Estate	.7223[b]	21,175
23. Other Business & Professional Services	.5120[b]	2,031
24. Local & State Government	--	--
25. Defense-Related Government	.0000	--
26. Other Federal Government	.0000	--
27. Households	--	--
28. Unallocated	.4001[c]	4,830

[a]Unless otherwise specified, figures are adjusted from value-added coefficients in Canion, Robert L. and Warren L. Trock, Input-Output as

a Method of Evaluation of the Economic Impact of Water Resource Development, Water Resources Institute, Texas A&M University, May 1968, pp. 38-39.

[b]Office of Business Economics, Survey of Current Business, United States Department of Commerce, Washington, D. C., Vol. 49, No. 11, November 1969.

[c]Charleston Survey.

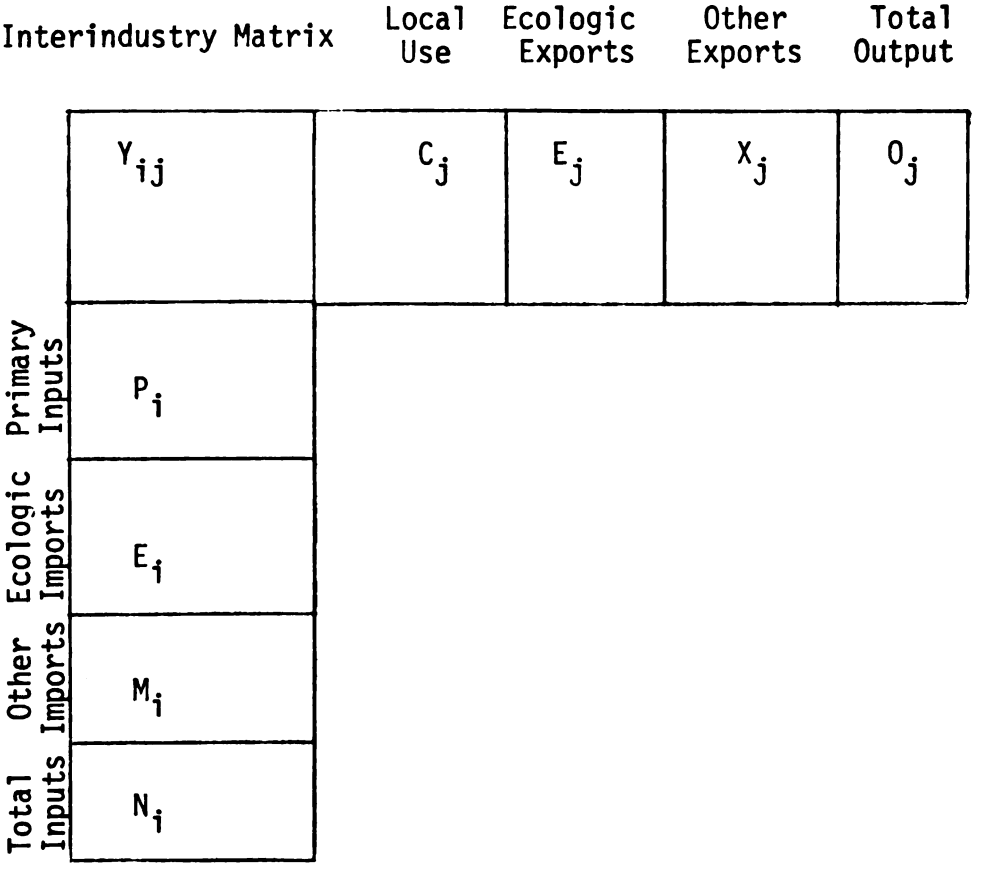
[d]Sector 24 & Sector 6.

SOURCE: Laurent and Hite, Economic-Ecologic Analysis in the Charlestown Metropolitan Region: An Input-Output Study, April 1971.

APPENDIX 11

THE ECONOMIC-ECOLOGIC MODEL WITHIN A LEONTIEF GENERAL PRODUCTION SYSTEM

It is useful to view the ecologic model as fitting into the overall input-output model. It is difficult to put dollar values on environmental goods. Environmental goods form a separate matrix which when quantified by post-multiplying the environmental matrix by the inverse of the input-output model show the economic-ecologic linkages. The following chart emphasizes the economic-ecologic linkages.



The above chart was developed by Eugene A. Laurent and James C. Hite of the Water Resources Research Institute, Clemson University.[1]

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[1]Eugene A. Laurent and James C. Hite, Economic-Ecologic Analysis in the Charlestown Metropolitan Region: An Input-Output Study, Water Resources Research Institute, Clemson University.

APPENDIX 12

TABLE 68

THE DIRECT ENVIRONMENTAL IMPACT OF A DOLLAR INCREASE IN OUTPUT BY SECTORS FOR MANISTEE COUNTY, 1970

Sector*	Total Water Intake	5-Day BOD (lbs)
1. Agriculture		
2. Forestry, Fish		
3. Mining		
4. Construction		
5. Lumber & Lumber Products		
6. Paper & Allied Products	2.47 lbs.	.002 to .012
7. Manufacturing		
8. Transportation		
9. Comm., Public Utils.		
10. Trade		
11. Finance, Ins., Real Est.		
12. Lodging Services		
13. Amusement Services		
14. Other Services		
15. Government		

*Other environmental linkages could include hydrodarbons (lbs.), sulfur dioxides (lbs.) and solid wastes (cu. yards) to name just a few.

APPENDIX 13

TABLE 69

DIRECT ENVIRONMENTAL IMPACTS FOR A DOLLAR INCREASE
BY SECTOR FOR MANISTEE COUNTY, 1970

Sector	Total Water Intake	5-Day BOD (lbs)
1. Agriculture		
2. Forestry, Fish		
3. Mining		
4. Construction		
5. Lumber & Lumber Products		
6. Paper & Allied Products	(2.47 x 2.1) = 5.1	(.002 or .012 x 2.1) = .004 or .025
7. Manufacturing		
8. Transportation		
9. Comm., Public Utils.		
10. Trade		
11. Finance, Ins., Real Est.		
12. Lodging Services		
13. Amusement Services		
14. Other Services		
15. Government		

*Environmental Matrix x Inverse.

APPENDIX 14

TABLE 70

MANISTEE COUNTY VALUE-ADDED MATRIX FOR 1970

Sector*	
1. Agriculture	
2. Forestry, Fish	
3. Mining	
4. Construction	
5. Lumber & Lumber Products	
6. Paper & Allied Products	.71
7. Manufacturing	
8. Transportation	
9. Comm., Public Utils.	
10. Trade	
11. Finance, Ins., Real Est.	
12. Lodging Services	
13. Amusement Services	
14. Other Services	
15. Government	

*Each sector x the inverse of that sector summed equals the value-added for that sector.

APPENDIX 15

TABLE 71

DIRECT ENVIRONMENTAL IMPACTS PER DOLLAR OF LOCAL INCOME FOR MANISTEE COUNTY, 1970

Sector*	Total Water Intake	5-Day BOD (lbs)
1. Agriculture		
2. Forestry, Fish		
3. Mining		
4. Construction		
5. Lumber & Lumber Products		
6. Paper & Allied Products	.71 x 5.1 = 3.6	.71 x .004 or .025 x .017
7. Manufacturing		
8. Transportation		
9. Comm. Public Utils.		
10. Trade		
11. Finance, Ins., Real Est.		
12. Lodging Services		
13. Amusement Services		
14. Other Services		
15. Government		

*Value-Added Matrix x table 69 = Direct Environmental Emissions Per Dollar.

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