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TOWARD A FRAMEWORK FOR CONSIDERING THE ECONOMICS OF SURFACE COAL MINING ON MICHIGAN AGRICULTURAL LANDS

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PREFACE

This report is drawn from a study by Mary Patrino, supported by Michigan Agricultural Experiment Station, Michigan State University. The full study is an unpublished Masters thesis for the Department of Agricultural Economics. Assistance and cooperation by personnel of the Land Resource Programs Division and the Geological Survey Division of the Michigan Department of Natural Resources were instrumental to completion of this study.

The manuscript was reviewed by Dr. Eileen van Ravenswaay from the Department of Agricultural Economics and Dr. Daniel Chappelle from the Department of Resource Development, both at Michigan State University. Their comments and suggestions helped produce what is hopefully a useful report. The reviewers should not, however, be held accountable for the final product.

Authors are, respectively, Research Analyst for the Oregon State legislature and Professor of Agricultural Economics at Michigan State University.

TOWARD A FRAMEWORK FOR CONSIDERING THE ECONOMICS OF SURFACE COAL MINING ON MICHIGAN AGRICULTURAL LANDS*

INTRODUCTION

Beginning in the late 1970's, small surface coal mine operators began expressing interest in developing the bituminous coal resources located in the southeastern portion of the lower peninsula of Michigan. Although Michigan has never been a major coal producing state, surface and underground mines produced more than forty-six million tons of coal between 1835 and 1976 (Webber and Ehlke, p. 64, 1981). Higher prices for energy fuels, more efficient extraction methods, an increasing demand for coal and a nearby coal market have led potential investors to conclude that coal mining can be profitable in Michigan during the 1980's and 1990's (Roethele and Parrish, p. 37, 1982). State officials feel that surface coal mining will contribute to the state economy by providing new employment opportunities, attracting industry into the state, and decreasing the amount of coal imported to meet state energy demands.

A significant amount of the state's strippable coal reserve underlies agricultural land considered essential to the future of the Michigan economy. The renewal of surface coal mining in Michigan will cause withdrawals from the supply of land available to meet future demand for farmland and agricultural products. In addition, the impending actions elicit concerns over the impacts surface coal mining will have on the land, the surrounding environment, and the communities in which the mining occurs. In response to these concerns, the state legislature passed the Michigan Surface and Underground Mine Reclamation Act (P.A. 303) on October 12, 1982. This Act, patterned after the Federal Surface Mining Control

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Michigan Agricultural Experiment Station Article No. 12144.

and Reclamation Act of 1977 (P.L. 95-87), is intended to protect agricultural lands and the surrounding environment through the implementation of a regulatory framework to control the operation of surface mines in the State.

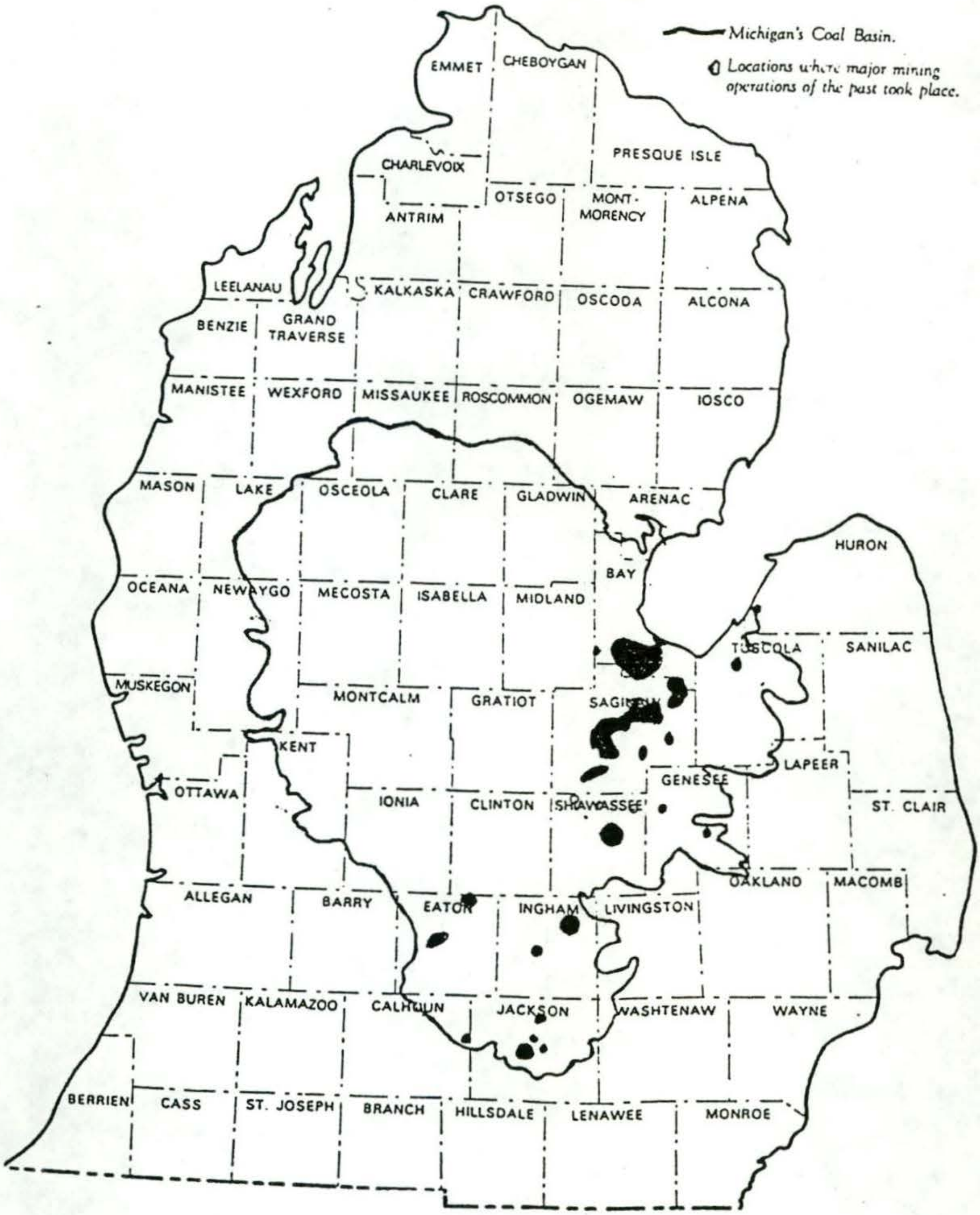
The purpose of this report is to examine surface coal mining on Michigan agricultural lands within an economic framework. By applying the conceptual framework of economics to the situational variables existing in Michigan, a perspective and procedure are developed that will be of use in future policy decisions related to surface mining.

COAL RESOURCES OF MICHIGAN

This section establishes the background for the study through a discussion of the history and characteristics of the Michigan coal resources as well as a brief description of the role of agriculture in the Michigan economy.

History of Coal Mining in Michigan

Coal mining in Michigan began in 1835 when workmen digging the foundation for a grist mill in Jackson County (see Figure 1) discovered a small seam of coal (Cohee et al., p. 4, 1950). In 1860, the first year that records were kept, 2,320 tons of coal were produced in Michigan. With exception of a period of low production between 1883 and 1894, production rose steadily until the turn of the century. The opening of two underground mines in Bay and Saginaw Counties in 1897 led to a doubling of coal production and resulted in the coal industry playing a significant role in the state economy during the late 1800's and early 1900's (Ibid, pp. 4-56). Production peaked in 1907 when thirty-seven mines produced 2,035,858 tons of coal with a dollar value of $3,660,833 (Webber and Ehlke, p. 63, 1982). After 1907 production steadily declined. By 1946 only the Swan Creek Mine, located northeast of St. Charles in Saginaw County, was operating with an average output of eighty tons per day. In 1952, when more coal was being produced than sold, the mine closed (Arnold, p. 101, 1954).



Source: Roethele and Parrish (1982).

Figure 1

Michigan Coal Basin

The closing of the Swan Creek Mine effectively ended the era of coal production in Michigan. Analysts of the era (Cohee 1950, Arnold 1954, and Dorr and Eschman, 1970) agree that the decline of the Michigan coal industry can be traced to three main sources: (1) competition from coal-rich Appalachian states, (2) the high cost and difficulty involved in extracting Michigan coal, (3) the relatively poor quality and low concentration of Michigan coal. In essence, high prices for Michigan coal led consumers to choose lower priced, higher quality substitutes from Appalachian states. The oil embargo of the early 1970's and subsequent rise in the price of petroleum fuels induced the reopening of an abandoned surface mine south of Williamston, Michigan, for a two year period, 1974-1976. The operation produced and sold approximately 20,000 tons of coal to a local utility company (Minerals Yearbook, p. 377, 1976). Since 1977, there has been on commercial production of coal in Michigan.

Michigan Coal Basin

The geological structure in which Michigan coal lies is called the Michigan Basin. The structure, extending over 11,500 square miles in the central portion of the lower peninsula, is bounded on the north by Houghton Lake, on the south by Jackson, on the east by Bay City, and on the west by Big Rapids.

The coal beds are essentially flat, dipping toward the center of the basin at an average rate of 20 to 50 feet per mile and varying in thickness from several inches to several feet (Bureau of Mines, Staff, p. 41, 1971). Only a few of the coal beds in Michigan average more than three feet in thickness. The irregularities of the coal beds are described as "varying in thickness from thirty to fifty feet or more in a quarter mile; thicken thin or pinch out entirely in a few hundred feet, or split into two or more distinct beds" (Cohee et al., p. 4, 1950). These irregularities cause coal mined in one location to exhibit different characteristics from that mined a short distance away. The size of any one bed is relatively limited; most areas of proven coal reserves cover less than 150 acres (Ibid). Kalliokoski and Welch (1977) found the distribution of past coal production to be a good indicator of the geographic distribution of the Michigan coal beds.

Quality of Michigan Coal

The poor quality of Michigan coal, frequently described as "flaky", is attributed to insufficient pressure present at the shallow depths where the coal was formed (Arnold, pp. 101-2, 1954). Michigan coal is high volatile B and C bituminous, with an ash content of 3-9 percent, volatile material of 31-41 percent, and sulphur content of 1-3 percent (Cohee et al., p. 4, 1950). Coal containing less than one percent sulphur is considered low sulphur coal, greater than two percent is considered high sulphur. The BTU value per pound of Michigan coal ranges from 10,500 to 12,300. Michigan coal is suitable for residential heating, electrical generation, and industrial processes. It is not suited to the production of coal used in making steel.

Quantity of Michigan Coal

Estimates of the amount of recoverable Michigan coal vary widely. Cohee (1950) estimated that 110 million tons of recoverable coal existed in Michigan. A more recent study, completed by Kalliokoski and Welch (1976), calculated a total state reserve of 126.50 million short tons, 1.3 million (about 1%) of which is recoverable by surface mining methods. This estimate is based on seams 28 inches thick and an overburden depth of 100 feet or less. A 1981 report released by the U.S. Department of Energy updates the Kalliokoski report and lists a demonstrated reserve base of coal in Michigan at 127.70 million tons, 4.58 recoverable by surface mining. The Geological Survey Division of the Michigan D.N.R. estimates that approximately 250 million tons of coal are potentially recoverable in Michigan. This estimate is based on an overburden depth of less than 150 feet and significantly lower losses during mining than are often reported in the literature (Roethele and Parrish, p. 37, 1982). In part, variances between estimates can be attributed to differing definitions of physical stock and specification of recovery rates. For example, Cohee's estimate is based upon 50 percent rate of recovery while the Michigan Department of Natural Resources (D.N.R.) basis its estimate on recovery rates nearing 100 percent.

ANALYSIS OF THE ALLOCATION OF LAND BETWEEN FARMING AND SURFACE COAL MINING IN MICHIGAN

Economics contributes a conceptual framework within which choices among alternative courses of action may be examined. By structuring choices into a framework that provides a rational and operational set of rules, the analyst can compare benefits and costs of alternative actions (Brooks, p. 17, 1966). Further, economic analysis can help clarify choices by providing an orientation toward a decision based on indicators of consequences involved. By applying an economic perspective to the choice presented in this paper -- that is, the allocation of land between agricultural and surface coal mining uses -- the choice will be more clearly defined.

Economics of Land Allocation Between Farming and Surface Coal Mining

Economic theory suggests that in the absence of significant externalities, the private market allocates land in a way that is economically efficient. However, surface mining operations impose significant externalities on nearby landowners and the communities in which they are located. State and federal regulations have been passed in an attempt to control the impact of these externalities by regulating various aspects of the conversion of land from agricultural to surface mining uses (Huff et al. p. 241, 1982). It is important to note that agricultural practices may also create externalities in the form of water pollution, noise pollution, soil erosion, and unpleasant odors.

To examine the unregulated private market allocation process in the absence of externalities, the concepts of discounting and net present value can be used. Consider an acre of currently productive farmland in Michigan that has some amount of coal beneath it. To begin, assume an infinite time period and that the acre of land in question can be farmed each year forever. Additionally, assume that the net income accruing to this acre is \$200 per year. If the appropriate rate of discount for this farmland is 10 percent, the net present value of this acre in farming is \$2,000:

$$NPV = \frac{a}{r} = \frac{200}{.10} = 2,000.00$$

where: NPV = net present value
a = permanent annual return
r = discount rate

Now, assume that the coal lying beneath this acre of farmland has a value of \$5,000 at current prices, that the cost to extract this coal and restore the land as required is \$2,500, and that all of the coal can be mined in one year. The coal operator must estimate the net present value of the future stream of benefits and costs when deciding whether or not to undertake a mining operation at a particular site. Under these conditions, for example, the coal mine operator would value this acre of land at \$2,500 and, even if coal production permanently removes this acre from farming, it will be economically efficient to mine this acre of land if differences in salvage value are not significant. Indeed, private bargaining between the coal producer and farmer could lead to this solution; the farmer will accept at least \$2,000 for the acre and the coal producer is willing to pay as much as \$2,500 making a trade beneficial to both parties. It is important, however, to note that economic efficiency ignores considerations which may strongly influence a landowner's decision to sell or lease his/her land for surface coal mining. For example, some landowners may consider farming a preferred way of life and, therefore, may not be willing to sell or lease their land at the market price.

Huff et al. (1982) identify three points regarding the allocation of land between surface coal mining and agriculture:

1. The purchase price of the farmland compensates the farmer (and society, assuming no externalities) for the foregone net cash flow from crop production over the entire life of the farmland. The discounting procedure makes the differential timing of net cash flows irrelevant (i.e., farming yields a steady stream forever, while surface mining yields early returns and then zero revenue returns). Presumably land would have asset value in either case.

2. The discounting process illuminates the role of various determinants of cash flow to both farming and surface mining; a change in the magnitude of one of these determinants may affect the entire process. When estimating the net present value of future income streams, the coal operator must account for changes in the price of coal. In the preceding example, a drop in the price of coal after the introduction of a substitute energy fuel might reduce the value of the acre for coal production below $2,000. In this case, the land would remain in farming.

3. The effect of governmental regulations on the conversion of land from farming to surface coal mining can also be better understood as a result of the discounting process; reclamation requirements increase the cost of coal mining, thereby decreasing returns per acre and the overall value of the acre for surface mining.

LOCAL ECONOMIC IMPACTS OF SURFACE COAL MINING OPERATIONS

A change in land use from farming to surface coal mining will cause changes in the local economy. These changes involve adjustments in income accruing to local businesses, local tax base and employment structure. When evaluating the effects of change in land use on the local economy, policy makers should be concerned with identifying the net effects that result from a land conversion.

Income Changes

Central to the discussion of economic impact assessment is the concept of a multiplier. The income effects of a change in land use may be primary or secondary. Primary effects are those benefits or costs which are a direct result of the change in land use. Secondary effects are an indirect result of the land conversion.

Multipliers measure the degree of interdependence within regional economies. For example, assume a farmer purchases seed at a cost of $20 from a local store. The store owner must in turn pay his/her supplier, labor costs, management costs, operational costs and other miscellaneous payments. Likewise, recipients of these payments will spend money according to their own consumption/savings functions (Gartner and Holecek, p. 2, 1982). The end result is that the original $20 payment is recycled through the economy many times, resulting in a multiplier effect. The total amount of income that is generated from the original payment is a function of the characteristics of the local economy and the household consumption function. The larger the economy's economic base, involving both the capacity to export and reduced reliance on import substitution, the greater the share of the original payment that will remain in the local economy.

Tax Impacts

The use of land of an economic activity generates tax revenue for state and local governments. A change in land use may alter the tax base of a local community, thereby changing governmental revenues. Local governmental officials must be prepared to deal with land conversions initiated in the private sector which may significantly alter local revenue sources.

An important factor for a community to recognize when facing the onset of surface mining operations is the impact of residential patterns on the purchases of goods and services and the resulting sales tax revenues. The size and diversity of the local economic base will strongly influence the impact of changing land uses. For example, Huff et al. report that smaller communities located near mining sites do not receive additional business activity, rather these purchases are made in larger business centers. Communities with population of 5,000-10,000 experience business growth from surface mining that is very similar to agriculture (Huff et al., p. 333, 1981).

A change in land use may also affect property tax receipts. Because many localities rely heavily on property taxes as a source of income, a significant change in these funds may hamper the provision of local services. The limited and discontinuous nature of Michigan coal make it unlikely that any one community will experience dramatic changes in property tax receipts.

Employment

It is difficult to predict the employment impacts of surface mining in local communities in Michigan. A number of scenarios seem possible. High unemployment in Michigan in the early 1980's suggests that there are workers to fill mining jobs. If previously unemployed workers are hired, the state as a whole will benefit from an increase in employment opportunities. However, it is also possible that workers will simply be transferred from other jobs into the mining industry. For example, the most recent surface mine in Michigan employed gravel workers and did not represent any new employment. Additionally, it is possible that new employment opportunities may not benefit the community in which the mine operates if the worker is a resident of another nearby community. In this case, studies show that only a small percentage of a miner's income flows through the local economy. Of course communities are not isolated entities and overall economic health of a region may be enhanced by such changes.

PROCEDURE FOR LOCAL ECONOMIC IMPACT ASSESSMENT

By using a procedure developed at the University of Illinois, it is possible for local decision makers in Michigan to objectively estimate the economic impacts of a change in land use, or proposed change, within a local community (Scott et al., p. 1, 1978). Although the framework is of limited scope, it provides local officials with a method for estimating the costs and returns of a change in land use and organizing information with relative ease.

The procedure is straightforward: costs and returns are calculated for present agricultural and proposed surface mine land uses and the resulting returns are compared to determine the benefits accruing to the local community from each land use. The analysis deals with both private and public sector effects of land conversion. Private sector effects include direct and indirect benefits and costs, while public sector effects involve revenues received and expenses incurred as a result of land use. Because any discussion of public sector effects is complicated by the large variations which exist between communities, this procedure centers on private sector effects.

To begin, costs and returns will be estimated for two types of farms in Michigan: Saginaw Valley cash crop farms and average Michigan cash grain farms. Both types are further broken down into two size classifications: less than 400 acres and 400-800 acres. Following this, a procedure suitable for calculating the returns to surface coal mining in Michigan is presented. At the onset of this research it was hoped that these returns could be calculated for comparison to agricultural returns. Unfortunately, an inassessable data base makes these calculations impossible. Even without such data, however, this assessment procedure can provide a method for organizing information and, if nothing else, can aid local policy makers in formulating the right questions to ask state regulating officials and prospective coal operators while illuminating areas in which further research is needed.

Estimating Costs and Returns to Michigan Agriculture by Farm Type and Size

The benefits of an acre of farmland are defined in terms of direct and indirect returns. Data used to calculate these benefits are taken from the 1982 Telefarm Business Analysis Summaries complied in the Department of Agricultural Economics at Michigan State University. Financially, 1982 was a bad year for Michigan farmers. These figures are used exclusively for illustration.

Table 1 summarizes per acre costs and returns to farmland. Included are expenditures made by a farmer both within and outside the local business community. Returns data show gross income per acre for each farm type and size. Net returns to management are found by subtracting total costs from total returns.

An income multiplier is used to estimate the secondary benefits associated with the use of an acre of land. Determining the correct multiplier to use in an analysis can be a costly and difficult procedure (Gartner and Holecek, p. 2, 1978). The Illinois procedure suggests using average multiplier values that reflect the relationship between the size of the county labor force and the relative complexity of the economy; the larger, more varied the labor force, the more complex the economy and the higher the multiplier used. These values are summarized in Table 2.

The cost estimates in Table 1 include both local and non-local farm operator expenditures. However, non-local expenditures do not contribute to the local economy and must be deducted when determining impacts. Similarly, adjustments must be made for state and federal taxes which decrease the amount of income accruing to the local economy. In Table 3 the allocation of expenditures in and out of the local economy are presented for a Saginaw Valley cash crop farm of 400-800 acres using percentages estimated by Scott, et al., (1978). Additionally, appropriate expenditures are reduced for state and federal taxes and sales taxes.

TABLE 1 . Estimated Costs and Returns Per Acre of Farmland, by Acreage and Farm Type ($/acre), 1982

	Saginaw Valley Cash Crop Farm		Average Michigan Cash Grain Farm	
	[<400]	[400-800]	[<400]	[400-800]
COSTS				
Power and Equipment	$ 85.54	97.32	$ 70.04	70.89
Buildings & Improvs.	11.70	16.88	15.16	10.57
Soil Fertilization	76.24	68.38	58.29	56.15
Seed and Plants	12.91	22.53	6.70	11.61
Livestock Expenses	.28	.01	.48	.41
Labor	51.51	40.74	32.14	27.97
Land Charge	17.01	21.58	8.67	21.70
Taxes	28.37	24.61	25.47	9.99
Insurance and Miscell	13.24	10.96	13.61	8.97
Interest	120.26	123.57	102.12	69.12
Total Costs	$417.06	$426.58	332.68	287.38
RETURNS				
Crops	$244.00	268.00	185.00	212.00
Livestock	1.00	-	-1.00	1.00
Custom	8.00	3.00	5.00	3.00
Government	1.60	7.00	7.00	9.00
Other Income	20.00	16.00	11.00	5.00
Total returns	$274.00	$294.00	207.00	230.00
NET RETURNS(management)	$-143.02	$-132.58	$-125.68	$-57.38

Data Sources:

Brown, L.H., and M.P. Kelsey, Business Analysis Summary for Saginaw Valley Cash Crop Farms: 1982 Telefarm Data, Agricultural Economics Report No. 435, East Lansing: Michigan State University, Department of Agricultural Economics, 1983.

Brown, L.H., and M.P. Kelsey, Business Analysis Summary for Cash Grain Farms: 1982 Telefarm Data, Agricultural Economics Report No. 434, East Lansing: Michigan State University, Department of Agricultural Economics, 1983.

TABLE 2 Average Multiplier Value and Ranges, by Size Class, for County Employment [a]

County Employment Size Class	Average Multiplier	Probable Range
1,000-2,999	1.7	1.5 - 1.9
3,000-4,999	1.8	1.5 - 2.0
5,000-9,999	1.9	1.6 - 2.1
10,000-19,999	2.0	1.8 - 2.2
20,000-49,999	2.2	2.0 - 2.4
50,000 - +	2.2	2.0 - 2.5

Source: Scott et al., 1978.

[a] Based on data for 375 Appalachian Counties, there is a probability of 70 percent that an individual county multiplier will be included in these ranges.

TABLE 3 Allocation of Costs In and Out of Local Economy, in General and Saginaw Valley Cash Crop Farm (400-800 acres)

	General		Saginaw Valley Farm	
	In	Out	In	Out
	percent		(*)	
PRIVATE SECTOR COSTS				
Power and Equipment	30	70	29.20	68.12
Building and Improv.	60	40	10.13	6.75
Soil Fertilization	20	80	13.68	54.70
Seed and Crop	60	40	13.52	9.01
Livestock Expense	70	30	--	--
Labor	100	0	40.74*	--
Land Charge	80	20	17.26	4.31
Insurance and Misc.	67	33	7.34	3.62
Interest	67	33	82.79*	40.78*
Management	67	33	-88.83	-43.75
Private sector subtotal			122.52	134.32
PUBLIC SECTOR COSTS				
Real Estate Taxes	100	0	24.61	
Sales Taxes	20	80	1.64	
Federal Taxes		100^		6.56
Michigan State Income Taxes		100^		7.56
Public sector subtotal			26.25	43.70

These items reduced when added into private sector subtotal by 4.6% State Income Tax and 18% Federal Income Tax (assuming this is an appropriate average tax rates).

^Although various Federal and State Taxes return to local governments, they vary substantially and are a small portion of total public expenditures in local area.

TABLE 4 . Estimated Costs and Returns to the Local Economy, per Acre by Farm Type and Size

	Saginaw Valley Cash Crop Farm		Average Michigan Cash Grain Farm	
	[<400]	[400 - 800]	[<400]	[400 - 800]
COSTS				
Power and Equipment	25.66	29.20	21.01	21.27
Building and Improv	7.02	10.13	9.10	6.34
Soil Fertilization	15.25	13.68	11.66	11.23
Seed and Crop	7.75	13.52	4.02	6.96
Livestock Expenses	.20	--	.34	.29
Labor	51.51*	40.74*	32.14*	27.97*
Land Charge	13.60	17.26	6.94	17.36
Taxes	28.36	24.61	25.63	9.99
Insurance and Miscell	6.62*	7.34*	6.80*	4.48*
Interest	80.57*	82.79*	68.42*	46.31*
MANAGEMENT	-95.82	-88.83	-75.41	-38.44
PRIVATE SECTOR SUBTOTAL	110.87	122.52	82.92	95.35

*These items reduced before added into private sector subtotal by the Federal (18%) and State (4.6%) taxes, assuming these are appropriate average figures.

In Table 4 this procedure is carried out on private costs and returns for all farm types and sizes. By selecting an appropriate multiplier, the private sector benefits accruing to a local community from an acre of farmland can be estimated. Below, this calculation is carried out for a Saginaw Valley cash crop farm assuming a multiplier of 2.2. Using this procedure, the total estimated private sector benefits from a acre of Saginaw Valley cash crop farmland is $269.54.

Direct, private sector subtotal $122.52

Indirect, $122.52 x 1.2 .... $147.02

TOTAL BENEFITS/ACRE $269.54

Because the benefits from farming represent a flow of returns over time, the present value of these returns should be calculated for comparison to the present value of the returns from surface mining. Table 5 presents the discounted estimated agricultural benefits per acre to the local economy. Determination of the proper discount rate to use in an analysis is a difficult task. Scott et al. (1978) recommend that county officials select a discount rate that reflects their own judgements about the future. Because of the uncertain time period during which surface mining will occur and the difficulties involved in choosing a discount rate, Table 5 displays present value calculations for an infinite time period and three different discount rates, 5 percent, 7-1/2 percent and 10 percent. (1)

Estimating Costs and Returns to Surface Coal Mining in Michigan

The procedure used to estimate the benefits accruing to a local community from surface coal mining is analytically similar to that used for agricultural uses. Benefits include direct and indirect increases in personal income, plus any inputs purchased in the local economy (Scott et al., p. 25, 1978). In addition, the benefits associated with the use of the land after reclamation must be included. Costs include the direct and indirect discounted agricultural benefits foregone during the mining operation.

As noted earlier, the empirical data needed to calculate benefits from surface mining in Michigan are not available. Instead, this section briefly outlines the procedure that can be used by local officials to determine benefits when data become available.

The worksheet developed by Scott et al. (1978) for determining benefits to the private sector from surface mining is presented in Table 6. Basically, direct and indirect costs are added (II-A, II-B) and then subtracted from the sum of the benefits associated with the mining activity (I-A) and the postmining agriculture benefits (I-B). The resulting surplus or deficit is the private sector benefit accruing to the local economy from an acre of surface mined land (III). Data on the annual costs of mine production per ton of coal are obtained and converted to annual costs per acre (costs/ton X tons of coal/acre = costs/acre). Table 7 provides a worksheet for calculating the direct and fixed costs of a mining operation. These costs are then adjusted for leakages in an out of the local economy. Similarly, adjustments must be made for state and federal taxes and sales taxes which decrease the amount of income accruing to the local economy. Estimates of expenditure allocation developed by Scott et al. (1978) are presented in Table 8. Local officials using this framework should be cautious about assumptions regarding distribution of costs; changes in these assumptions can significantly affect results.

Expenditures occurring within the local economy are then used to estimate direct and indirect benefits accruing to the community from a surface mine operation (I-A): direct benefits are found by adding together personal income per acre of coal mind (production plus maintenance costs) and the amount of mining inputs purchased in the local economy. Indirect benefits are determined by multiplying personal income a county multiplier. Direct and indirect benefits are summed to determine the benefits per acre accruing to a local economy from a surface mining activity (I-A).

TABLE 6 . Worksheet for Estimating Returns to the Local Economy From an Acre of Surface Coal Mining in Michigan

I. BENEFITS	
A. Mining activity	
[1] Direct	
a. Personal income per acre	----
b. Mining inputs purchased locally per acre	----
[2] Indirect	
a. Personal income x county multiplier	----
Total benefits per ton	----
Benefits per acre	----
B. Postmining agricultural benefits	
[1] Direct	
a. Estimated discounted agricultural returns/acre	----
[2] Indirect	
a. Direct benefits x county multiplier	----
Total, postmining	----
II. COSTS	
A. Direct	
[1] Estimated discounted agricultural returns per acre for appropriate type of farm and size, during mining operation.	----
B. Indirect	
[1] Direct cost x county multiplier	----
Total costs/acre	----
III. SURPLUS OR DEFICIT/ACRE (I - II)	----

Source: Scott et al. (1978).

TABLE 7. Worksheet for Calculating Annual Mine Production Costs/Acre

	Total Annual Costs	Cost/ton	Cost/acre
1. Direct Costs			
A. Production Costs (labor and supervision)			
B. Maintenance (labor and supervision)			
C. Operating Supplies			
Electrical			
Equipment parts			
Explosives			
Drill Bits			
Fuel and Lubrication			
Tires			
Reclamation and Miscell			
D. Utilities			
E. Haulage road construction			
F. Payroll overhead			
G. Royalty			
H. Union welfare			
I. Strip License and reclamation fee			
2. Fixed Costs			
A. Taxes and Insurance			
B. Depreciation			
C. Deferred Expenses			
TOTAL PRODUCTION COSTS			

Source: Scott et al. (1978).

TABLE 8. Worksheet for Estimating Expenditure Allocation In and Out of Local Economy

	Inside	Outside	Per acre
	percent		($)
DIRECT COSTS			
Production Costs	70	30	
Maintenance Costs	70	30	
Operating Supplies	20	80	
Utilities	100	0	
Haulage and Road Construct	100	0	
Payroll overhead	70	30	
Royalty	100	0	
Union Welfare	70	30	
Strip mine reclamation fee and license	80	20	
Indirect costs (including reclamation)	70	30	
FIXED COSTS			
Taxes and Insurance	30	70	
Depreciation	0	100	
Deferred Expenses	30	70	
Private Sector Subtotal			
Public Sector Subtotal			
Gross Revenue			
State Taxes			
Sales taxes			
Services rendered			

Source: Scott et al. (1978).

Estimation of benefits from postmining agricultural uses is difficult. Factors influencing the extent of benefits from reclaimed land include the structure of the organizations that operate postmining activities and the type of farming or forestry enterprises that return to the land. Even with no loss in productivity after mining, variations in returns from different land uses may cause a change from the pre-mining land use to result in a lower level of benefits to the local economy. Nevertheless, by making assumptions regarding (1) the appropriate rate of discount, (2) the number of years after mining that returns from agriculture will begin and, (3) the probable use of reclaimed land, users of this framework can calculate postmining agricultural benefits (I-B) with the same procedure as used for agricultural returns.

The costs accruing to a local economy from a surface coal mining operation include foregone benefits from agriculture. These benefits were calculated in the previous section. By subtracting the total costs per acre (II) from the total benefits per acre (I), the additional returns accruing to the local economy from an acre of surface mining can be estimated (III). By comparing returns from surface mining (III) to returns from continuous farming (calculated in previous section), local decision makers can estimate the net effect of a change in land use on the local economy.

SUMMARY AND CONCLUSIONS

The state of Michigan presently faces the possibility of renewed surface coal mining within its borders. And, although the size and number of these future operations is likely to be limited, mining will impose impacts on state residents and communities located near mining sites. The intent of this research is to consolidate information on surface coal mining in Michigan using economics as a conceptual framework within which choices among alternative courses of action may be structured. Available data indicate that the extent of surface coal mining in Michigan will be limited. It is, therefore, unlikely that mining operations will seriously affect Michigan's important agricultural sector on a statewide basis. Rather, the most serious impacts will be experienced at the local level where the transition from agriculture to coal could be painful indeed. This study developed an economic framework that can be used to understand and estimate economic impacts of surface coal mining on Michigan agricultural lands.

The possibility of surface coal mining typically generates some debate. Michigan is no exception. Some state officials and residents believe that agricultural land should be protected from use by surface coal mine operations. Yet, others believe that renewal of mining has the potential to benefit Michigan by attracting new industry into the state, providing new employment opportunities, and decreasing dependence on imported sources of energy. Both view points have merit: renewal of surface mining in Michigan will, at least temporarily, remove acres from farming while at the same time lowering state coal imports, developing new employment opportunities, and attracting small surface coal operators from neighboring states. By enacting P.A. 303, the Michigan legislature has chosen to allow surface coal mines to operate protection for agricultural land.

General Conclusions

The market process of land allocation is assumed to move land to those uses that generate the highest returns to factors of production and command the highest market prices. Data collected throughout this analysis suggest that coal resources of Michigan are neither of sufficient quantity nor quality to generate high levels of returns or prices except in a very few number of cases.

Coal development will concentrate in the eastern section of the lower peninsula within the counties of Midland, Bay, Saginaw, Tuscola, Shiawassee, Genesee, Ingham and Jackson. Presently, the Michigan Department of Natural Resources estimates that ten to twelve mines, each covering three to five hundred acres, will operate in this region and produce a total annual output of approximately 2.5 million tons of coals. Unless this scenario is significantly altered by changes in the economic conditions which have sparked renewed interest in mining Michigan coal, it is unlikely that these will significantly alter state coal imports, employment opportunities or general economy for the following reasons:

1. Assuming that coal production levels reach those estimated by the D.N.R., Michigan coal will supply less than 8 percent of total state coal demand.

2. Because interest in extracting Michigan coal is being expressed by small, out-of-state coal operators, it is possible that the state as a whole will benefit to some degree from new employment opportunities generated by coal mining. However, at the present time, it appears that the overall impact on state employment will be minimal. In fact, it is possible that mining operations will simply transfer workers from other employment sectors and not produce any new employment opportunities for state residents. Additionally, mine operators may find it to their advantage to simply relocate trained workers from nearby states to fill skilled positions. While the state as a whole will benefit from the development of new employment opportunities, the effect on communities located near mining sites is not as clear. If mine employees reside and purchase goods and services within the community, the local economy will benefit from the onset of surface mining operations. If, however, mine employees travel from nearby communities to work it is unlikely that the local economy will experience employment gains from new mining operations.

Policy Implications

The possibility of coal development in Michigan has several important policy implications.

1. <u>Participation in the Regulatory Process by Local Officials and Citizens</u>. Local policy makers and citizens should be encouraged to participate in the regulatory process. Surface coal mining is a highly emotional issue capable of generating conflict and tension within a local community. Because this study suggests that mining impacts will be highly localized and relatively minor, participation by local officials and residents should act to alleviate the conflict and tension that the onset of surface coal mining operations my induce. Because mining impacts are highly correlated to historical residential patterns, purchasing habits and local tax policies, participation by residents and officials may contribute an important perspective to the regulatory process. Given the highly localized nature of mining impact, it appears that such a structure will be more effective than broad policy initiatives developed for the entire coal basin.

2. <u>The Role of the D.N.R. as the State Regulatory Agency</u>. The role of the D.N.R. in regulating surface coal mining in Michigan is outlined in P.A. 303. The Geological Survey Division (G.S.D.) of the D.N.R. is the lead agency, thus its perception of the mission is crucial. Our position is that the overall role of the D.N.R. should be to protect the long-term interests of state residents by allowing those mining operations which produce net benefits to the state and local communities in which mining occurs. In carrying out this role, the D.N.R. should act as a source of information for local residents and decision makers of communities that will be affected by surface coal mining operations. Increased participation by other divisions of the D.N.R. and state and local governments may facilitate the regulatory process.

3. <u>Development of P.A. 303 Administrative Rules</u>. Nearly four years after the passage of P.A. 303, the administrative rules needed to implement the act have not been finalized. Until these rules are completed and approved by the federal Office of Surface Mining, there exists a question regarding who will

control surface coal mining operations in Michigan. While active because mine operators are in the process of buying and leasing land for future mining operations, it is imperative that the administrative rules be completed and approved as quickly as possible to ensure attainment of the state's goal of controlling surface coal mining in Michigan.

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