PROJECTED ACREAGE OF PRIME FARMLAND TO BE DISTURBED BY COAL SURFACE MINING IN THE CORN BELT, 1980-2000

by

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Introduction

In April 1977, President Carter submitted to Congress a National Energy Plan (NEP) which called for increasing annual coal production to more than one billion tons by 1985.[1] Among the many environmental concerns associated with accelerated coal extraction is the potential for an increasingly large amount of agricultural land--specifically, prime farmland--to be disrupted by the mining process. Despite the vastness of our country, prime farmland comprises but 15% of the total land surface,[2] and yet 17% of the strippable coal is beneath this land.[3]

Concern for the susceptibility of farmland to surface mining is by no means confined to recent times. In 1939, Hanna and Vandervliet[4] pointed out that in certain Illinois counties, strip mine companies owned or controlled land which on the average had a better productivity index (on a scale of 1 to 10) than the remainder of the land in the given county. This led them to suggest that lands in strippable areas should be rated according to their agricultural value and that mining should be prohibited in the better farming areas. A 1976 report by Ostendorf and Gibson[5] contained the same message, again for Illinois. In 1977, Interior Secretary Andrus proposed to Congress that a national moratorium on mining prime farmland be imposed for a period of five years to allow a study to be conducted into the impacts of surface mining on prime farmland.

In passing the Surface Mining Control and Reclamation Act (SMCRA) of 1977, Congress rejected the suggestion for a moratorium on mining prime farmlands, indicating that as long as a given parcel of land could, and would, be restored within a reasonable amount of time to its original level of productivity, mining could commence at that site. Consequently, although numerous authors (e.g., see References 6-9) have indicated concern over the agricultural impact which can accompany coal extraction, it is now important to begin a dialogue in which the reality of surface mining on prime farmland is considered in quantitative terms. As a first step toward this goal, this report presents a numerical analysis of the acreage of prime farmland which could be affected by surface coal extraction in the Corn Belt during a 20-year period, 1980-2000.

Method

The Corn Belt farm production region was chosen for this study because all five states--Ohio, Indiana, Illinois, Iowa, and Missouri--contain mineable coal and are important producers of agricultural products. To achieve as high a degree of accuracy as possible, modeling was carried out at the county level; however, the results are of greatest value when considered at the regional level.

Direct prime farmland disturbance (the acreage immediately over the coal being removed) at a county level was calculated using the equation:

$$P = \left[\left(\frac{e \cdot s}{d \cdot t}\right) r\right] \frac{p}{c}$$

where P = prime farmland disturbed annually, in acres

e = projected total yearly coal extraction, in tons

s = fraction of total coal extraction to be surface mined

d = coal density, in tons/acre-foot

t = seam thickness, in feet

r = recovery rate, fraction of total coal mined

p = county prime farmland area, in acres

c = total county prime farmland area, in acres

The assumptions were: (1) the bulk density of coal throughout the Corn Belt region is 1800 tons/acre-foot, (2) coal surface mining in this region is 98% efficient in removing coal from the seam, (3) there is but one major seam per mining operation which may contain partings, (4) the coal and prime farmland are homogeneously distributed throughout the county, (5) prime farmland will not be differentiated and avoided by surface mining operations, and (6) the SEAS model data for future coal mining[10] reflect the NEP and are an acceptable indication of potential future mining activity when considered at the regional level. According to Treworgy et al.,[11] the bulk density of Illinois coal is around 1790 tons/acre-foot, but for most calculations involving bituminous coals, a value

of 1800 tons/acre-foot is considered acceptable. On the average, current surface mining operations remove 80 to 90% of the coal, but future methods are expected to be more efficient, hence 98% efficiency. Although there are multiple seams in the vertical profile of most mining areas in the Corn Belt, usually only one is mined at a time, because the others may either be uneconomically thin or too deep. The best available information on prime farmland distribution is given at the county level; therefore, calculations combining data for coal and prime farmland resources inherently have the assumption that each of these two resources is homogeneously distributed throughout the counties being considered. The flat land surface and the lack of woody vegetation and buildings make prime farmland sites attractive to mine operators; thus, without economic or regulatory disincentives, these lands are often considered choice sites for mining operations. Furthermore, as noted earlier, the SMCRA has made it possible for operators to legally mine these lands, provided certain regulations and performance standards are met. Finally, the SEAS data are considered to be reasonable forecasts of future coal production, as shown by a comparison between them and two other sets of estimates (see Reference 12).

In addition to direct disturbance of land, surface mining also results in indirect land disturbances at the mine site such as: haulage and service roads, overburden and topsoil storage areas, sediment retention ponds, and coal storage piles. Together, the direct and indirect land disturbances give an estimate of the total acreage affected. Based upon data of the Council on Environmental Quality and the EPA,[13] it is assumed that the total acreage affected in the Corn Belt is a factor of 1.2 higher than the acreage directly disturbed there. Thus, to arrive at an estimate of the total land disturbed, an additional acre is assumed to be affected by the above-named land uses for every five acres directly disturbed.

Results

During the 20-year period 1980-2000, the level of coal production in the Corn Belt states is expected to increase, reaching 130 million tons per year by the turn of the century (Table 1). If this level of coal production is reached at the rate predicted in the model, by the year 2000 some 433,000 acres of land and 122,000 acres of prime farmland are forecast to have been affected by the previous 20 years of surface mining for coal (Table 2). This is equivalent to 0.2% of the total prime farmland acreage in this farm production region.

It is important to note that the relationship between non-prime farmland disturbance and prime farmland disturbance is not linear. As seen in Table 2, Ohio is projected as having the largest acreage of land disturbed, but the amount of prime farmland forecast for disturbance is lower than for several other states. This is because the coal producing areas of eastern Ohio do not contain as much prime farmland as do the coal producing areas of other states, such as Illinois.

To lend perspective to the analysis of the prime farmland acreage disturbed by surface coal mining in the Corn Belt, preliminary estimates have been made of the future acreage which could be affected if the present rate of prime farmland conversion to urban, roadway, and water uses (Table 2) continues at a constant rate. Data used to extrapolate the acreage devoted to urban, built-up, and water areas were taken from Lee[13] and represent historical events of the period 1967-1975; definitions of the land use terms follow criteria published by the U.S. Soil Conservation Service. Presently, over 1.3 million acres of prime farmland are devoted to "irreversible" land uses;[14] if current trends continue, another 3.4 million acres could be affected during the next 20 years (Table 2).

Discussion

Estimates of the prime farmland acreage that could be disturbed by future surface coal mining should be viewed as trend indicators rather than absolute predictions, for considerable uncertainty still surrounds the coal industry and the legislation affecting it. For example, the Clean Air Act Amendments of 1977, the Surface Mining Control and Reclamation Act of 1977, and the Federal Coal Leasing Program Amendments of 1977 are likely to affect coal mining throughout the remainder of this century; however, the full impact of these legislative actions has yet to be registered by the industry. Furthermore, productivity in the coal industry is in part related to other factors such as the supply of foreign oil, strength of the national economy, and dependability of the labor force servicing the coal mines and shipping routes. To ignore the possibility that future changes in these areas could occur is unrealistic, but to predict these changes is impossible. Consequently, the forecasts in this paper, although made as realistically as possible, must be regarded with caution.

Reconsideration of several assumptions in the equation suggests that the acreage forecasts may be too low. For example, the bulk density figure of 1800 tons per acre-foot and the 98% extraction efficiency are probably too high, yielding estimates of the direct acreage affected which are too low. In addition, the factor of 1.2 used to estimate total acreage disturbed is conservative, since the National Academy of Sciences[15] estimates a factor of 2.0 and the environmental statement for the Star Lake-Bisti coal mining project in northwestern New Mexico[16] uses a factor of 1.56. However, both of these studies refer to western mining operations, and thus the factors used may not be appropriate for operations in the Midwest.

In most counties, neither coal nor prime farmland is homogeneously distributed. For this reason the county-level data may be inaccurate, because although a county may contain a substantial acreage of prime farmland, mining operations

Table 1. Land Area and Projected Surface Coal Mining Activity in the Corn Belt

State/Area	Land Area (10^6 acres)		Projected Surface Mining (10^6 tons/year)		
	Total	Prime Farmland	1980	1990	2000
Illinois	35.7	20.6	24.8	30.6	38.2
Indiana	23.1	14.0	23.4	29.9	37.3
Iowa	35.8	18.6	<1.0	<1.0	<1.0
Missouri	44.2	12.2	5.8	9.4	14.8
Ohio	26.2	11.0	28.8	33.5	41.4
Corn Belt	165.0	76.8	83.0	103.9	132.4

Table 2. Projected 20-Year Total Land Disturbance by Surface Coal Mining and Urbanization in the Corn Belt, 1980-2000

State/Area	Land Disturbed (10^3 acres)		
	Non-Prime Farmland	Prime Farmland	
		Mining	Urban and Water Use*
Illinois	84.6	38.6	864.4
Indiana	91.0	40.6	547.2
Iowa	1.6	0.8	549.6
Missouri	73.3	21.4	627.8
Ohio	183.1	21.0	804.1
Corn Belt	433.6	122.4	3393.2

*Based on data of Lee (Reference 14).

in that county may be entirely on non-prime farmland. For example, in eastern Ohio, much of the mining is done along ridge contours where the operation is unlikely to encounter prime farmland; yet because there is prime farmland in the valley below, our calculations for that county would indicate surface disturbance of some prime farmland by the mining operation. It is likely, though, that throughout the remainder of the Corn Belt in counties where much of the land is prime farmland, the non-prime farmland may also be of good quality--viz., a significant portion of the non-prime farmland disturbed may be valuable cropland.

Consideration of data in Table 2 results in the conclusion that if current trends continue, more prime farmland will be disturbed by urbanization and water use than will be affected by surface mining for coal. Because there was a period of rapid expansion in the Corn Belt land acreage devoted to water uses such as stock ponds, flood control projects, and impoundments during the late 1960s and early 1970s, it is probable that the rate of land conversion to water use will not continue linearly as has been assumed for this paper. Nevertheless, land conversion to water use accounted for less than 25% of the total land conversions during the 1967-1975 period; thus if urban growth continues, the trend that these estimates describe will still be adequately represented. Furthermore, since the prime farmland acreage projected to be affected by urban and water use is on an order of magnitude higher than that forecast as being affected by mining, the conclusion that more prime farmland is affected by urbanization and other such uses than by surface mining for coal appears correct.

The purpose of giving special recognition to prime farmlands in P.L. 95-87 was to afford added protection to the nation's best farmland, and to ensure that these lands would not be lost from the cropland base. Although it is unlikely that all of the land affected by mining--e.g., sediment ponds and final-cut reservoirs--will be reclaimed, a substantial portion of the prime farmlands affected will at least initially be returned to cropland use. The ultimate fate of these lands, after the performance bond is released by the regulatory authority upon completion of successful reclamation, is still unknown. Past reclamation practice has led to a substantial shift of former cropland to pasture, grazing, or forested land use (see Reference 17). Theoretically, however, the new permanent regulations promulgated by the Office of Surface Mining will promote the reuse of prime farmland for crop production by clearly demonstrating that the 48 inches of "reconstructed topsoil" will support crop growth at economic levels for a minimum of three consecutive years. Thus, assuming successful reclamation to crop use in a long term (> 20 years) context, surface mining for coal may be viewed as a temporary land use--a feature that distinguishes it from urban and water use which are considered irreversible.[13]

To complete the analysis of land affected by surface mining, it would be necessary to consider the remainder of the surface mining industry such as sand and gravel, limestone, and metallic and nonmetallic mineral mining operations. The acreage of prime farmland affected by underground mining (both directly through surface disruption and indirectly through subsidence) should also be investigated. Finally, studies into the feedback loop between coal mining and the expansion of railroad lines, electrical switching stations, towns, and highways should begin to add further to our ability to quantify indirect land disturbances associated with surface coal mining.

Summary

In the 20-year period 1980-2000, 433,000 acres of land in the Corn Belt are forecast to be affected by surface mining for coal. Of this land area, 122,000 acres are expected to be prime farmland, which is equivalent to 0.2% of the total regional prime farmland area. During this same period, over 3 million acres of prime farmland could be affected by urban expansion, road building, and water projects if current trends continue. Overall, the acreage of prime farmland affected by mining is significant, especially at the local level. Considering the small amount of prime farmland which has successfully been returned to crop production, the resulting challenge to reclamation specialists is large.

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