ECONOMIC AND ENVIRONMENTAL IMPACTS OF COAL MINING IN EASTERN OKLAHOMA

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CHAPTER I

INTRODUCTION

General Problem

The United States energy scene has stabilized on a new and higher energy spectrum since the 1973 price shock from the Arab oil embargo. U.S. policy makers have been forced to cope with a new era, where group and individual members of the Organization of Petroleum Exporting Countries (OPEC) make frequent price hikes and threats of supply cut-backs. The new policy theme has been conservation and development of alternative energy sources to reduce in the short run and eliminate in the long run, United States dependency on foreign petroleum imports.

The United States coal reserve was estimated to be 438.3 billion tons in 1976, of which 297.0 billion tons is available for recovery by deep or underground mining, and 141.3 billion tons can be recovered by surface or strip mining. Recoverability, i.e., that portion of the coal that can be recovered, is between 40% and 90% depending on characteristics of coal bed, mining techniques and environmental constraints (1, p. 21).

Two dramatic and lasting impacts have emerged from the oil embargo. First, energy consumption patterns have changed. Energy demand is shifting to coal. Between 1974 and 1975, coal consumption on a British Thermal Unit (BTU) basis declined by 32% but rebounded in 1977 to contribute 18% to total energy consumption. The adverse effect on coal demand from the effects of the Clean Air Act Amendments of 1970 largely has been overcome. Future consumption is expected to be intensified by sustained progress in coal conversion technology. Processes are being developed to desulfurize high sulfur coals, demineralize high ash coals, and depolymerize solid coal into conventionally acceptable liquid and gaseous products (2).

Second, energy production sources have been modified to reflect changing consumption patterns. Coal production between 1970 and 1973 had declined by 7%, with an average growth rate of -2.3%. But this was turned around between 1973 and 1977 when coal production increased by 16.8% with an average annual growth rate of 4.2%.

Some of this coal is produced in Oklahoma, which has over three billion tons of known reserves. Within a ten-year span, 1963-1973, coal production in Oklahoma increased by 54% which represents an average annual growth rate of 5.4%. This growth rate was surpassed between 1973 and 1977 when the average annual growth rate was 36% (3).

The share of total United States domestic coal produced by strip mining increased by 92% between 1963 and 1973. Actually that share levelled off in 1971 because of environmental constraints. By 1973, 50% of total coal produced was strip mined; the strip mining share of total coal output increased to 60% in 1977 (4, p. 344). The proximity of coal to the surface, economy, productivity of inputs per ton of coal mined, and safety have been the reasons for industry's preference for strip mining.

Commercial production of bituminous coal in Oklahoma dates back to 1880. Coal is found in an area of about 15,000 square miles of the eastern portion of the state with surface coal existing in 17 counties. Underground mining is done mostly in the southeastern part of the state while strip mining is prevalent in the northeastern part of the state. The thickness of workable coal beds have been estimated to range from two to six feet and in a few locations up to eight feet (5, p. 30). Since 1950, strip mining has contributed a greater share of total Oklahoma coal production than underground mining. Between 1963 and 1973, the share of underground mining declined from 5.5% to a small trickle. On the other hand, the share of strip mining to total coal output had increased from 95% in 1963 to almost 100% in 1973. Between 1974 and 1978, coal output from strip mining increased by 128%.

Specific Problem

Strip mining is a surface technique by which giant power shovels tear up the soil and rock overlying coal beds, place it aside and remove the exposed coal. In 1973, 35,000 acres of farmland were disturbed by strip mining in Oklahoma. Out of this total, 5,000 acres were partly reclaimed and 3,400 acres were fully but not successfully reclaimed. Successful reclamation is defined as that reclamation effort which restores the land to at least its premining productive potential. Full reclamation refers to reclamation effort that completely restores the physical nature of the land but may not restore fertility. Most of the 5,000 acres partly reclaimed had not been properly graded and levelled. As a result, the terrain is not suited to working with farm equipment. In addition, many areas of these reclaimed lands had lost most of their top soil from poor soil management and the long lag between mining and reclamation. Strip mining without concurrent reclamation therefore competes with agriculture, pollutes water and air and threatens the life and safety of man and wildlife.

Strip mining interrupts agricultural production. More than 36,000 acres of abandoned coal mine land (orphan land) existed in Oklahoma in 1977 (6, p. 9). It is argued that without reclamation, strip mining is tantamount to trading off food for energy. Another view argues that if the land retirement program of the United States Department of Agriculture is relaxed, no shortages in poor production would arise from strip mining (7, p. 96).

The lag in establishing a reclamation regulation has been attributed to the conflicting objectives of many interest groups for many years. Conservationists disgusted with the resulting landscape have none-the-less shown their approval for the increased human safety and quantity of coal recoverable from strip mining. Agronomists displeased with the loss of arable land to strip pits were ready to acknowledge that losses from improper farming practices could be worse. Social scientists, worried about the negative externalities of strip mining on the quality of life of local communities, had to admit more coal mining activity meant more jobs, income and social services (8, p. 17). In more recent times, environmentalists while decrying the pollution of air and water by strip mining, have conceded that the real threat to our environment is radio-active fallout from nuclear energy. The above dilemma underscores the fact that a viable energy alternative has some social costs not reflected in the pricing equation of coal company operators. Policy makers therefore accepted that the modus operandi for strip coal mining had to internalize at least some of these social costs. This induced many coal producing states to formulate reclamation laws and guidelines in 1970. In 1977, the federal government enacted a comprehensive reclamation law to strengthen and/or to supplement the state laws.

Many acres of prime agricultural land are lost annually to urbanization, highway construction and other commercial facilities like airports. Unlike strip mining, such uses involve the conversion of agricultural land into permanent intensive non-agricultural uses. In strip mining without reclamation, the land is usually used for a brief period of time, when it is scarred and finally left desolate and derelict. Reclamation provides a means of increased the inventory of cropland, pastureland and forestland. Increases in regional income from improved agricultural output may be attained. In addition, the visual quality of the landscape is improved.

Objectives of the Study

The general objective of this study is to estimate resource productivity in agriculture before and after strip mining and reclamation, and to formulate an environmental impact matrix for alternative reclamation strategies. The specific objectives are:

1. Develop pasture and livestock budgets for reclaimed land and compare net cash returns to existing pre-mining budgets.
2. Use the developed budgets to formulate static linear programming (LP) models which evaluate the profitability of a cattle ranching operation before and after strip mining and reclamation.
3. Use the developed LP model to estimate and project the wealth and net cash returns under alternative mineral rights transfer strategies.

4. Use the developed LP model to estimate and project the opportunity costs in wealth and net cash returns to ranchers from being locked into an unsuccessfully reclaimed land using the land leasing arrangement.
5. Estimate the economic, social and environmental impacts of strip mining on the region's economy under alternative reclamation strategies.

Selection of Study Area

The bituminous coal producing counties of Craig, Okmulgee, Nowata, and Rogers were selected for this study (Figure 1). Rogers, Nowata, and Craig counties are contiguous to each other in northeastern Oklahoma while Okmulgee is in the eastern portion of Oklahoma. Temperatures in this area range from 0°F to 105°F with an average annual precipitation of 38 to 48 inches. The major enterprise on the gently sloping, mostly Class III soils, is cattle ranching. Most of the cow-calf enterprises are part-time owner-operated. The area laborers are known to prefer higher paying jobs in the coal fields to farm jobs. Even some of the livestock owner-operators who own coal land work in the coal fields.

These four counties were selected for two main reasons. First, they fall within the strip mining coal zone with the desired characteristics in coal seam, coal depth, sulfur content, ash content, and British Thermal Unit requirements. Second, they represent the area with a combination of family owned and company owned active coal companies and differing tonnage of coal produced. In addition, the number of strip mines abandoned, partly reclaimed and completely reclaimed in these counties are representative of the entire region.

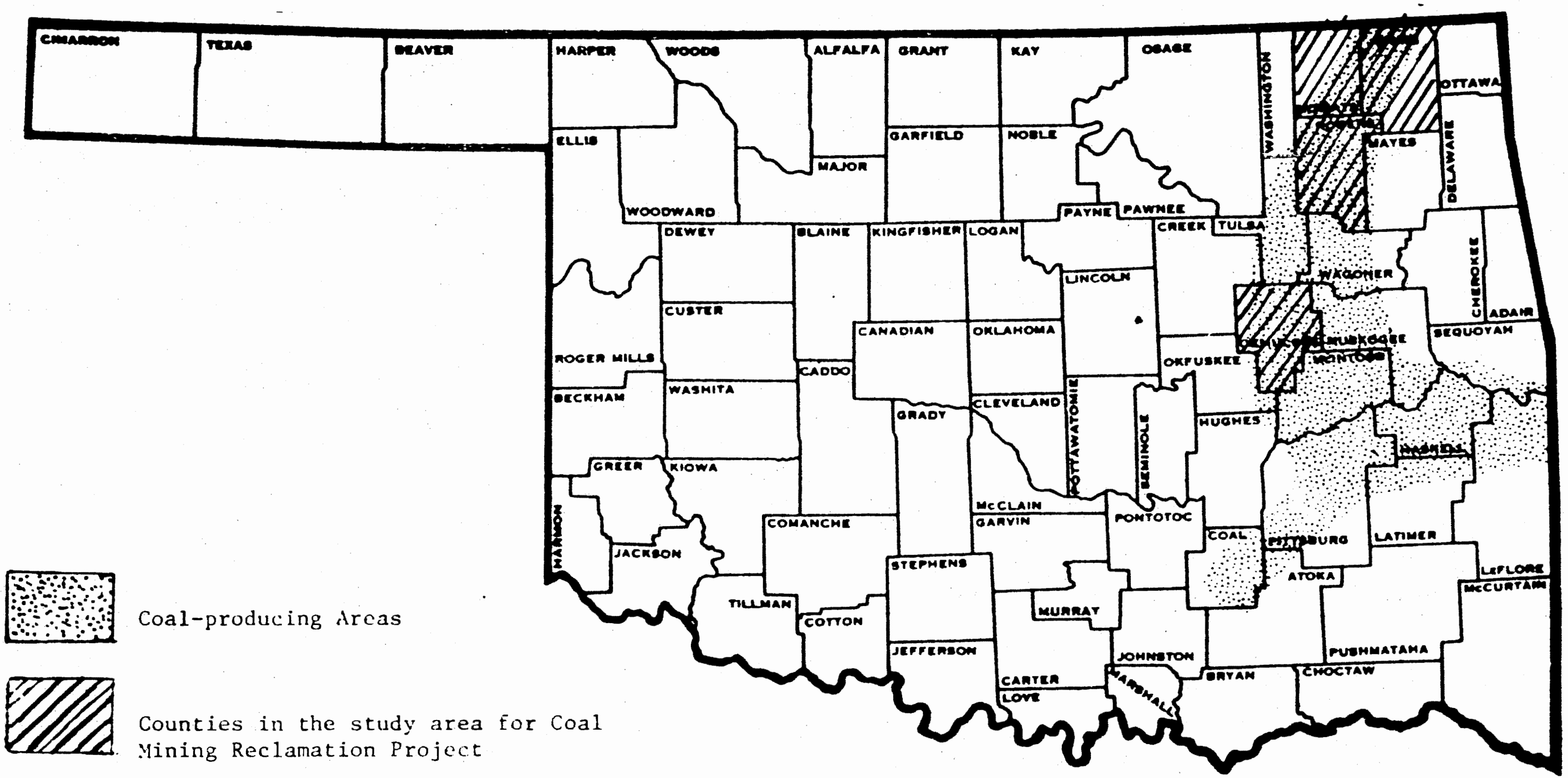

Figure 1. Study Area and All Coal Producing Counties in Oklahoma

Legislation to Control Strip Mining and Reclamation

The 1971 Oklahoma Legislation

The "Mining Lands Reclamation Act" of 1971 was the first attempt by the State to regulate strip mining activity in Oklahoma (9). This act covers many minerals including coal. It stipulated that reclamation plans must accompany application for mining permits. The mining permit requirements were a fee of $50 and a penalty range of $50 to $1,000 per day for mining without a valid permit. The reclamation provision included a sketchy guideline for handling the soil and a performance bond of $350 to $650 per acre. The penalty for failure to reclaim was forfeiture of the bond and denial of new mining permit.

The reclamation guidelines specified grading to reduce peaks, dam construction, covering of acid forming material with earth to a depth of three feet, and different revegetation methods for specified land uses. Other stipulations were: (1) where feasible, grading shall be complated no later than one year following cessation of mining and initial seeding should follow thereafter; and (2) reclamation bonds shall not be released until the office of the Chief Mining Inspector has approved and released the disturbed areas as completely graded and satisfactorily reclaimed. This release comes at least two years after completion of reclamation, during which time cattle are kept off the land to let the soil set and the pasture become established.

Sections of the 1971 Oklahoma Reclamation Act regarding definition of surface mining, bond setting, and mining maps were amended in 1972.

Despite these efforts, the regulations were not comprehensive and enforcement was haphazard.

The 1977 Federal Law

In 1977, a federal act, the "Surface Mining Control and Reclamation Act PL 95-87" was passed to assist, complement and where necessary replace state programs of surface mining and reclamation control (10). The law provided for an Office of Surface Mining Reclamation and Enforcement in the U.S. Department of Interior to work in close cooperation with state regulatory agencies. The 1978 Amendment of the Oklahoma Law coincided with the detailed standards and enforcement frame-work of PL95-87.

Under the new federal law, the planning process, progress and eventual success of reclamation is supervised by a regulating agency, the Office of Surface Mining (OSM). Any landowners' alternatives to the reclamation program must be approved by OSM. The key items of the new law include: (1) separation of soil layers, preservation and replacement of top soil; (2) reclamation concurrent with strip mining; (3) retention of hydrologic balance in water quality and quantity; (4) use of fertilizer and other soil amendments through soil tests to promote revegetation and soil productivity; (5) return of land to its pre-mining highest and best use or other use approved by OSM; (6) posting of a performance bond of no less than $10,000 per permit, in the event of failure to complete the reclamation plan; (7) provide ponds and fences as required; and, (8) holding land out of production for at least five years after revegetaion/reclamation, before released to landowner (11, pp. 15311-15463). The new mining and reclamation regulation provides for a detailed timetable of mining engineering techniques and considerations to meet local, state and national applicable environmental protection performance standards.

Organization of Remainder of Thesis

The remainder of the thesis is organized into seven chapters. The literature review and theoretical considerations are presented in Chapter II. The analytical model utilized in estimating and projecting economic impact is presented in Chapter III. Chapter IV is a presentation of the survey results, secondary data and development of enterprise budgets. The application of the analytical model with the aid of linear programming tableaus is presented in Chapter V. In Chapter VI, the impact of coal mining reclamation on the monetary position of landowners is presented. Chapter VII is a presentation of the analysis of the region with an environmental impact matrix, including a summary of the environmental impacts. In Chapter VIII, the summary, conclusions and potentials for future research are presented.

CHAPTER II

LITERATURE REVIEW AND THEORETICAL CONSIDERATIONS

Revegetation Studies

The present state of the literature on strip mining and reclamation can be subdivided into two study areas namely, revegetation and socio-economic effects.

Although revegetation process on abandoned and reclaimed mines is predicated on soil age, conditions of soil formation, the controlling substrate and climatic conditions, the probability of revegetation success hinges on a good knowledge of the seasonal dynamics of soil moisture, nutrient availability, mineral weathering process, plant-soil interaction and soil gas exchange in a given geographical region. Several studies of this nature based on experimental tests and observations are being reviewed. Spess's (12) study of the strip mined spoils of Haskell county in eastern Oklahoma showed that suitable grass and legumes can be successfully grown with fertilizer treatments. The highest and best use of Oklahoma coal land is cattle grazing. This is underscored by the individual studies of Garner (13) and Einspahr (14). They indicated that the low fertility and nutrient level could be traced to the Pennsylvania Age parent materials from which the soils are formed. Johnson (15) reported that the natural revegetation of some 24,000 acres of orphan land (abandoned strip mines) mined before

1968 in 15 counties of eastern Oklahoma were varied, scattered and bare of plant life in many spots.

The report by Curry (16) indicated that the dynamic structure of the soil and vegetation existing before land disturbance should be considered in order to establish a succession of vegetative cover that is self sustaining. He added that current reclamation efforts in the Northern plains of Montana and Wyoming do not lead to a progression of self-sustaining vegetation and are therefore experimental and short-run in their success. He concluded that preplanning reclamation in the mining plan to consider individual site biogeochemical data would lead to calculable risks of success or failure.

Thames and Verma (17) have noted that the major problem in establishing and maintaining a progression of vegetation in the Black Mesa coal mining area of northern Arizona, is inadequate on-site conservation of moisture. They added that another possible set-back to establishing vegetation is over-grazing. Hodder (18) reported that a critical factor in revegetating mine spoils in Southeastern Montana is erosion from wind and water. The solutions suggested are reduction of slope gradient, use of mulches including plant materials and mechanical ripping of the soil to increase bulk density. The study by Gould et al. (19) in San Juan Basin of New Mexico showed that high sodium absorption rate, high salt content, inhibited plant growth from seeds of species established on the land before mining. He concluded that many years of good range management practices and conservative grazing must accompany the establishment of vegetation.

Socio-Economic Studies

Socio-economic studies have centered on land use changes and socio-economic impacts on rural communities. The success of the pre-planned concurrent mining and reclamation program completed in Centralia (Washington) coal area has been reported by McCarthy (20). The premining land use was forestry and marginal valley farms on poorly drained soils. Families had to rely on off-farm employment to supplement their income. However, the reclamation project resulted in improved water quality and volume, self sustaining vegetation, better topography and long range land use. The potential for forestry, christmas tree plantations, wildlife preserves, cattle grazing and farm crops were higher and better. Thus the reclaimed land showed improvements over its natural state prior to mining.

Miller's (21) survey of farmers using reclaimed land in Pennsylvania indicated that the land was more productive after strip mining and reclamation than at the pre-mining stage. Wheat yield, pasture, and dairy output surpassed their pre-mining level.

Higgins (22) explained the success of a cow-calf enterprise operated by the Peabody Coal Company on their reclaimed coal lands in Illinois and Indiana. Among other climatic and timing considerations, he observed that future land use and capabilities depended on geologic strata overlying the coal. Special consideration should be given to the soil and rock ratio and its final handling. Preplanned reclamation, limited toxic elements in the overburden, planned vegetation, and controlled rotation and grazing have been mentioned as important for a higher and better land use. On suitable and properly reclaimed strip mines, livestock carrying capacity, hay, dairy and crops have increased in that order. A study of reclamation efforts in the strip coal mines of the Northern Great Plains Coal Province was completed by Barth (23). Under carefully planned reclamation and good soil management, reclaimed areas produced more crops per acre than comparable undisturbed areas. However, reclaimed areas had more bare spots and as levels of soil salinity increased, crop production decreased.

Callahan and Callahan (24) applied survey data results to a linear programming model to estimate the socio-economic effect of strip mining on communities and natural resources. Using some adjacent non coal producing counties of Indiana as control, it was concluded that although tax revenues increased, strip mining had not been crucial in inducing the economic development of the coal producing counties. As strip mining increased, land use was shifted from more intensive to less intensive uses. Rural populations and communities in the coal areas were adversely affected by new farming technology, farm consolidation and corporate farming. Leistritz et al. (25) used an input-output model to estimate three alternative policy options for gross business volume, employment and population in the Fort Union coal communities of North and South Dakota, Montana and Wyoming. The study concluded that extensive coal development may create economic hardships on rural communities. Such level of coal development could impact on existing public services thereby imposing a social cost on residents. An input-output analysis was used by Supalla and Gray (26) to assess the socio-economic impacts of coal development in New Mexico. The study emphasized economic, social and environmental variables such as income, employment, tax revenues, infrastructure, city services, attitudes, culture and natural resources. The results indicate, among other things, that (a) extensive mining would be less disruptive if it is phased in longer periods of time, (b) if disturbed land is reclaimed within four years, the impact on land resources would be low, and (c) gainers would include adjacent landowners, workers, and businessmen.

Randall et al. (27) estimated the benefits and costs of reclaiming coal surface mines in Central Appalachia. Time series and cross sectional data were pooled to estimate 18 water quality equations simultaneously using the seemingly unrelated regression technique. They concluded that under existing Kentucky coal mining reclamation regulations, the private costs of reclamation are less than the social benefits. It further suggests that no efficient form of reclamation effort could completely internalize all residual costs of environmental damage.

Psychological, social and cultural factors in the coal strip mine areas of Harrison county, Ohio, were studied and evaluated by Hill (28). Strip mining was found to impact negatively on the tax base, business volume and agricultural land prices.

The study by Catlett and Boehlje (29) reviewed the current reclamation laws, estimated the costs associated with their compliance and analyzed the impacts of the costs on different coal producing regions. Average reclamation costs per ton of mined coal was regressed on annual tonnage mined, overburden depth, number of coal seams, average slope, total seam thickness and mining method at specified time period. The cost equations for Appalachia, Midwest and Mountain were estimated by the least squares technique. The results show that under existing production levels, Appalachia would bear the highest unit cost if new laws which require land reclaimed to their original state, were enforced.

The effect of coal development on agriculture and rural communities of North Dakota was studied by Leistritz and Hertsgaard (30). For an eight-county study area, it was found that coal development competes with agriculture for land, water and rural labor force. The communities experienced more changes in employment, population and income.

A study by Narayanan and Padungchai (31) investigated the effects of of energy development (includes coal) in the upper Colorado basin on irrigated agriculture and salinity. An optimum water and environmental quality level was estimated using a two-sector linear programming model. The model was subdivided into agriculture, energy, water resources, and salinity levels. Alternative environmental control measures were included. The results indicate that without salinity control measures, the concentration of salts would increase with future energy development. The 1972 salinity standards was found inequitable in costs and benefits to lower and upper basin water users.

An input-output model was used to project both a baseline (without the project) and an impact model for a large coal gasification plant in North Dakota, by Dalstead et al. (32). Economic and social impact sectors were incorporated in the model. It is projected that agricultural production would decrease leading to reduced local tax revenues. At the state level, revenue exceeded additional costs throughout the life of the plant. However, the impacted counties could expect larger increases in public sector costs from the influx of more people using the schools, streets, water and sewer facilities. Alternatives for alleviating the fiscal burden of the small impacted local governments include the State Coal Impact Fund and direct financial assistance.

Theoretical Considerations

This study is designed to analyze the externalities associated with coal mining. Theoretically, when resources are allocated efficiently as in a perfectely competitive market, the pareto optimum condition prevails. This implies no alternative resource arrangement exists whereby someone could be better off without anyone being worse off. For a private commodity such as coal, the key conditions for pareto optimality are:

$$MRS_{x,z} = MRT_{x,z} = P_x/P_z \tag{1}$$

$$MRS_{e,y} = MRT_{e,y} = w \tag{2}$$

$$MRS_{ct,ct+i} = MRT_{ct+i,ct} = \frac{1}{(1+r)} \tag{3}$$

where MRS = marginal rate of substitution,

MRT = marginal rate of transformation,

x,z = two commodities,

P = price,

e = leisure,

y = income,

w = price of leisure or wage rate,

ct,ct+i = current and future consumption,

r = rate paid for putting off consumption or the rate of interest, and

i = 1, 2, 3, ..., n.

The marginal rate of substitution in all three cases have to be equal to their marginal rate of transformation. Commodities therefore are to be priced to equate their marginal costs. If any of the above conditions is upset, economic welfare deteriorates until public policy is designed to move toward the conditions.

Due to many landowners and coal company operators involved in coal mining, individual bargaining and compensation for external economies and diseconomies is not feasible. A feasible option thus, is government intervention. The impact of the government in regulating strip mining and reclamation is illustrated in Figure 2. Assume a fixed relationship between production and environmental deterioration. Also, assume D_c, the market demand curve and S_c, the industry supply curve for coal reflect only private outlays by firms. Total output OX_c is produced at the price, OP_c.

However, strip coal mining without reclamation generates some external costs. Strip mines discharge chemicals which pollute streams and lakes. Also, this process of mining lowers the quality of agricultural land and the beauty of the landscape. To allow for proper resource allocation, let S_t reflect the cost of the environmental damage. X_cR is thus the external cost at output OX_c. Social cost (vertical summation of S_t and S_c) is then represented by S_w. To incorporate social cost, laws regulating strip coal mining (equal at each level of output to S_t) should be enforced thereby shifting the supply curve from S_c to S_w. Output of coal now falls from OX_c to OX_w and price rises from OP_c to OP_w. At output OX_w, the private outlay is X_wM while the addition to private outlay due to regulation is $ML = X_wN$ per unit.

Regulation will not eliminate the deterioration of the environment completely. Depending on the completeness of the regulations and their

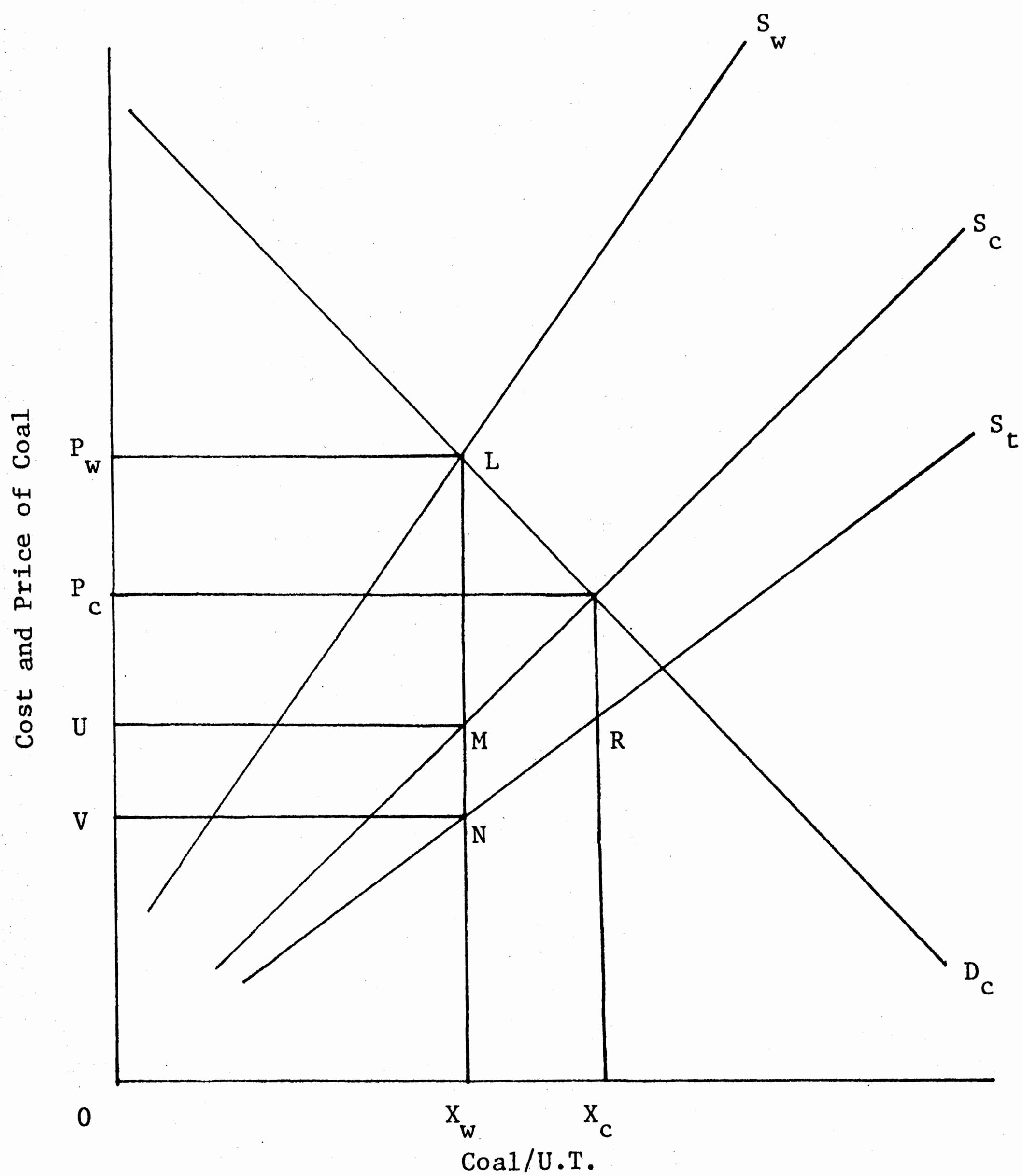

Figure 2. Impact of Government Regulation on Coal Production

enforcement, some degree of deterioration cost, X_wN, remains, which is less than the pre-regulation level X_cR. The objective of regulating strip coal mining is to control the resulting deterioration to an efficient level where the marginal cost of producing it equals the benefits derived by those consuming coal (33).

In practice, deterioration depends on the size of the coal company, mining technology, topography, and regulation enforcement. Regulation costs would therefore vary according to individual producer's ability to comply with higher strip mining and reclamation standards. As a result, we have reclaimed lands which differ in productive and esthetic quality. Such lands which possess divergent use-capacity in agriculture is illustrated in Figure 3. The horizontal axis is a measure of decreasing use-capacity while the vertical axis measures the economic capacity or number of productive variable inputs required for each successive quality of reclaimed land. Land D is completely reclaimed to its pre-mining productivity potential. It has the highest use capacity. Land C is completely reclaimed but below its pre-mining productivity potential. It has intermediate use-capacity. Land E, partly reclaimed, has the lowest use-capacity.

As illustrated in Figure 3, 30 inputs are used at the intensive margin in land D, while 20 inputs are used in C, and 10 inputs used in E. Assuming a profit motive, the intensive margin for each quality of land indicates the economic point beyond which it is unprofitable to use additional variable inputs. In product curve analysis, this is where the marginal factor cost (MFC) equals the marginal value product (MVP). This also coincides with the point where marginal cost (MC) equals marginal revenue (MR) in the cost curve analysis.

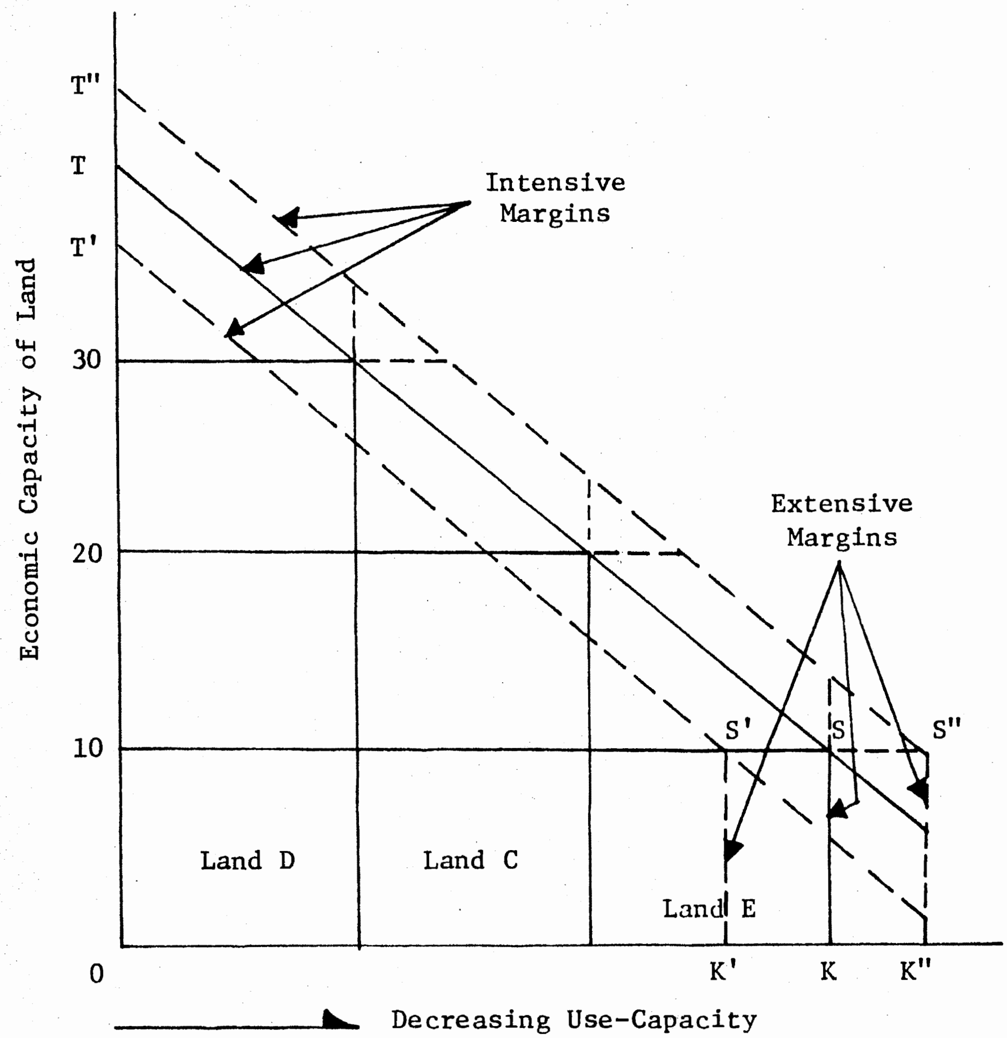

Figure 3. Reclaimed Lands with Divergent Use-Capacity

The line SK is defined here as the no-rent or extensive margin of land use. This represents the point in a continuum of land qualities beyond which it is unprofitable to use additional land. The line SK intersects those points on the horizontal axis and on the TS line beyond which it is unprofitable to put new units of land into production.

Changes in strip mining and reclamation laws and their enforcement can shift both the intensive and extensive margins through their impacts on production costs or product prices, ceteris paribus. If production costs increase or if product prices fall, the last input in land D (unit 30) will be unprofitable to the producer. The producer on land C may use less than 20 units of input while the producer on land E may cease production entirely. In this case, the intensive margin would move downwards to T'S' while the extensive margin becomes S'K'. The opposite effect would result if production costs drop or if product prices increase. Thus the producer would be induced to use 31 units of input in D, 21 units of input in C, and 11 units of input in E. The intensive margin then moves upwards to T"S" while the extensive margin becomes S"K" (34).

In practice, production costs and product price have responded to supply and demand forces. To the extent that public policy on strip mining and reclamation influence the supply and demand of the affected agricultural product, this analysis is valid. In the specific case of cattle ranching, the reduced use capacity (carrying capacity) of the lowest quality of land may lead producers to cease production and seek off-farm employment.

CHAPTER III

THE ANALYTICAL MODEL

The model is a derivative and an extension of an enterprise budget used to represent a 332 acre ranch in eastern Oklahoma. The conceptualization of the model to both production and production/ investment decisions is presented in two parts: (1) assumptions, and (2) model structure.

The analysis of a linear programming problem is facilitated by the use of the Mathematical Programming System--Extended (MPSX) (35). Where a precise answer must be found for a large number of restrictive resources, alternative enterprises and techniques, linear programming provides a more efficient solution than budgeting. The MPSX system has a routine for changing prices, resources and input-output coefficients so as to simulate different management levels. This affords the analyst the option of reviewing a range of possibilities simultaneously. The MPSX system is also capable of deriving shadow prices and range results while efficiently evaluating the profitability of activities. Simplex routines calculate the shadow prices (marginal value products) of the various activities and resources while another routine calculates the range of prices or costs over which the optimum solution is obtainable (36). The flexibility and adaptability of the MPSX system in time, resources, and products range, place it above a budgeting procedure in optimizing an objective function.

Linear Programming Assumptions

For a sufficiently precise solution to a linear programming problem, four assumptions are made: (a) additivity and linearity; (b) divisibility; (c) finiteness; and, (d) single value expectations.

When two or more activities are used the resulting total product and the sum of their individual products must be equal. This is the assumption of additivity. This eliminates any interaction of resources used in producing a single product or a combination of products. The linearity assertion implies that the output response to a proportionate increase of all inputs is constant. Constant returns to scale relates to a production function that is homogeneous of degree one. A production function is homogeneous of degree K if

$$g(ry_1, ry_2) = r^K g(y_1, y_2)$$

where K is a constant and r is any positive real number. If both inputs y_1 and y_2 are increased by the factor K, then output would increase by the factor r^K. Returns to scale are constant if $K = 1$, increasing if $K > 1$ and decreasing if $K < 1$. This assumption is limiting because we may have products exhibiting all three types of returns in their production functions. Moreover, the interactions of some inputs in production of certain outputs occurs in practice. The application of linear programming under these circumstances would therefore produce less efficient solutions.

Divisibility means that the use of inputs and the production of outputs could be achieved in fractional units. This assumption provides for a continuous rather than discrete operation of inputs and outputs. Thus inputs and outputs could be considered in infinitesimal units. The shortcomings of this assumption is corrected by rounding up activity and resource solutions to the nearest whole units. In this way, decisions based on those solutions would not be appreciably altered.

Finiteness means a limit to the number of alternative activities and resource restrictions considered for linear programming, is assumed. This assumption concedes that it would be counter-productive in time and costs for a producer to consider an unlimited number of alternative activities and restrictions in one program. In practice, this assumption is valid and thus does not limit the capability of linear programming.

It is assumed that resource supplies, input-output coefficients and prices are known with certainty. This is the assumption of single-valued expectations. This may be unrealistic when applied to some farming or other enterprise situation where demand and supply factors are very unstable. However, the technique of farm budgeting necessarily relies on this same assumption.

Model Structure

Mathematically, linear programming maximizes or minimizes an objective function. The model could be set up in an algebraic or a matrix notation to represent a problem of a static or dynamic nature. The algebraic form could be either the compact summation or the complete summation structure. To illustrate the general version of the model, the complete summation is presented.

Static Linear Programming Model

In its general form, a static linear programming problem maximizes or minimizes:

$$Z = c_1x_1 + c_2x_2 + \ldots + c_jx_j + \ldots + c_kx_k \tag{1}$$

Subject to (S•to) the input-output relationships and the resource levels:

$$\begin{aligned}
a_{11}x_2 + a_{12}x_1 + \ldots + a_{1j}x_j + \ldots + a_{1k}x_k &\leq b_1 \\
a_{21}x_1 + a_{22}x_2 + \ldots + a_{2j}x_j + \ldots + a_{2k}x_k &\leq b_2 \\
a_{i1}x_1 + a_{i2}x_2 + \ldots + a_{ij}x_j + \ldots + a_{ik}x_k &\leq b_i \\
a_{n1}x_1 + a_{n2}x_2 + \ldots + a_{nj}x_j + \ldots + a_{nk}x_k &\leq b_n
\end{aligned} \tag{2}$$

and subject to (S•to), no negative amount of real activities or products be produced:

$$x_j \geq 0 \quad \text{for all } j \tag{2.1}$$

where Z = the objective function,

c_j = per unit prices, net incomes, or costs of associated activities,

x_j = the possible alternative activities,

a_{ij} = the intput-output relationships between the i^{th} resources and and j^{th} activities, for j = 1, 2, ..., n, and

b_i = the given resource levels or activity restrictions, for i = 1, 2, ..., m.

Dynamic Linear Programming Model

A "dynamic" version of the general model was developed by expanding and modifying the static model. The concept of a dynamic model is to use a specific time period to identify, in a Hicksian sense, each coefficient. Thus the model is dynamic in the sense that each input and output are dated in a multi-period formation. Because of the absence of variability in prices and coefficients as the program is solved, the model is often referred to a multi-period programming. The coefficients in the programming matrix are identified according to row (i), column (j), and year (k). The multi-period linear programming model is set to maximize:

$$
\begin{aligned}
Z = {} & c_1^1x_1^1 + c_2^1x_2^1 + \ldots + c_j^1x_j^1 + \ldots + c_n^1x_n^1 + \\
& c_1^2x_1^2 + c_2^2x_2^2 + \ldots + c_j^2x_j^2 + \ldots + c_n^2x_n^2 + \\
& c_1^kx_1^k + c_2^kx_2^k + \ldots + c_j^kx_j^k + \ldots + c_n^kx_n^k + \ldots + \\
& c_1^tx_1^t + c_2^tx_2^t + \ldots + c_j^tx_j^t + \ldots + c_n^tx_n^t
\end{aligned} \qquad (3)
$$

(S•to) input-output relationships and the resource levels in the problem. The first resource level in the first year (year 1) is expressed as:

$$
\begin{aligned}
& a_{11}^1x_1^1 + a_{12}^1x_2^1 + \ldots + a_{1j}^1x_j^1 + \ldots + a_{1n}^1x_n^1 + \\
& a_{11}^2x_1^2 + a_{12}^2x_2^2 + \ldots + a_{1j}^2x_j^2 + \ldots + a_{1n}^2x_n^2 + \\
& a_{11}^kx_1^k + a_{12}^kx_2^k + \ldots + a_{1j}^kx_j^k + \ldots + a_{1n}^kx_n^k + \ldots + \\
& a_{11}^tx_1^t + a_{12}^tx_2^t + \ldots + a_{1j}^tx_j^t + \ldots + a_{1n}^tx_n^t \leq b_1^1
\end{aligned} \qquad (4)
$$

and (S•to) non-negativity in real activities or products:

$$x_j^k \geq 0 \quad \text{for all } j, \qquad (4.1)$$

where Z = the objective function estimated as present value of expected returns,

c_j^k = the discounted per unit prices, net incomes, or costs of the j^{th} activity in the k^{th} year, for k = 1, 2, ..., t,

x_j^k = the possible alternative activities in the k^{th} year,

a_{ij}^k = the amount of the i^{th} resources used per unit of the j^{th} activity in the k^{th} year, and

b_i^k = the given resource or activity restrictions in the k^{th} year, for the i^{th} resource, i = 1, 2, ..., m.

In developing the input-output relationships and resource levels of equation (4) it is important to note that a_{ij}^{k}'s = 0, for $k \neq 1$, unless the input-output coefficient is used to show capital flows between years. Thus, equation (4) is truncated to become:

$$a_{11}^{1}x_{1}^{1} + a_{12}^{1}x_{2}^{1} + \ldots + a_{i}^{1}\,x_{j}^{1} + \ldots + a_{1n}^{1}x_{n}^{1} \leq b_{1}^{1} \qquad (5)$$

The logic of truncating equation (4) to (5) is that resource supply from year 1 will not be used for activities in year 2 and beyond. However, equation (5) need not result for b_{i}^{k} (k = 2, 3, ..., t), if some resources from one year are transferred to other resources for the next year from years 2 to t. For example some portion of capital investment may be transferred from one year to operating capital in the subsequent years. We may have wealth in future years increased by interest earnings transferred from savings in the previous year. The set of equations for year 1 may then be expressed after equation (5) for all $a_{mj}^{1} = 0$ for $j \neq n$. Equations for years 2 through t may be enlarged for any rows which involve transfer activities (37).

CHAPTER IV

SURVEY RESULTS AND DEVELOPMENT OF BUDGETS

The Sample Survey

The bulk of the data used to estimate the effects of strip mining and reclamation on the local economy and environment were obtained by personal interviews conducted in the summers of 1978 and 1979. The counties in the study area are in eastern Oklahoma: Rogers, Craig, Nowata, and Okmulgee. After consultations with county extension directors and farm management specialists in the area, survey forms were designed and pre-tested. Copies of the survey forms are in Appendix A.

Four groups of people were interviewed: (a) professionals, including county extension directors, soil conservationists, bankers, school superintendents; (b) local government officials, including district commissioners, county treasurers, county assessors, and excise board members; (c) land owners involved with strip mining; and (d) coal company operators. The survey forms were different for each category of interviewees, with varying degrees of emphasis placed on economic and environmental questions.

The interview list included interviewees estimated by county extension specialists to reside in the study area. An undergraduate student assisted in conducting the surveys. Randomness of data was assumed to the extent that interviews were limited to those present and consenting to be interviewed. It was also assumed that the interview of professionals, government officials, coal land owners and coal company operators was an unbiased sample and a cross-section of the population. The survey data was therefore expected to represent parent population characteristics.

A total of 21 professionals, 16 local government officials, 36 coal land owners, and 11 coal company operators were interviewed in the four counties (Table I). The estimated number of professionals and local government officials interviewed in each county varied according to the number of major towns and total population. Counties with higher population have more bankers and school superintendents. The total number of professionals and local government officials interviewed was approximately the same for each county.

The divergence in the total number of coal land owners and coal company operators interviewed per county was due to inherent problems in completing those surveys. More than 80% of the land owners had off-farm jobs either in Tulsa, nearby towns or in the coal fields. Interviews had to be scheduled for night time and weekends. Approximately 30% of the total estimated land owners were either unwilling to give an interview or could not be located. Many of those interviewed were willing to discuss the pitfalls of previous reclamation practice. However, when questions about their financial dealings with coal company operators were asked, less than 30% of the land owners responded. Between 1978, when the survey was started, and 1979, when it was completed, the estimated total number of coal company operators had shrunk from 33 to 12. This represents a decline of 64% for all counties combined. This decline was caused partly by the financial burden of

TABLE I

ESTIMATED INTERVIEWEES AND ACTUAL NUMBERS OF PROFESSIONALS, LOCAL GOVERNMENT OFFICIALS, COAL LAND OWNERS AND COAL COMPANY OPERATORS INTERVIEWED

County	Number	1978 Interviews	1979 Interviews	Total Interviews
		Professionals		
Craig	10	5	0	5
Rogers	8	5	1	6
Nowata	7	2	3	5
Okmulgee	12	0	5	5
Total	37	12	9	21
		Local Government Officials		
Craig	7	4	0	4
Rogers	5	4	0	4
Nowata	5	3	1	4
Okmulgee	8	0	4	4
Total	25	11	5	16
		Coal Land Owners		
Craig	19	8	3	11
Rogers	15	7	2	9
Nowata	14	3	5	8
Okmulgee	11	0	8	8
Total	59	18	18	36
		Coal Company Operators		
Craig	6	0	4	4
Rogers	14	0	3	3
Nowata	4	0	1	1
Okmulgee	9	0	3	3
Total	33	0	11	11

the more stringent strip mining and reclamation regulations of PL95-87, which forced many coal company operators to cease operations. The high foreclosure rate was accentuated by the fact that 80% of the coal company operators were small family operations. Interviews were difficult to obtain because authority to give an interview rested with one majority owner who rotates his office between the mine sites, a distant head office, and his home.

The coal land transactions, reclamation standards, pasture type and pasture carrying capacity, by county are presented in Table II. Since this is a regional study, the aggregated county data were considered to be representative of the area. Excluding coal land sizes of larger than 300 acres, the representative size for coal land was estimated at 100 acres. Non-coal land which has good quality pasture was estimated at a representative size of 197 acres. After excluding all land sizes of 240 acres and above, reclaimed land was estimated at a representative size of 35 acres.

The data included all strip mining and reclamation that occurred between 1970 and 1979. Under the 1971 Oklahoma "Mining Lands Reclamation Act", all lands reclaimed in 1977 were released in 1979 for grazing cattle (a two-year "hold back" requirement). All land reclaimed in 1978, after PL95-87 was passed in 1977 would be released for grazing cattle in 1983 due to a five-year "hold back" requirement. The implications of these "hold back" requirements was that the post reclamation carrying capacity of such lands could not be determined.

The soil structure of reclaimed land was described as stony or non-stony. Stony soils bore large deposits of limestone usually with zero to four inches of top soil. The absence of limestone and a top

TABLE II

CHARACTERISTICS OF COAL LAND TRANSACTED AND RECLAIMED BY COUNTY[a]

Coal Land		Transaction	Reclamation (R)			Type of Pasture		Acres/Animal	
Acres	Year	Type	Soil	Status	Acres	Before (R)	After (R)	Before (R)	After (R)
				Rogers County					
60	1979	Lease	Stony	Complete	6	Native	Fescue/Bermuda	7	--
315	1977	Lease	Non-Stony	Complete	80	Lespedisa/Bermuda	Fescue/Bermuda	3	--
600	1975	Lease	Non-Stony	Complete	60	Native	Fescue/Bermuda	6	3
180	1970	Trade	Stony	Complete	18	Native	Clover/Bermuda	7	--
100	1976	Lease	Non-Stony	Complete	10	Lespedisa/Bermuda	Fescue/Bermuda	6	3
210	1977	Lease	Stony	Complete	126	Fescue/Bermuda	Fescue/Bermuda	4	4
90	1977	Lease	Stony	Complete	10	Fescue/Lespedisa	Fescue/Lespedisa	4	7
700	1973	Lease	Non-Stony	Complete	450	Fescue/Lespedisa	Fescue/Lespedisa	3	3
975	1972	Lease/Trade	Stony	Incomplete	240	Native	Native	6	12
				Craig County					
90	1978	Sale	--	--	--	--	--	--	--
230	1977	Sale	Stony	Complete	40	Lespedisa/Fescue	Alfalfa/Fescue	4	--
5,000	1970	Lease	Non-Stony	Complete	550	Native	Fescue/Bermuda	6	3
200	1978	Lease	Non-Stony	Incomplete	70	Fescue/Bermuda	Fescue/Bermuda	3	--
40	1940	Lease	Stony	Complete	20	Native	Fescue/Bermuda	7	4
360	1978	Trade	Stony	Complete	--	Fescue/Bermuda	--	4	--
80	1979	Lease	Non-Stony	Complete	--	Fescue/Bermuda	--	3	--
400	1975	Trade	Stony	Incomplete	50	Fescue/Bermuda	--	4	--
70	1970	Lease	Stony	Incomplete	70	Crop	Fescue/Bermuda	--	20
370	1978	Trade	Non-Stony	--	--	--	--	--	--
170	1977	Trade	Stony	--	--	--	--	--	--

TABLE II (Continued)

Coal Land		Transaction	Reclamation (R)			Type of Pasture		Acres/Animal	
Acres	Year	Type	Soil	Status	Acres	Before (R)	After (R)	Before (R)	After (R)
				Nowata County					
620	1971	Sale	Stony	Incomplete	--	Native	Fescue/Bermuda	--	--
70	1968	Lease	Stony	Incomplete	35	Native	Fescue/Bermuda	7	10
325	1971	Lease	Stony	Incomplete	20	Native	Fescue/Bermuda	7	21
15	1976	Lease	Non-Stony	Complete	15	Fescue/Bermuda	Fescue/Bermuda	3	3
100	1975	Lease	Stony	Incomplete	16	Native	Fescue/Bermuda	7	10
100	1978	Lease	Very Stony	Complete	10	Native	Alfalfa/Bermuda	15	15
210	1975	Sale	Stony	--	--	Native	--	7	--
255	1979	Lease	Non-Stony	--	--	Native	--	--	--
				Okmulgee County					
80	1976	Lease	Non-Stony	Incomplete	20	Crop	--	--	--
40	1976	Lease	Non-Stony	Complete	15	Fescue/Bermuda	Fescue/Bermuda	3	2
2	1978	Lease	Non-Stony	Complete	2	Native	--	4	--
35	1978	Lease	Non-Stony	Incomplete	35	Native	Fescue/Bermuda	2	--
20	1979	Lease	Non-Stony	Incomplete	--	Native	Fescue/Bermuda	2	--
240	1979	Lease	Non-Stony	Incomplete	60	Crop	--	--	--
30	1977	Lease	Non-Stony	Incomplete	30	Fescue/Bermuda	Fescue/Bermuda	12	12
25	1977	Lease	Non-Stony	Incomplete	25	Native	Fescue	12	12

[a]Data obtained from 1978 and 1979 surveys of land owners.

soil layer of four inches and above depicts the non-stony soils which could be loamy or clayey. Reclamation effort was described as complete or incomplete depending on the quality and progress of the effort. Complete reclamation indicates that all stages of the reclamation process was completed. However, the resulting pasture may fall short of its expected productivity. Incomplete reclamation borders on haphazard grading, levelling and revegetation or reclamation efforts abandoned before it was completed. The resulting terrain lacks the top soil to support pasture and is difficult to work.

Data Summary

A summary of the survey of land owners showing representative or typical area data are presented in Table III. Three types of mineral right transfers between coal company operators and land owners are practiced. About 72% of those interviewed leased their land for two years to the coal company; 17% traded one acre of coal land for 2.5 acres of non-coal land or one acre of coal land for 4 acres of low quality reclaimed land; and, 11% had an outright sale of the surface and mineral rights to the coal operators. Coal output was estimated at 2,000 tons per acre at a royalty payment of one dollar per ton. This coincides with an average coal seam of 18 inches. One of every three acres was reclaimed. The market or dollar value of trading depends on the bargaining skill of the mineral rights owner. An acre of coal land (sell 1) sells for $2,000 while an acre of reclaimed land (sell 2) sells for $400.

A summary of the results of the survey of professional, coal company operators, and local government officials is enclosed in

TABLE III

SUMMARY OF MINERAL TRANSFERS, ACRES INVOLVED AND ROYALTY FOR OKLAHOMA COAL MINING OPERATIONS, 1970-1979[a]

Mineral Transfer	Percent	Mined (acres)	Reclaimed (acres)	Period	Royalty	Coal/Acre	Ratio Trade
Lease	72.0	100	35	1970-1979	$1.00/ton	2,000 ton	---
Trade Land A for B	17.0	---	--	1970-1979	---	---	1:2.5
Trade Land A for C				1970-1979	---	---	1:4.0
Sell 1[b]	11.0	---	--	1970-1979	$2,000/acre	---	---
Sell 2[c]	-- ;	---	--	1970-1979	$400/acre	---	---

[a]Data obtained from 1978 and 1979 surveys of land owners and coal company operators.

[b]Refers to coal land (Land A).

[c]Refers to reclaimed land (Land C).

Appendix C. These results indicate the responses to economic, environmental, and social well-being impact which were later used to develop an Environment Impact Matrix.

Secondary Data

Secondary (published) data were used to show the dramatic changes in Oklahoma coal production and changes in number of coal operators since 1975 (Table IV). The increase in coal output ranged from 57% in Rogers county to 411% in Okmulgee county. However, coal output declined in the state and in all the counties except Nowata in 1979. The decrease in output was caused mainly by the foreclosure of coal company operators. The number of coal company operators reached a peak in May 1978, with the large companies operating multiple mines in more than one county. In 1979 many small family-owned operators closed due to the intensified reclamation regulations. As a result, the number of coal operators declined from 55 in 1978 to 31 in 1979. Nine coal companies went out of business in Rogers county alone.

Alternative Steps to Pastureland Development

Four land groups identified in the study have been classified: land A (coal land); land b (non-coal land); land C (low quality reclaimed land); and land D (high quality reclaimed land). Land A has native pasture while lands B, C, and D have improved pasture. Lands C and D are actually land A after reclamation under the 1971 Oklahoma law and the 1977 Federal law, respectively. Assuming that the latter law resulted in a higher quality reclaimed land, alternative steps involved

TABLE IV

CHANGES IN OKLAHOMA STRIP COAL PRODUCTION AND NUMBER OF ACTIVE COAL COMPANY OPERATORS BY SELECTED COUNTY AND STATE TOTALS, 1974-1979

County	Coal Output (Million Short Tons)						% Change in Output		Number of Active Coal Operators			
	1974	1975	1976	1977	1978	1979	1975-78	1978-79	1974	1975	1978	1979
Craig	0.88	1.25	2.14	2.50	2.30	1.70	+84	-26	3	5	6	3
Okmulgee	0.00	0.09	0.22	0.37	0.46	0.33	+411	-28	0	1	9	3
Nowata	0.01	0.04	0.10	0.26	0.14	0.42	+250	+200	1	1	4	1
Rogers	1.00	0.67	0.50	0.84	1.05	0.63	+57	-40	4	8	14	5
State	2.40	2.90	3.60	5.30	5.40	4.78	+86	-11	12	29	55	31

Source: Department of Mines, Chief Mines Inspector, Annual Reports, and Newsletters, 1974-1979, Oklahoma City.

in developing pastureland from its unimproved native pasture to an improved state is illustrated (Figure 4).

Native pastureland in eastern Oklahoma may have coal deposits under it. If it does not contain coal, the land owner could develop it by removing the native grass and establishing in its place high yielding varieties of grass and legumes (land B). On the other hand, if native pastureland has coal under it, the interaction of economics, technology, and lifestyle (energy shortages and higher prices for fuel) may induce the production of coal. The cost-price relationships of energy and the resulting changes in energy consumption patterns since the 1973 Arab oil embargo have combined with more efficient technology to encourage strip coal mining in eastern Oklahoma.

Before 1971 when no reclamation law existed in Oklahoma, coal bearing native pastureland was strip mined, then abandoned and finally depreciated in value. Such lands became known as orphan lands or abandoned strip mined lands. Between 1971-1977, the Mining Lands Reclamation Act of Oklahoma, (the "old law") was in effect. Reclamation became mandatory, but could be implemented several months after strip mining. The law required that coal companies establish high yielding pasture on the reclaimed land. However due to the shortcomings in the strip mining and reclamation regulations, the resulting pasture never achieved its high quality potential (land C). Land values depreciated during this era of the old law, but not nearly so much as the decline in land values of the non-reclaimed land.

Under the 1977 federal law, PL95-87 the "new law", the delay stage where the land was not reclaimed for several months after mining was eliminated. As in the old law, the new law places the burden to

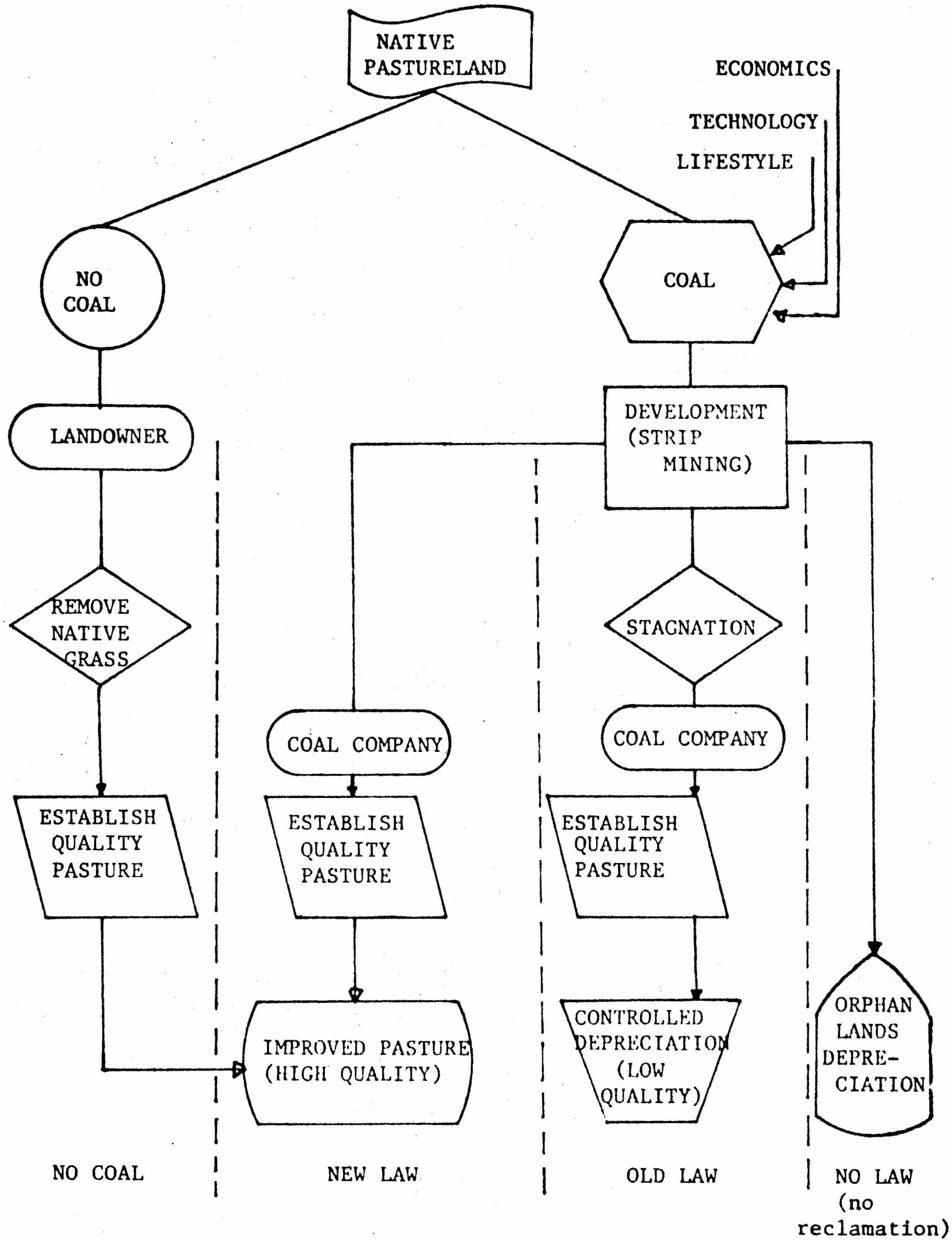

Figure 4. Alternative Steps to Pastureland Development With and Without Strip Mining and Reclamation

establish high yielding varieties of grass and legumes on the coal companies. The resulting reclaimed land (land D) is expected to have improved pasture of quality comparable to that established by the land owner (land B). Thus the reclamation effort should be successful. Successful reclamation is defined as that reclamation effort which restores the land to its pre-mining productivity potential.

Enterprise Budgets

Cost and returns estimates for all farm enterprises require budgeting. The enterprise budget is a tool for measuring costs and returns for each unit of a given enterprise. In this study, pasture is estimated on per acre basis and livestock in cow units. These budgets are statements of expected revenues from and expenses incurred in the production of hay/pasture and cattle for a specified period. As a result, the information relating particular input combinations to output is incomplete. However, they have been found useful in farm planning and analysis (38). Representative cow-calf and pasture production budgets for lands A, B, and D based on regional (area) data have been developed by the Agricultural Economics Department at Oklahoma State University, Stillwater. The cow-calf and production budgets for land C are the modified versions of land B budgets. These revised budgets were accomplished with the assistance of agronomists, animal scientists, area extension specialists and agricultural economists. These sets of budgets are in Appendix B. All budgets present the per unit return to land capital, overhead, operator's labor, risk and management used in a linear programming model to estimate and project the organization of an optimum ranching enterprise (39).

Pasture and Hay Budgets

The cost and returns for pasture production are based on input levels and machinery/equipment operations specified by the area extension specialists. The inputs used represent those used by efficient producers in the area. Fertilizer usage, timely harvest of hay, rotation of grazing, and above average management are assumed. For improved pasture on lands B and D, the establishment cost is usually pro-rated over ten years. However, the establishment cost has been deleted from these budgets to achieve comparability with the improved pasture on land C (reclaimed land) where pasture is established at no cost to the landowener. The quality of the pasture has been estimated by the amount of hay produced in the summer months and the Animal Unit Months (AUM's) of pasture provided in the winter and summer months.

Cow-Calf Budgets

Data for designated areas provided by the area extension specialists are used to calculate cost and returns based on livestock investment, production, and operating inputs including pasture charges and machinery/ equipment operations. Since the farm organization would produce and use its own hay and pasture, such charges have been deleted. Protein supplement and crude protein equivalent for hay are inclusive in the operating inputs. The calf crop is assumed at 90%. The carrying capacity for pasture on land B and D are three acres per cow; carrying capacity for pasture on land D is five acres per cow. Pasture on lands B and D pasture could be rented at $16.00 above operating costs per acre. This level of input management also is above average.

Comparative productivity coefficients for the four land classes are presented in Table V. The change in land D (Δ land D) shows improved carrying capacity (40% less acres per head), and 79% increase in hay and AUM supply over land C. This also implies that land D would sell at a higher price.

Additional data obtained from publications of the Soil Conservation Service, USDA, and the Office of the Chief Mine Inspector for the State of Oklahoma, were combined with some aspects of the survey results to develop an environmental impact matrix. The assumptions and framework of this matrix are described in Chapter VII.

TABLE V

COMPARATIVE PRODUCTIVITY COEFFICIENTS AND CHANGES IN LAND QUALITY

Land Class (1)	Acres/ Head (2)	Number of Head (3)	Hay Supply (Tons) (4)	Pasture Type (5)	AUM Supply Oct.-March (6)	AUM Supply April-Sept. (7)	AUM Supply Total (8)	AUM Demand Oct.-March (9)	AUM Demand April-Sept. (10)	AUM Demand Total[a] (11)
Land A	8.0	1.12	--	Native	0.46	0.75	1.21	7.80	6.45	15.96
Land B	3.0	1.12	0.50	Fescue/Bermuda	2.40	5.50	7.90	6.00	6.00	13.44
Land C	5.0	1.12	0.28	Fescue/Bermuda	1.34	3.07	4.41	6.00	6.00	13.44
Land D[b]	3.0	1.12	0.50	Fescue/Bermuda	2.40	5.50	7.90	6.00	6.00	13.44
Δ Land D[c]	-2.0	0	+0.22	0	+1.06	+2.43	+3.49	0	0	0
% Land D	-40.0	0	+78.60	0	+79.10	+79.15	+79.14	0	0	0

[a]Total Demand = Col. 3 x (Col. 9 + Col. 12).

[b]Land D is land A (high quality) reclaimed to its full productive potential and having the same productivity coefficients as land B.

[c]Δ Land D = Land D - Land C coefficients.

CHAPTER V

APPLICATION OF THE ANALYTICAL MODEL

Linear Programming Tableaus

The application of the model in linear programming tableaus is presented in six parts: (1) explanation of variables; (2) alternative mineral rights transfer strategies; (3) opportunity costs of transfer strategies; (4) modeling for land D and quality changes in reclaimed coal lands; (5) objective function values; and (6) limitations of the model.

Static and "dynamic" versions of the model were used to evaluate (compare) the profitability of cattle ranching on different qualities of coal land and to project the monetary impact of coal mining and reclamation, respectively.

The static (one period) linear programming model was set to maximize net cash returns from a ranching enterprise. The ranch had two land classes, initially comprised of 100 acres of land A and 197 acres of land B. Three identical models were developed (Table VI). OBJ 1, the baseline strategy, maximized the net cash income in the pre-mining state of lands A and B. OBJ 2, the present strategy, maximized the net cash income on lands B and C. Net cash income from operating lands B and D is maximized in OBJ 3, the future strategy. The major activities in the model are cow-calf and pasture/hay production. Hay is produced on lands B, C, and D and may be bought, sold and/or

TABLE VI

STATIC LINEAR PROGRAMMING TABLEAU TO COMPARE NET CASH RETURNS FROM DIFFERENT QUALITIES OF COAL LAND

BASELINE STRATEGY				Livestock A	Livestock B	Pasture A	Pasture B	Labor Hire 1	Labor Hire 2	Hay Buy	Hay Trnf	Hay Sell
	Row Type		B[1]	P01	P02	P03	P04	P05	P06	P07	P08	P09
	N[2]			141.07	247.80	-1.18	-29.30	3.0	3.0	-47	0	35
Land A (ac)	L[4]	R01[3]	100			1			0[5]			
Land B (ac)	L	R02	197				1		0			
Labor 1 (hr)	L	R03	295	6.30	4.56		.11	-1	0			
Labor 2 (hr)	L	R04	148	5.74	4.29		.22		-1			
Pasture A 1 (AUM)	L	R05	0	7.80		-.46						
Pasture A 2 (AUM)	L	R06	0	6.90		-.75						
Pasture B 1 (AUM)	L	R07	0		6.72		-2.40					
Pasture B 2 (AUM)	L	R08	0		6.72		-5.50					
Hay 1 (ton)	L	R09	0	.60	.40		- .50			-1	1	
Hay 2 (ton)	L	R10	0	.25	.20						-1	1

CURRENT STRATEGY				Livestock B	Livestock C	Pasture B	Pasture C	Labor hire 1	Labor hire 2	Hay Buy	Hay Trnf	Hay Sell
	Row Type		B[1]	P01	P02	P03	P04	P05	P06	P07	P08	P09
	N[2]			247.8	247.8	-29.30	-37.0	3.0	3.0	-47.0	0	35.0
Land B (ac)	L[4]	R01[3]	197			1				0[5]		
Land C (ac)	L	R02	100				1			0		
Labor 1 (hr)	L	R03	295	4.56	5.20	.11	.16	-1		0		
Labor 2 (hr)	L	R04	148	4.29	5.16	.22	.32		-1	0		
Pasture B1 (AUM)	L	R05	0	6.72		-2.40						
Pasture B2 (AUM)	L	R06	0	6.72		-5.50						
Pasture C1 (AUM)	L	R07	0		6.72		1.34					
Pasture C2 (AUM)	L	R08	0		6.72		3.07					
Hay 1 (ton)	L	R09	0	.40	.40	.50	.28			-1	1	
Hay 2 (ton)	L	R10	0	.20	.20						-1	1

FUTURE STRATEGY (NEW LAW)				Livestock B	Livestock D	Pasture B	Pasture D	Labor hire 1	Labor hire 2	Hay Buy	Hay Trnf	Hay Sell
	Row Type		B[1]	P01	P02	P03	P04	P05	P06	P07	P08	P09
	N[2]			247.8	247.8	-29.30	-29.30	3.0	3.0	-47.0	0	35
Land B (ac)	L[4]	R01[3]	197	0[5]		1						
Land D (ac)	L	R02	100	0			1					
Labor 1 (hr)	L	R03	295	4.56	4.56	.22	.22	-1				
Labor 2 (hr)	L	R04	148	4.29	4.29	.11	.11		-1			
Pasture B1 (AUM)	L	R05	0	6.72		-2.40						
Pasture B2 (AUM)	L	R06	0	6.72		-5.50						
Pasture D1 (AUM)	L	R07	0		6.72		-2.40					
Pasture D2 (AUM)	L	R08	0		6.72		-5.50					
Hay 1 (ton)	L	R09	0	.40	.40	.50	.50			-1	1	
Hay 2 (ton)	L	R10	0	.20	.20						-1	1

[1] B is used to identify the activities serially form P01...P09.
[2] N is a neutral factor to identify the objective function values.
[3] The rows are identified serially from R01...R10.
[4] L (less than) indicates the type of restriction on the resource/row indicated.
[5] All blank spaces have zero values, unless indicated otherwise.

transferred between the summer and winter months. The resource restrictions are land, labor, pasture, and hay. It is assumed that all land A was reclaimed by law and that additional labor was hired to achieve full utilization of all available land. The three OBJ values are then compared for differences in cash return attributable to the quality of reclamation.

Explanation of Variables in the Linear Programming Tableaus

Land Resources

The important factors affecting land are the climate, soils, topography, and land use. Climate and soils affect the ability of plant and animal life to thrive. Topography has a bearing on erosion, drainage, and coal mining technique. The land-use depends on the soil capability classifications and is important in recreating similar land use patterns before and after strip coal mining and reclamation. A large portion of the coal lies beneath land that has Soil Capability Classification III, which indicates suitability of the land for small grains, pasture, and hay production. A breakdown of the capability class by units, soil texture, and limitations is presented in Table VII.

The development of the LP models does not include land capability units because the enterprise budgets have been treated according to geographical areas or zones. A more general representation of this land characteristics is therefore used in this study. Climatic factors have been discussed in Chapter I.

TABLE VII

CHARACTERISTICS OF SOIL CAPABILITY CLASS III

Capability Unit	Texture	Limitations
IIIe-1	Deep loamy, red or dark colored, moderately sloping soil on uplands. Well drained.	Severe erosion if unprotected.
IIIe-2	Summit silty clay loam; deep clayey dark colored soil. Moderately well drained. Gently sloping.	Severe erosion if unprotected. Water concentration.
IIIe-3	Fine Sandy loam; deep, loamy, well drained, moderately sloping soil.	Severe erosion if unprotected. Water concentration.
IIIe-4	Deep or moderately deep loamy, gently sloping or moderately sloping eroded soils in uplands.	Depleted fertility. Severe erosion, if unprotected.
IIIe-5	Silt loam. Moderately deep, reddish brown well drained soil underlain by limestone. Gently sloping.	Erosion. Limestone bedrock near the surface. Water concentration.
IIIw-1	Deep clayey, dark colored nearly level soil on bottom lands.	Difficult to work. Poorly drained.

Sources: See References (47), (48), (49), and (50).

Wealth and Cash Resources

Wealth A, B, and C (R04, R05, and R06) are the market value of the corresponding land classes if they are traded, sold, or leased. The total values of Wealth A ($2,000 x 100 acres $\leq$ $200,000), Wealth B ($500 x 197 acres $\leq$ $98,500), Wealth C ($400 x 35 acres $\leq$ $14,000) are determined by the quality of the land, coal, and the acreage involved. Cash is composed of CASH (R07) and CFMLVG (R08). An initial CASH value of $10,000 was assumed and cash flow was generated from net cash returns from the individual activities in the model. CFMLVG was assumed to start from $8,000. In solving for OBJ 5, all the wealth and cash rows (resources) namely, R04, R05, R06, R07, and R08 are deleted from the model.

Labor

A total of 443 family labor hours per year was separated into two seasonal periods. Period 1 is the summer months (April-September) and Period 2, the winter months (October-March). Because most land owners are parttime ranchers, less family labor is expended. The use of hired labor was limited by the preference of area farm labor for non-farm jobs in the coal fields.

Pasture and Hay

Three types of pasture are produced to conform with the different land classes. The maximum number of animals (animal units per acre or acres per animal unit) that a grazing land can support adequately without deterioration was estimated in months (AUM's). Hay was produced in the summer and winter months from Pasture B and C. The resource level for all pasture and hay was set at zero.

Livestock

The column activities in the model use the restricted resources, produce resources to be utilized by other activities, use resources produced by other activities, or some combination of these. The livestock investment and production for each land class are specified in the enterprise budgets. The cow-calf unit on land A consists of 1,000 pound cow, 4% of a 1,000 pound bull, and 12% of a replacement heifer. The cow-calf unit on each of lands B and C consists of one 950 pound cow, 4% of a 1,600 pound bull, and 12% of one 800 pound replacement heifer. The cow-unit on each land class (A through C) produces .45 unit of a heifer calf, .13 unit of a replacement heifer, and .1 unit of a cull cow. There is a 2% death loss per year in the cow herd.

Family Living Expenses (CFMLVG)

An initial sum of $8,000 was allotted to family living expenses. This sum was allowed to grow by 8% annually to keep pace with inflation. The expense stream was discounted by 10% annually to derive the present value. CFMLVG was calculated period by period as follows:

$$PV = C + \frac{C(1.08)}{1.1} + \frac{C(1.08)^2}{(1.1)^2} + \frac{C(1.08)^3}{(1.1)^3} + \sum_{t=4}^{39} \frac{C(1.08)^t}{(1.1)^t}$$

where PV = present value of cash for family living,

C = $8,000 (starting cash), and

t = 4, 5, 6, ..., 39 years.

Buy-Sell and Transfer Activities

Hay may be bought and used as an operating input or sold off the ranch. Alternatively, hay may be bought and sold simultaneously on the ranch. Hay may be transferred from the first period to the second of each year. Wealth from the transactions on lands A, B, C and cash balances may be transferred between years. It was assumed that land A appreciates at 10%, lands B and C at 12% and surplus cash can be invested at 8% annually.

Alternative Mineral Rights Transfer Strategies

Trading one acre of land A for 2.5 acres of land B, yields a cash balance of $750. This value is derived from the difference between the $2,000 value of land A and the $1,250 value of land B ($500 per acre). By the same token a cash balance of $400 results by trading one acre of land A for 4 acres of land C. The cash balance is obtained by subtracting the $1,600 value of land C ($400 per acre) from the $2,000 value of land A. By selling one acre of land A, a cash balance of $2,000 is realized. Leasing out one acre of land A brings in $2,000 in the first year and an additional $400 in the fifth year after reclamation and when that land is used as land C.

Leasing Arrangement

A typical coal lease has a two-year duration commencing after the primary term, defined as the period of time in which production must be initiated. The lease period was a sufficient time for the completion of mining and reclamation if both are properly timed and coordinated.

Usually the coal companies furnish ready made forms that make necessary provisions for the mining and removal of coal. Such forms may not contain the necessary provisions to protect the interests of the land owner. For example, default provisions, location, depth, and quality of the coal including a provision for price escalation, are often omitted. Verbal promises from the coal company operators are often not kept. Land owners receive a royalty payment (for coal and top soil loss) per ton of coal mined. The size of the royalty depends on the bargaining skill of the land owner, the quality of the coal (if known beforehand to the land owner) and the personal relationship between the land owner and the coal company.

Trading Arrangement

Land is exchanged on market or dollar value basis. One acre of coal land is exchanged for a given number of acres of non-coal land, which may include reclaimed land. For example, if one acre of coal land is worth exactly X acres of a given quality of non-coal land, then no cash payments accompany the trade. In other words, cash payments are used to equalize dollar or market value of the trade only where there is not sufficient land to make an even trade. The owner of the coal land may exercise the right of choosing the quality and location of the land he wants in exchange. Often times when reclaimed land is involved in the trade, the land owner has limited choice of land quality and location. Therefore more acres of land are exchanged than when trading for non-reclaimed, non-coal land.

Outright Sale Arrangement

This arrangement implies the exchange of coal land for cash only. This transaction may be accompanied by a "buy back" provision, and in some cases, a "first refusal" provision to the seller. A "buy back" provision in the sale agreement legally binds the land owner to buy back the land after reclamation at some specified price per acre. This "buy back" price is usually lower than the sale price established by the coal company after reclamation of land it has acquired through other means. This concept also is used as the basis for the "first refusal" right. A "first refusal" right guarantees the original land owner the first offer to buy back the land after reclamation. This offer by the original land owner may be refused by the coal company. The reclaimed land price depends on the quality of reclamation, demand for reclaimed land, and the personal relationship between the coal company and the original land owner.

Opportunity Costs of Transfer Strategies

An important concept in transferring coal rights is opportunity cost. The land owner must compare the value of the chosen transfer arrangement (lease, trade, sell) against expected revenues/expenses of a particular arrangement that is not chosen. For example, leasing must be matched by expected revenue from agricultural production while trading and selling must be matched by the replacement value of the land.

Most information provided by a lease arrangement may be used to evaluate the coal and land to be traded or sold. Courthouse records, resident farmers, and real estate brokers are good sources for valuation of the land to be received in exchange. Without such information, trading or selling could be risky. The risk posed by leasing occurs when reclamation is incomplete or unsuccessful. Incomplete reclamation may occur if the coal company forecloses. Incomplete and/or unsuccessful reclamation may reduce the potential of the land to reach its pre-mining highest and best use. Trading may be used to trade up land and improvements (buildings) so that a reduction in physical deterioration, functional, and locational obsolescence can be attained. In practice, however, difficulty arises in making these decisions because of the limited information on related economic, legal, and geologic factors available to many land owners.

Modeling for Land D and Quality Changes in Reclaimed Coal Lands

Four objective functions, OBJ 6, OBJ 7, OBJ 8, and OBJ 9 are maximized. Models for OBJ 6 and OBJ 7 estimate and project expected wealth from unsuccessful and successful reclamation, respectively. Both models are obtained by deleting all the mineral rights transfer strategies but leasing from model OBJ 4 such that model OBJ 6 had land C values and land D values are substituted for land C values in model OBJ 7. Models for OBJ 8 and OBJ 9 estimate and project the present value of net cash returns from unsuccessful and successful reclamation respectively. By deleting all the mineral rights transfer strategies but leasing from model OBJ 5, two models are developed. The first model, OBJ 8, has land C values and the latter model, OBJ 9, has land D values in place of the land C values. The difference in objective function values between OBJ 6 and OBJ 7 is the projected loss in land value (wealth), while the difference between OBJ 8 and OBJ 9 values represent the projected loss in net cash return. This opportunity cost in wealth and cash income indicate the impact of quality changes in reclaimed coal lands.

Objective Function Values

The net cash returns in OBJ 1, OBJ 2, and OBJ 3 are obtained by subtracting value of operating inputs, capital costs, ownership costs and labor costs from total receipts. Thus the return to land, overhead, risk and management is being maximized. In OBJ 5, OBJ 8, and OBJ 9, the net cash returns is obtained from total receipts less operating inputs costs, and ownership costs. These returns are then discounted into the future at an annual rate of 10%. Thus the model is set to maximize the present value of net returns to land, capital, overhead, operator's labor, risk and management.

Limitations of the Model

Multi-period linear programming provides cost-minimizing or profit-maximizing solutions which are useful for long-run predictions because farmers may overcome inertia, lack of knowledge, risk and uncertainty or other restrictions as time progresses. However, it is unable to estimate intermediate-run response or the actual process of adjustment (51). Risk and uncertainty, and non-economic considerations are not specifically recognized to the extent that linear programming solutions are more normative than positive. In linear programming, confidence intervals of predicted levels of net returns and wealth cannot be estimated. As a result, the error of prediction is unknown.

Despite its shortcomings, linear programming is beneficial in allowing many sections of the ranching enterprise and their interaction to be considered simultaneously. This avoids the problems of other approaches that consider each section separately and thereby isolate the interaction between sections. Moreover, linear programming is relatively easy, flexible and less expensive in data requirements and computer time than such methods as integer programming or recursive programming. The short time series of the data and the objective sought in this study render the use of this model appropriate and the results which appear in the next chapter relevant.

The application of "dynamic" linear programming models to solve multi-period problems of farm growth have flourished after Dorfman's theoretical exposition on the applicability of the model (40). The first applied model was developed by Swanson (41). The five-year planning model included a transfer of some portion of the income from one year to the next, subject to a minimum consumption and fixed cost allowance.

A later development of the model by Loftsgard-Heady detailed the structural composition of the model as applied to farm and home planning (37). The multi-period model is formulated so that separate activities and restrictions are included in the same matrix. These activities and restrictions are arranged in groups by period. By grouping activities and restrictions by time period and placing those successive periods in time sequence, a block diagonal matrix is formed. Each block on the principal diagonal belong to activities and restrictions for one time period. Coefficients which link the activities of period t to those of period t+1 lie below the principal diagonal. Usually, the model is constructed so that the upper triangle blocks have zero values. Because all activities and restrictions are included in the same matrix, the level of activities in the basis in period t will not affect the basic activities for period t+1, and also those for period t-1. In this way, the model is built to solve an entire planning horizon simultaneously. Loftsgard-Heady used their model to incorporate annual expansion of hog production on a fixed acreage farm and to generate surplus funds.

Other applications of the model by Irwin-Baker (42) and Barr-Plaxico (43) were based on intra-year financial transfers and capital flows among years respectively. A version of the capital flows study by Martin (44) incorporated long-run investment of resources and transfer of funds between years on a representative farm. These earlier applications of the model have formed the foundations for later extensions of linear programming in a multi-period or poly-period framework to analyze micro and macro problems of farm and business enterprises (45, 46).

The multi-period linear programming tableau used to identify optimal strategies associated with leasing, selling or trading coal land, estimates and projects wealth and net cash returns (Table VIII). The introduction of the three alternatives to surface and mineral right transfers necessitated the use of a model with a 40-year planning horizon as follows:

Year 1 : Trade and/or sell

Year 1, 2 : Coal mining lease

Year 3, 4 : "Hold Back" period for non-use of reclaimed land

Years 5-40: Projected period

TABLE VIII

LINEAR PROGRAMMING TABLEAU USED IN PROJECTING WEALTH AND NET CASH RETURN ANALYSIS

(a) YEAR 1

Row ID	Activity	Row Type	Resource Level	Units	P01	P02	P03	P04	P05	P06	P07	P08	P09	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19
	Activity Identification:				L T O K[6]			P A S T U R E			H A Y			MINERAL RIGHTS STRATEGIES					WEALTH TRANSFER				
					A	B	C	A	B	C	Buy	Transfer period 2	Sell	Trade A/B	Trade A/C	Sell Land A	Lease Out Land A	Rent In Land B	Land A	Land B	Land C	Cash	Family Living Expense
	Objective Functions: (cj values)			No. 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				No. 2	222.56	353.65	353.65	-1.15	-43.35	-43.35	-47.0	0	35.0	0	0	2,000	2,400	59.35	---	---	---	---	0
	Year 1																						
R01	LAND1A	L	100	ac	0[1]			1.0						1.0	1.0	1.0	1.0						
R02	LAND1B	L	197	ac	0				1.0					-2.5									
R03	LAND1C	L	35	ac	0					1.0					-4.0				1.0				
R04	WLTH1A	L	200,000	dol.	0									2,000	2,000	2,000	2,000			1.0			
R05	WLTH1B	L	98,500	dol.	0									-1,250			-400				1.0		
R06	WLTH1C	L	14,000	dol.	0										-1,600							1.0	
R07	CASH1	L	10,000	dol.	-222.56	-353.65	-350.00	1.15	43.35	41.00	47.0	0	-35.0	-750	-400	-2,000	-2,000	-59.35					
R08	CFMLVG1[2]	G	8,000	dol.																			
R09	LABOR1F	L	295	hr.	6.30	4.56	4.56	0	0.11	0.11													
R10	LABOR1S	L	148	hr.	5.74	4.29	4.29	0	0.22	0.22													
R11	ANPAS1F[3]	L	0	A.U.M.	8.74			-.46															
R12	ANPAS1S	L	0	A.U.M.	7.22			-.75															
R13	ANPAS1F[4]	L	0	A.U.M.		6.72			-2.4									-2.4					
R14	BIPAS1S	L	0	A.U.M.		6.72			-5.5									-5.5					
R15	CIPAS1F[5]	L	0	A.U.M.			6.72			-1.54													
R16	CIPAS1S	L	0	A.U.M.			6.72			-3.07													
R17	HAY1F	L	0	Ton	.60	.40	.40	0	-.50	-.28	-1.0	1.0											
R18	HAY1S	L	0	Ton	.25	.20	.20	0	0	0		-1.0	1.0										
	Year 2																						
R01	LAND2A	L	100	ac													1.0						
R02	LAND2B	L	197	ac																			
R03	LAND2C	L	35	ac															-1.12				
R04	WLTH2A	L	0	dol.																-1.10			
R05	WLTH2B	L	0	dol.																	-1.10		
R06	WLTH2C	L	0	dol.																		-1.08	
R07	CASH2	L	0	dol.																			
R08	CFMLVG2	G	8,640	dol.																			
R09	LABOR2F	L	295	hr.																			
R10	LABOR2S	L	148	hr.																			
R11	ANPAS2F	L	0	A.U.M.																			
R12	ANPAS2S	L	0	A.U.M.																			
R13	BIPAS2F	L	0	A.U.M.																			
R14	BIPAS2S	L	0	A.U.M																			
R15	CIPAS2F	L	0	A.U.M.																			
R16	CIPAS2S	L	0	A.U.M.																			
R17	HAY2F	L	0	Ton																			
R18	HAY2S	L	0	Ton																			

TABLE VIII (Continued)

	Year 3				1.0
R01	LAND3A	L	100	ac	
Ro2	LAND3B	L	197	ac	
R03	LAND3C	L	35	ac	
R04	WLTH3A	L	0	dol.	
R05	WLTH3B	L	0	dol.	
R06	WLTH3C	L	0	dol.	
R07	CASH3	L	0	dol.	
R08	CFMLVG3	G	9,331	dol.	
R09	LABOR3F	L	295	hr.	
R10	LABOR3S	L	148	hr.	
R11	ANPAS2F	L	0	A.U.M.	
R12	ANPAS2S	L	0	A.U.M.	
R13	BIPAS2F	L	0	A.U.M.	
R14	BIPAS2S	L	0	A.U.M.	
R15	CIPAS2F	L	0	A.U.M.	
R16	CIPAS2S	L	0	A.U.M.	
R17	HAY3F	L	0	Ton	
R18	HAY3S	L	0	Ton	
	Year 4				1.0
R01	LAND4A	L	100	ac	
Ro2	LAND4B	L	197	ac	
R03	LAND4C	L	35	ac	
R04	WLTH4A	L	0	dol.	
R05	WLTH4B	L	0	dol.	
R06	WLTH4C	L	0	dol.	
R07	CASH4	L	0	dol.	
R08	CFMLVG4	G	10,078	dol.	
R09	LABOR4F	L	295	hr.	
R10	LABOR4S	L	148	hr.	
R11	ANPAS4F	L	0	A.U.M.	
R12	ANPAS4S	L	0	A.U.M.	
R13	BIPAS4F	L	0	A.U.M.	
R14	BIPAS4S	L	0	A.U.M.	
R15	CIPAS4F	L	0	A.U.M.	
R16	CIPAS4S	L	0	A.U.M.	
R17	HAY4F	L	0	Ton	
R18	HAY4S	L	0	Ton	
	Year 5-40				
R01	LAND5A	L	100	ac	
R02	LAND5B	L	197	ac	
R03	LAND5C	L	35	ac	-1.0
R04	WLTH5A	L	0	dol.	
R05	WLTH5B	L	0	dol.	
R06	WLTH5C	L	0	dol.	
R07	CASH5	L	0	dol.	
R08	CFMLVG5	G	2,036,388	dol.	
R09	LABOR5F	L	295	hr.	
R10	LABOR5S	L	148	hr.	
R11	ANPAS5F	L	0	A.U.M.	
R12	ANPAS5S	L	0	A.U.M.	
R13	BIPAS5F	L	0	A.U.M.	
R14	BIPAS5S	L	0	A.U.M.	
R15	CIPAS5F	L	0	A.U.M.	
R16	CIPAS5S	L	0	A.U.M.	
R17	HAY5F	L	0	Ton	
R18	HAY5S	L	0	Ton	

TABLE VIII (Continued)

(b) YEAR 2

Row ID	Activity	Row Type	Resource Level	Units	P01	P02	P03	P04	P05	P06	P07	P08	P09	P14	P15	P16	P17	P18	P19
					L T O K[6]			P A S T U R E			H A Y			WEALTH TRANSFER					
					A	B	C	A	B	C	Buy	Transfer period 2	Sell	Rent In Land B	Land A	Land B	Land C	Cash	Family Living Expense
Objective Functions: (cj values)				No. 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				No. 2	202.32	321.50	321.50	-1.05	-39.41	-39.41	-42.73	0	31.82	53.95	---	---	---	---	0
	Year 1																		
R01	LAND1A	L	100	ac	0[1]														
R02	LAND1B	L	197	ac	0														
R03	LAND1C	L	35	ac	0														
R04	WLTH1A	L	200,000	dol.	0														
R05	WLTH1B	L	98,500	dol.	0														
R06	WLTH1C	L	14,000	dol.	0														
R07	CASH1	L	10,000	dol.	0														
R08	CFMLVG1	G	8,000	dol.	0														
R09	LABOR1F	L	295	hr.	0														
R10	LABOR1S	L	148	hr.	0														
R11	ANPAS1F	L	0	A.U.M.															
R12	ANPAS1S	L	0	A.U.M.															
R13	ANPAS1F	L	0	A.U.M.															
R14	BIPAS1S	L	0	A.U.M.															
R15	CIPAS1F	L	0	A.U.M.															
R16	CIPAS1S	L	0	A.U.M.															
R17	HAY1F	L	0	Ton															
R18	HAY1S	L	0	Ton															
	Year 2																		
R01	LAND2A	L	100	ac															
R02	LAND2B	L	197	ac															
R03	LAND2C	L	35	ac															
R04	WLTH2A	L	0	dol.															
R05	WLTH2B	L	0	dol.															
R06	WLTH2C	L	0	dol.															
R07	CASH2	L	0	dol.	-222.56	-353.65	-353.65	1.15	43.35	43.35	47.0	0	-35.0	-59.35					
R08	CFMLVG2	G	8,640	dol.															
R09	LABOR2F	L	295	hr.	6.30	4.56	4.56	0	.11	.11									
R10	LABOR2S	L	148	hr.	5.74	4.29	4.29	0	.22	.22									
R11	ANPAS2F	L	0	A.U.M.	8.74			-.46											
R12	ANPAS2S	L	0	A.U.M.	7.22			-.75											
R13	BIPAS2F	L	0	A.U.M.		6.72			-2.40										
R14	BIPAS2S	L	0	A.U.M.		6.72			-5.50					-2.40					
R15	CIPAS2F	L	0	A.U.M.			6.72			-1.54				-5.50					
R16	CIPAS2S	L	0	A.U.M.			6.72			-3.07									
R17	HAY2F	L	0	Ton	.60	.40	.40	0	-.50	-.28	-1.0	1.0							
R18	HAY2S	L	0	Ton	.25	.20	.20	0	0	0		-1.0	1.0						

TABLE VIII (Continued)

	Year 3							
R01	LAND3A	L	100	ac				
Ro2	LAND3B	L	197	ac				
R03	LAND3C	L	35	ac	-1.12			
R04	WLTH3A	L	0	dol.		-1.10		
R05	WLTH3B	L	0	dol.			-1.10	
R06	WLTH3C	L	0	dol.				-1.08
R07	CASH3	L	0	dol.				
R08	CFMLVG3	G	9,331	dol.				
R09	LABOR3F	L	295	hr.				
R10	LABOR3S	L	148	hr.				
R11	ANPAS2F	L	0	A.U.M.				
R12	ANPAS2S	L	0	A.U.M.				
R13	BIPAS2F	L	0	A.U.M.				
R14	BIPAS2S	L	0	A.U.M.				
R15	CIPAS2F	L	0	A.U.M.				
R16	CIPAS2S	L	0	A.U.M.				
R17	HAY4F	L	0	Ton				
R18	HAY4S	L	0	Ton				
	Year 4							
R01	LAND4A	L	100	ac				
Ro2	LAND4B	L	197	ac				
R03	LAND4C	L	35	ac				
R04	WLTH4A	L	0	dol.				
R05	WLTH4B	L	0	dol.				
R06	WLTH4C	L	0	dol.				
R07	CASH4	L	0	dol.				
R08	CFMLVG4	G	10,078	dol.				
R09	LABOR4F	L	295	hr.				
R10	LABOR4S	L	148	hr.				
R11	ANPAS4F	L	0	A.U.M.				
R12	ANPAS4S	L	0	A.U.M.				
R13	BIPAS4F	L	0	A.U.M.				
R14	BIPAS4S	L	0	A.U.M.				
R15	CIPAS4F	L	0	A.U.M.				
R16	CIPAS4S	L	0	A.U.M.				
R17	HAY4F	L	0	Ton				
R18	HAY4S	L	0	Ton				
	Year 5-40							
R01	LAND5A	L	100	ac				
R02	LAND5B	L	197	ac				
R03	LAND5C	L	35	ac				
R04	WLTH5A	L	0	dol.				
R05	WLTH5B	L	0	dol.				
R06	WLTH5C	L	0	dol.				
R07	CASH5	L	0	dol.				
R08	CFMLVG5	G	2,036,388	dol.				
R09	LABOR5F	L	295	hr.				
R10	LABOR5S	L	148	hr.				
R11	ANPAS5F	L	0	A.U.M.				
R12	ANPAS5S	L	0	A.U.M.				
R13	BIPAS5F	L	0	A.U.M.				
R14	BIPAS5S	L	0	A.U.M.				
R15	CIPAS5F	L	0	A.U.M.				
R16	CIPAS5S	L	0	A.U.M.				
R17	HAY5F	L	0	Ton				
R18	HAY5S	L	0	Ton				

TABLE VIII (Continued)

(c) YEAR 3

Row ID	Activity	Row Type	Resource Level	Units	P01	P02	P03	P04	P05	P06	P07	P08	P09	P14	P15	P16	P17	P18	P19
	Activity Identification:				P01	P02	P03	P04	P05	P06	P07	P08	P09	P14	P15	P16	P17	P18	P19
					L T O K[6]			P A S T U R E			H A Y			WEALTH TRANSFER					
					A	B	C	A	B	C	Buy	Transfer period 2	Sell	Rent In Land B	Land A	Land B	Land C	Cash	Family Living Expense
	Objective Functions: (cj values)		No. 1		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			No. 2		183.93	292.27	292.27	-0.95	-35.83	-35.83	-35.84	0	29.92	49.05	---	---	---	---	0
	Year 1																		
R01	LAND1A	L	100	ac															
R02	LAND1B	L	197	ac															
R03	LAND1C	L	35	ac															
R04	WLTH1A	L	200,000	dol.															
R05	WLTH1B	L	98,500	dol.															
R06	WLTH1C	L	14,000	dol.															
R07	CASH1	L	10,000	dol.															
R08	CFMLVC1[2]	G	8,000	dol.															
R09	LABOR1F	L	295	hr.															
R10	LABOR1S	L	148	hr.															
R11	ANPAS1F[3]	L	0	A.U.M.															
R12	ANPAS1S[4]	L	0	A.U.M.															
R13	ANPAS1F	L	0	A.U.M.															
R14	BIPAS1S	L	0	A.U.M.															
R15	CIPAS1F[5]	L	0	A.U.M.															
R16	CIPAS1S	L	0	A.U.M.															
R17	HAY1F	L	0	Ton															
R18	HAY1S	L	0	Ton															
	Year 2																		
R01	LAND2A	L	100	ac	0[1]														
R02	LAND2B	L	197	ac	0														
R03	LAND2C	L	35	ac	0														
R04	WLTH2A	L	0	dol.	0														
R05	WLTH2B	L	0	dol.	0														
R06	WLTH2C	L	0	dol.	0														
R07	CASH2	L	0	dol.	0														
R08	CFMLVC2	G	8,640	dol.	0														
R09	LABOR2F	L	295	hr.															
R10	LABOR2S	L	148	hr.															
R11	ANPAS2F	L	0	A.U.M.															
R12	ANPAS2S	L	0	A.U.M.															
R13	BIPAS2F	L	0	A.U.M.															
R14	BIPAS2S	L	0	A.U.M.															
R15	CIPAS2F	L	0	A.U.M.															
R16	CIPAS2S	L	0	A.U.M.															
R17	HAY2F	L	0	Ton															
R18	HAY2S	L	0	Ton															

TABLE VIII (Continued)

	Year 3																	
R01	LAND3A	L	100	ac														
Ro2	LAND3B	L	197	ac														
R03	LAND3C	L	35	ac														
R04	WLTH3A	L	0	dol.											1.0			
R05	WLTH3B	L	0	dol.												1.0		
R06	WLTH3C	L	0	dol.													1.0	
R07	CASH3	L	0	dol.	-222.56	-353.65	-353.65	1.15	43.35	43.35	47.0	0	-35.0	-59.35				1.0
R08	CFMLVG3	G	9,331	dol.														
R09	LABOR3F	L	295	hr.	6.30	4.56	4.56	0	.11	.11								
R10	LABOR3S	L	148	hr.	5.74	4.29	4.29	0	.22	.22								
R11	ANPAS2F	L	0	A.U.M.	8.74			-.46										
R12	ANPAS2S	L	0	A.U.M.	7.22			-.75										
R13	BIPAS2F	L	0	A.U.M.		6.72			-2.40					-2.40				
R14	BIPAS2S	L	0	A.U.M.		6.72			-5.50					-5.50				
R15	CIPAS2F	L	0	A.U.M.			6.72			-1.54								
R16	CIPAS2S	L	0	A.U.M.			6.72			-3.07								
R17	HAY3F	L	0	Ton	.60	.40	.40	0	-.50	-.28	-1.0	1.0						
R18	HAY3S	L	0	Ton	.25	.20	.20	0	0	0		-1.0	1.0					
	Year 4																	
R01	LAND4A	L	100	ac														
Ro2	LAND4B	L	197	ac														
R03	LAND4C	L	35	ac														
R04	WLTH4A	L	0	dol.											-1.12			
R05	WLTH4B	L	0	dol.												-1.10		
R06	WLTH4C	L	0	dol.													-1.10	
R07	CASH4	L	0	dol.														-1.08
R08	CFMLVG4	G	10,078	dol.														
R09	LABOR4F	L	295	hr.														
R10	LABOR4S	L	148	hr.														
R11	ANPAS4F	L	0	A.U.M.														
R12	ANPAS4S	L	0	A.U.M.														
R13	BIPAS4F	L	0	A.U.M.														
R14	BIPAS4S	L	0	A.U.M.														
R15	CIPAS4F	L	0	A.U.M.														
R16	CIPAS4S	L	0	A.U.M.														
R17	HAY4F	L	0	Ton														
R18	HAY4S	L	0	Ton														
	Year 5-40																	
R01	LAND5A	L	100	ac														
R02	LAND5B	L	197	ac														
R03	LAND5C	L	35	ac														
R04	WLTH5A	L	0	dol.														
R05	WLTH5B	L	0	dol.														
R06	WLTH5C	L	0	dol.														
R07	CASH5	L	0	dol.														
R08	CFMLVG5	G	2,036,388	dol.														
R09	LABOR5F	L	295	hr.														
R10	LABOR5S	L	148	hr.														
R11	ANPAS5F	L	0	A.U.M.														
R12	ANPAS5S	L	0	A.U.M.														
R13	BIPAS5F	L	0	A.U.M.														
R14	BIPAS5S	L	0	A.U.M.														
R15	CIPAS5F	L	0	A.U.M.														
R16	CIPAS5S	L	0	A.U.M.														
R17	HAY5F	L	0	Ton														
R18	HAY5S	L	0	Ton														

TABLE VIII (Continued)

(d) YEAR 4

Row ID	Activity	Row Type	Resource Level	Units	P01	P02	P03	P04	P05	P06	P07	P08	P09	P14	P15	P16	P17	P18	P19
	Activity Identification:				P01	P02	P03	P04	P05	P06	P07	P08	P09	P14	P15	P16	P17	P18	P19
					S T O C K[6]			P A S T U R E			H A Y			WEALTH TRANSFER					
					A	B	C	A	B	C	Buy	Transfer period 2	Sell	Rent In Land B	Land A	Land B	Land C	Cash	Family Living Expense
	Objective Functions: (cj values)			No. 1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
				No. 2	167.21	265.70	265.70	-0.86	-32.57	-32.57	-35.31	0	26.30	44.59	---	---	---	---	0
	Year 1																		
R01	LAND1A	L	100	ac															
R02	LAND1B	L	197	ac															
R03	LAND1C	L	35	ac															
R04	WLTH1A	L	200,000	dol.															
R05	WLTH1B	L	98,500	dol.															
R06	WLTH1C	L	14,000	dol.															
R07	CASH1	L	10,000	dol.															
R08	CFMLVG1	G	8,000	dol.															
R09	LABOR1F	L	295	hr.															
R10	LABOR1S	L	148	hr.															
R11	ANPAS1F	L	0	A.U.M.															
R12	ANPAS1S	L	0	A.U.M.															
R13	ANPAS1F	L	0	A.U.M.															
R14	BIPAS1S	L	0	A.U.M.															
R15	CIPAS1F	L	0	A.U.M.															
R16	CIPAS1S	L	0	A.U.M.															
R17	HAY1F	L	0	Ton															
R18	HAY1S	L	0	Ton															
	Year 2																		
R01	LAND2A	L	100	ac					0[1]										
R02	LAND2B	L	197	ac					0										
R03	LAND2C	L	35	ac					0										
R04	WLTH2A	L	0	dol.					0										
R05	WLTH2B	L	0	dol.					0										
R06	WLTH2C	L	0	dol.					0										
R07	CASH2	L	0	dol.															
R08	CFMLVG2	G	8,640	dol.															
R09	LABOR2F	L	295	hr.															
R10	LABOR2S	L	148	hr.															
R11	ANPAS2F	L	0	A.U.M.															
R12	ANPAS2S	L	0	A.U.M.															
R13	BIPAS2F	L	0	A.U.M.															
R14	BIPAS2S	L	0	A.U.M.															
R15	CIPAS2F	L	0	A.U.M.															
R16	CIPAS2S	L	0	A.U.M.															
R17	HAY2F	L	0	Ton															
R18	HAY2S	L	0	Ton															

TABLE VIII (Continued)

	Year 3																	
R01	LAND3A	L	100	ac														
Ro2	LAND3B	L	197	ac														
R03	LAND3C	L	35	ac														
R04	WLTH3A	L	0	dol.														
R05	WLTH3B	L	0	dol														
R06	WLTH3C	L	0	dol.														
R07	CASH3	L	0	dol.														
R08	CFMLVG3	G	9,331	dol.														
R09	LABOR3F	L	295	hr.														
R10	LABOR3S	L	148	hr.														
R11	ANPAS2F	L	0	A.U.M.														
R12	ANPAS2S	L	0	A.U.M.														
R13	BIPAS2F	L	0	A.U.M.														
R14	BIPAS2S	L	0	A.U.M.														
R15	CIPAS2F	L	0	A.U.M.														
R16	CIPAS2S	L	0	A.U.M.														
R17	HAY3F	L	0	Ton														
R18	HAY3S	L	0	Ton														
	Year 4																	
R01	LAND4A	L	100	ac														
Ro2	LAND4B	L	197	ac														
R03	LAND4C	L	35	ac														
R04	WLTH4A	L	0	dol.											1.0			
R05	WLTH4B	L	0	dol.												1.0		
R06	WLTH4C	L	0	dol.													1.0	
R07	CASH4	L	0	dol.	-222.56	-353.65	-353.65	1.15	43.35	43.35	47.0	0	-35.0	-59.35				1.[illegible]
R08	CFMLVG4	G	10,078	dol.														
R09	LABOR4F	L	295	hr.	6.30	4.56	4.56	0	.11	.11								
R10	LABOR4S	L	148	hr.	5.74	4.29	4.29	0	.22	.22								
R11	ANPAS4F	L	0	A.U.M.	8.74			-.46										
R12	ANPAS4S	L	0	A.U.M.	7.22			-.75										
R13	BIPAS4F	L	0	A.U.M.		6.72			-2.40					-2.40				
R14	BIPAS4S	L	0	A.U.M.		6.72			-5.50					-5.50				
R15	CIPAS4F	L	0	A.U.M.			6.72			-1.54								
R16	CIPAS4S	L	0	A.U.M.			6.72			-3.07								
R17	HAY4F	L	0	Ton	.60	.40	.40	0	-.50	-.28	-1.0	1.0						
R18	HAY4S	L	0	Ton	.25	.20	.20	0	0	0		-1.0	1.0					
	Year 5-40																	
R01	LAND5A	L	100	ac														
R02	LAND5B	L	197	ac														
R03	LAND5C	L	35	ac														
R04	WLTH5A	L	0	dol.														
R05	WLTH5B	L	0	dol.											-30.912			
R06	WLTH5C	L	0	dol.												-59.136		
R07	CASH5	L	0	dol.													-59.136	
R08	CFMLVG5	G	2,036,389	dol.														-15.968
R09	LABOR5F	L	295	hr.														
R10	LABOR5S	L	148	hr.														
R11	ANPAS5F	L	0	A.U.M.														
R12	ANPAS5S	L	0	A.U.M.														
R13	BIPAS5F	L	0	A.U.M.														
R14	BIPAS5S	L	0	A.U.M.														
R15	CIPAS5F	L	0	A.U.M.														
R16	CIPAS5S	L	0	A.U.M.														
R17	HAY5F	L	0	Ton														
R18	HAY5S	L	0	Ton														

TABLE VIII (Continued)

(e) YEAR 5-40

Row ID	Activity	Row Type	Resource Level	Units	P01	P02	P03	P04	P05	P06	P07	P08	P09	P15	P16	P17	P18	P19
	Activity Identification:				P01	P02	P03	P04	P05	P06	P07	P08	P09	P15	P16	P17	P18	P19
					L T O K[6]			P A S T U R E			H A Y			WEALTH TRANSFER				
					A	B	C	A	B	C	Buy	Transfer period 2	Sell	Land A	Land B	Land C	Cash	Family Living Expense
	Objective Functions: (cj values)			No. 1	0	0	0	0	0	0	0	0	0	1.0	1.0	1.0	1.0	0
				No. 2	1470.94	2337.34	2337.34	-7.60	-286.51	-286.51	-310.63	0	231.32	---	---	---	---	0
	Year 1																	
R01	LAND1A	L	100	ac														
R02	LAND1B	L	197	ac														
R03	LAND1C	L	35	ac														
R04	WLTH1A	L	200,000	dol.														
R05	WLTH1B	L	98,500	dol.														
R06	WLTH1C	L	14,000	dol.														
R07	CASH1	L	10,000	dol.														
R08	CFMLVG1[2]	G	8,000	dol.														
R09	LABOR1F	L	295	hr.														
R10	LABOR1S	L	148	hr.														
R11	ANPAS1F[3]	L	0	A.U.M.														
R12	ANPAS1S	L	0	A.U.M.														
R13	ANPAS1F[4]	L	0	A.U.M.														
R14	BIPAS1S	L	0	A.U.M.														
R15	CIPAS1F[5]	L	0	A.U.M.														
R16	CIPAS1S	L	0	A.U.M.														
R17	HAY1F	L	0	Ton														
R18	HAY1S	L	0	Ton														
	Year 2																	
R01	LAND2A	L	100	ac														
R02	LAND2B	L	197	ac														
R03	LAND2C	L	35	ac														
R04	WLTH2A	L	0	dol.														
R05	WLTH2B	L	0	dol.														
R06	WLTH2C	L	0	dol.														
R07	CASH2	L	0	dol.														
R08	CFMLVG2	G	8,640	dol.														
R09	LABOR2F	L	295	hr.														
R10	LABOR2S	L	148	hr.														
R11	ANPAS2F	L	0	A.U.M.														
R12	ANPAS2S	L	0	A.U.M.														
R13	BIPAS2F	L	0	A.U.M.														
R14	BIPAS2S	L	0	A.U.M.														
R15	CIPAS2F	L	0	A.U.M.														
R16	CIPAS2S	L	0	A.U.M.														
R17	HAY2F	L	0	Ton														
R18	HAY2S	L	0	Ton														

TABLE VIII (Continued)

	Year 3																	
R01	LAND3A	L	100	ac						0[1]								
Ro2	LAND3B	L	197	ac						0								
R03	LAND3C	L	35	ac						0								
R04	WLTH3A	L	0	dol.						0								
R05	WLTH3B	L	0	dol.						0								
R06	WLTH3C	L	0	dol.														
R07	CASH3	L	0	dol.														
R08	CFMLVG3	G	9,331	dol.														
R09	LABOR3F	L	295	hr.														
R10	LABOR3S	L	148	hr.														
R11	ANPAS2F	L	0	A.U.M.														
R12	ANPAS2S	L	0	A.U.M.														
R13	BIPAS2F	L	0	A.U.M.														
R14	BIPAS2S	L	0	A.U.M.														
R15	CIPAS2F	L	0	A.U.M.														
R16	CIPAS2S	L	0	A.U.M.														
R17	HAY3F	L	0	Ton														
R18	HAY3S	L	0	Ton														
	Year 4																	
R01	LAND4A	L	100	ac														
Ro2	LAND4B	L	197	ac														
R03	LAND4C	L	35	ac														
R04	WLTH4A	L	0	dol.														
R05	WLTH4B	L	0	dol.														
R06	WLTH4C	L	0	dol.														
R07	CASH4	L	0	dol.														
R08	CFMLVG4	G	10,078	dol.														
R09	LABOR4F	L	295	hr.														
R10	LABOR4S	L	148	hr.														
R11	ANPAS4F	L	0	A.U.M.														
R12	ANPAS4S	L	0	A.U.M.														
R13	BIPAS4F	L	0	A.U.M.														
R14	BIPAS4S	L	0	A.U.M.														
R15	CIPAS4F	L	0	A.U.M.														
R16	CIPAS4S	L	0	A.U.M.														
R17	HAY4F	L	0	Ton														
R18	HAY4S	L	0	Ton														
	Year 5-40																	
R01	LAND5A	L	100	ac				1.0										
R02	LAND5B	L	197	ac					1.0									
R03	LAND5C	L	35	ac						1.0								
R04	WLTH5A	L	0	dol.										1.0				
R05	WLTH5B	L	0	dol.											1.0			
R06	WLTH5C	L	0	dol.												1.0		
R07	CASH5	L	0	dol.	-272.36	-353.65	-350.00	1.15	13.35	41.00	47.0	0	-35.0				1.0	1.0
R08	CFMLVG5	G	2,036,388	dol.														1.0
R09	LABOR5F	L	295	hr.	6.30	4.56	4.56	0	0.11	0.11								
R10	LABOR5S	L	148	hr.	5.74	4.29	4.29	0	0.22	0.22								
R11	ANPAS5F	L	0	A.U.M.	8.74			-.46										
R12	ANPAS5S	L	0	A.U.M.	7.22			-.75										
R13	BIPAS5F	L	0	A.U.M.		6.72			-2.4									
R14	BIPAS5S	L	0	A.U.M.		6.72			-5.5									
R15	CIPAS5F	L	0	A.U.M.			6.72			-1.54								
R16	CIPAS5S	L	0	A.U.M.			6.72			-3.07								
R17	HAY5F	L	0	Ton	.60	.40	.40	0	-.50	-.28	-1.0	1.0						
R18	HAY5S	L	0	Ton	.25	.20	.20	0	0	0		-1.0	-1.0					

Footnote:
1 unless indicated otherwise, all blank spaces represent zero values.
2 CFMLVG is cash for family living
3 ANPAS is Native Pasture on Land A
4 BIPAS is Improved Pasture on Land B
5 CIPAS is Improved Pasture on Land C
6 L T O K is Livestock

The planning horizon was thus divided into five time periods: years 1, 2, 3, and 4, and years 5-40. The first four years are required to incorporate a four year mining lease that consists of two years of mining and reclamation plus a two-year required "hold-back" period before reclaimed land can be utilized for grazing. Objective function number 4 (OBJ 4) maximizes total wealth. Objective function number 5 (OBJ 5) maximizes the present value of net cash returns.

CHAPTER VI

IMPACT OF COAL MINING RECLAMATION ON MONETARY POSITION OF LAND OWNERS

Maximized Net Cash Income

The maximum net cash returns obtained from solutions to models OBJ 1, OBJ 2, and OBJ 3 are shown in Table IX. The results indicate that the contribution to net income from land A and land C are almost the same in models OBJ 1 (no law) and OBJ 2 (old law). In both cases the returns to land, overhead, risk and management are \$13,224 and \$13,936, respectively. This represents a difference of \$712 in cash returns. On the other hand, the impact of the new law, as shown in model OBJ 3 (new law), maximized net cash income at \$18,771. This represents a difference of \$4,835 over the old law in model OBJ 2.

While using the same total acreage of land, differences in the quality of reclamation enabled the rancher to keep 76 head of cow-calf units in model OBJ 1, 90 head of cow-calf units in model OBJ 2, and 106 head in model OBJ 3. The family labor requirement was the same in all cases, but additional hired labor was required as the productivity of land increased. In each case, family labor was 443 hours, while hired labor increased from 315 hours in model OBJ 1 to 499 hours and 594 hours in models OBJ 2 and OBJ 3, respectively.

TABLE IX

SUMMARY OF NET CASH RETURNS, ACTIVITIES, AND RESOURCES FROM THE MODELS SOLUTIONS FOR COAL MINING RECLAMATION IN EASTERN OKLAHOMA

	Unit	OBJ 1 (Cash)	OBJ 2 (Cash)	OBJ 3 (Cash)
Period	year	one	one	one
OBJ Value	dollars	13,224	13,936	18,771
Activity				
Livestock A	head	6	--	--
Livestock B	head	70	70	70
Livestock C	head	--	20	--
Livestock D	head	--	--	36
Resource Use				
Land A	acre	100	--	--
Pasture A	acre	100	--	--
Land B	acre	197	197	197
Pasture B	acre	197	197	197
Land C	acre	--	100	--
Pasture C	acre	--	100	--
Land D	acre	--	--	100
Pasture D	acre	--	--	100
Family Labor	hours	443	443	443
Hire Labor	hours	315	499	594
Total Labor	hours	758	942	1,037
Total Livestock	head	76	90	106
Total Land	acres	297	297	297

Projected Wealth and Discounted Net Cash Returns

The optimal wealth and discounted net cash return including selected activities and resources obtained from the solutions to the linear programming models are presented in Table X. Total increase in wealth from land and cattle was $19.5 million. In OBJ 4, 30 head of cow-calf units were grazed on 84 acres of the best pasture (land B). All land A was either traded or leased out in year one. Thus land C increased by 263 acres in year one and by 34 acres in the year 5-40. Total land, therefore, increased from 332 acres to 529 at the end of the planning horizon. However, 445 acres of this total land was not grazed.

The present value of net cash return from operating land and cattle was $319,000. This represents a return to land, capital, overhead, operator's labor, risk and management. In model OBJ 5, 30 head of cow-calf units were grazed on 84 acres of pasture on land B, during each year. However, all 100 acres of land A were leased out in the first period and received back as land C but not grazed in year 5-40. The leasing of land A to a coal company represents a transfer of land between land classes but does not increase total acres owned.

Projected Opportunity Cost in Wealth and Discounted Net Cash Returns

The optimal projected wealth obtained from solutions to models OBJ 6 and OBJ 7 are reported in Table XI. The wealth for land C (sells for $400 per acre) was $15.254 million while that for land D (sells for

TABLE X

SUMMARY OF WEALTH AND DISCOUNTED NET CASH RETURNS FROM SOLUTIONS TO MODELS OBJ 4 AND OBJ 5

	Unit	Initial Resource	OBJ 4: Wealth					OBJ 5: Discounted Net Cash Return				
Period	Year		1	2	3	4	5-40	1	2	3	4	5-40
OBJ Value	dol(000)						19,518.42					319.30
Accumulated With	dol(000)		339.43	375.20	414.25	456.94	19,518.42					
Disc. Net Cash Return	dol(000)											319.30
Activity:												
Livestock	head		30.17	30.17	30.17	30.17	30.17	30.17	30.17	30.17	30.17	30.17
Resource Use:												
Land A	ac	100.00										
Pasture	ac		—	—	—	—	—	—	—	—	—	—
Trade A for B	ac		—	—	—	—	—	—	—	—	—	—
Trade A for C	ac		65.85	—	—	—	—	—	—	—	—	—
Lease out A	ac		34.15	34.15	34.15	34.15	—	100.00	100.00	100.00	100.00	—
Sell A	ac		—	—	—	—	—	—	—	—	—	—
Total	ac		100.00	34.15	34.15	34.15	—	100.00	100.00	100.00	100.00	—
Land B	ac	197.00										
Pasture	ac		84.47	84.47	84.47	84.47	84.47	84.47	84.47	84.47	84.47	84.47
Trade A for B	ac		—	—	—	—	—	—	—	—	—	—
Rent in B	ac		—	—	—	—	—	—	—	—	—	—
Non-Use	ac		112.53	112.53	112.53	112.53	112.53	112.53	112.53	112.53	112.53	112.53
Total	ac		197.00	197.00	197.00	197.00	197.00	197.00	197.00	197.00	197.00	197.00
Land C	ac	35.00										
Pasture	ac		—	—	—	—	—	—	—	—	—	—
Trade A for C	ac		263.38	—	—	—	—	—	—	—	—	—
Non-Use	ac		35.00	298.38	298.38	298.38	332.53	35.00	35.00	35.00	35.00	135.00
Total	ac		298.38	298.38	298.38	298.38	332.53	35.00	35.00	35.00	35.00	135.00
Land Summary												
Grazed	ac		84.47	84.47	84.47	84.47	84.47	84.47	84.47	84.47	84.47	84.47
Non-Grazed	ac		445.06	445.06	445.06	445.06	445.06	247.53	247.53	247.53	247.53	247.53
Total	ac	332.00	529.53	529.53	529.53	529.53	529.53	332.00	332.00	332.00	332.00	332.00

TABLE XI

SUMMARY OF PROJECTED WEALTH AND OPPORTUNITY COST FROM SOLUTIONS TO MODELS OBJ 6 AND OBJ 7

	Unit	Initial Resource	OBJ 6 Wealth/Land C					OBJ 7 Wealth/Land D					OBJ 7 -OBJ 6
Period	Year		1	2	3	4	5 -40	1	2	3	4	5-40	40 Years
OBJ Value	(000)dol						15,254					15,596	
Accumulated Wealth	(000)dol		341.28	375.16	411.90	451.77	15,254	345.40	379.77	417.10	457.55	15,596	
Opportunity Cost	(000)dol												342.00
Activity:													
Livestock	head		30.17	30.17	30.17	30.17	30.17	30.17	30.17	30.17	30.17	30.17	
Resource Use:													
Land A	ac	100.00											
Pasture	ac		—	—	—	—	—	—	—	—	—	—	
Lease Out A	ac		47.32	47.32	47.32	47.32	—	47.32	47.32	47.32	47.32	—	
Non-Use	ac		52.68	52.68	52.68	52.68	52.68	52.68	52.68	52.68	52.68	52.68	
Total	ac		100.00	100.00	100.00	100.00	52.68	100.00	100.00	100.00	100.00	52.68	
Land B	ac	197.00											
Pasture	ac		84.47	84.47	84.47	84.47	84.47	84.47	84.47	84.47	84.47	84.47	
Rent in B	ac		—	—	—	—	—	—	—	—	—	—	
Non-Use	ac		112.53	112.53	112.53	112.53	112.53	112.53	112.53	112.53	112.53	112.53	
Total	ac		197.00	197.00	197.00	197.00	197.00	197.00	197.00	197.00	197.00	197.00	
Land C (Land D)	ac	35.00											
Pasture	ac		—	—	—	—	—	—	—	—	—	—	
Non-Use	ac		35.00	35.00	35.00	35.00	82.32	35.00	35.00	35.00	35.00	82.32	
Total	ac		35.00	35.00	35.00	35.00	82.32	35.00	35.00	35.00	35.00	82.32	
Land Summary:													
Grazed	ac		84.47	84.47	84.47	84.47	84.47	84.47	84.47	84.47	84.47	84.47	
Non-Grazed	ac		247.53	247.53	247.53	247.53	247.53	247.53	247.53	247.53	247.53	247.53	
Total	ac	332.00	332.00	332.00	332.00	332.00	332.00	332.00	332.00	332.00	332.00	332.00	

$450 per acre) was $15.596 million. This represents an opportunity cost of $0.342 million. This loss in value of land wealth was due to unsuccessful reclamation under the old law. Included in the solution were 30 head of cow-calf which grazed on 84 acres of pasture B each year period. Forty-seven acres of the original 100 acres of land A were leased out in year one and received back in year 5-40 as land C (land D). This land transfer increased land C (land D) from 35 acres to 82 acres and reduced land A to 53 acres in the year 5-40. Two hundred and forty-seven acres of all land classes were not used due to a labor limitation.

The optimal projected present value of net cash returns and associated opportunity cost from solutions to models OBJ 8 and OBJ 9 are presented in Table XII. Net cash returns for land C and land D are $317,510 and $324,290, respectively. The opportunity cost is thus $6,780. This represents a loss in net cash returns to land, capital, overhead, operator's labor, risk and management. The configuration of activities and resources is identical to Table XI, except that 100 acres of land A are leased out in year one. Land C (land D) therefore increased to 135 acres in year 5-40. The non-use of 247 acres of all land classes was attributed to labor shortage.

Benefits and Costs of Reclamation

A comparison of land values and reclamation costs may be used to estimate the cost of complete and successful reclamation to society. If the average value of land and reclamation cost are known, then societal cost can be calculated as follows:

TABLE XII

SUMMARY OF PRESENT VALUE OF NET CASH RETURNS AND OPPORTUNITY COST FROM SOLUTIONS TO MODELS OBJ 8 AND OBJ 9

	Unit	Initial Resource	OBJ 8: PV Cash Returns/Land C					OBJ 9: PV Cash Returns/Land D					OBJ9–OBJ8
Period	Year		1	2	3	4	5–40	1	2	3	4	5–40	40 Years
OBJ Value	(000)dol						317.51					324.29	
Opportunity Cost	(000)dol												6.78
Activity:													
Livestock	Head		30.17	30.17	30.17	30.17	30.17	30.17	30.17	30.17	30.17	30.17	
Resource Use:													
Land A	ac	100.00	—	—	—	—	—	—	—	—	—	—	
Pasture	ac		—	—	—	—	—	—	—	—	—	—	
Lease Out A	ac		100.00	100.00	100.00	100.00	—	100.00	100.00	100.00	100.00	—	
Non-Use	ac		—	—	—	—	—	—	—	—	—	—	
Total	ac		100.00	100.00	100.00	100.00	—	100.00	100.00	100.00	100.00	—	
Land B	ac	197.00											
Pasture	ac		84.47	84.47	84.47	84.47	84.47	84.47	84.47	84.47	84.47	84.47	
Rent in B	ac		—	—	—	—	—	—	—	—	—	—	
Non-Use	ac		112.53	112.53	112.53	112.53	112.53	112.53	112.53	112.53	112.53	112.53	
Total	ac		197.00	197.00	197.00	197.00	197.00	197.00	197.00	197.00	197.00	197.00	
Land C (Land D)	ac	35.00											
Pasture	ac		—	—	—	—	—	—	—	—	—	—	
Non-Use	ac		35.00	35.00	35.00	35.00	135.00	35.00	35.00	35.00	35.00	135.00	
Total	ac		35.00	35.00	35.00	35.00	135.00	35.00	35.00	35.00	35.00	135.00	
Land Summary:													
Grazed	ac		84.47	84.47	84.47	84.47	84.47	84.47	84.47	84.47	84.47	84.47	
Non-Grazed	ac		247.53	247.53	247.53	247.53	247.53	247.53	247.53	247.53	247.53	247.53	
Total	ac	332.00	332.00	332.00	332.00	332.00	332.00	332.00	332.00	332.00	332.00	332.00	

$$C = \bar{P} - \bar{V}$$

where C = the cost of reclamation to society,

$\bar{P}$ = the average cost of reclamation per acre, and

$\bar{V}$ = the average value of land and buildings per acre.

In 1979, the average value of land and buildings was estimated to be $400 per acre in the study area. On the other hand, based on the survey of the active coal operators during the same period, the average reclamation cost per acre was estimated at $958 (52). Thus, it is estimated that the cost to society amounts to:

$$C = \$958 - \$400$$

$$C = \$558$$

This dollar difference, $558, between the average cost of reclamation and the average market value of land represents the cost to society, if the society places this value on reclaimed land.

Alternatively, if the coal recovery rate per acre is known, the actual cost of reclamation can be determined by:

$$K = \bar{P}/S$$

where K = the actual cost of reclamation per ton of coal mined, and

S = the coal recovery rate.

The Oklahoma Department of Mines has used a recovery rate of 80% of the original coal or 1,440 tons of coal per foot of seam per acre. Thus a coal seam thickness of 18 inches average would yield 2,160 tons of coal per acre. K may then be estimated:

$$K = \$958/2{,}160 \text{ tons}$$

$$K = \$.44$$

This indicates that K, the actual cost of reclamation for the land was $.44 per ton of coal mined. This represents only about 2% of the f.o.b. value of coal which averaged \$22.00 per ton in 1979. K is expected to increase under the new reclamation law.

Another method of estimating the advantage of complete and successful reclamation is the cost of top soil lost to erosion. The Soil Conservation Service in its Rural Abandoned Coal Mine Program (RAMP) has estimated that 75 tons of soil is lost per year if the land was unreclaimed while only 4 tons was lost per year from completely and has estimated that 75 tons of soil is lost per year if the land was unreclaimed while only 4 tons was lost per year from completely and successfully reclaimed land. The reclamation cost per ton of soil saved can be estimated as follows:

$$R = \bar{P}/([L_m - L_n] \times T)$$

where R = the cost per ton of soil saved,

L_m = the tons of soil lost per year, if no reclamation,

L_n = the tons of soil lost per year, if reclamation, and

T = the total number of years the soil is saved.

Applying the data, it is estimated that:

$$R = \$958/([75 - 4] \times 50)$$

$$= \$958/(71 \times 50)$$

$$R = \$.27/\text{ton of soil saved per acre}$$

To the extent that erosion is a major burden to society from strip mining of coal, the cost for preventing soil from water and wind erosion is \$.27 per ton of saved soil per acre, if computed for 50 years. If this cost is evaluated in perpetuity, then it would cost virtually nothing to provide the benefits of reduced erosion to society.

CHAPTER VII

ANALYSIS OF THE REGION WITH AN ENVIRONMENTAL IMPACT MATRIX

Assumptions, Strategies, and Considerations

A benchmark period of sometime before and including 1970, when a lull in coal mining activity prevailed, was assumed. This was based on the dwindling output of coal and the limited economic and environmental impacts of abandoned mines (orphan lands) which resulted from strip mining some decades ago. The survey data included quantitative and qualitative answers on economic and environmental factors. Using the benchmark period as control, these factors were compared for periods which included partial reclamation and complete reclamation. The alternative strategies in the reclamation continuum were: (1) partial reclamation after strip mining, (2) complete reclamation following strip mining, (3) complete reclamation concurrent with strip mining, and (4) no reclamation after strip mining.

Under the 1971 Oklahoma law, many acres of strip mines were partially reclaimed either by the coal company or by the land owner several months after strip mining was completed. Economic and environmental damage was at their peak during this lag period before reclamation. The extent of this damage was only reduced but not eliminated by partial reclamation associated with poor soil handling and scanty vegetation. Complete reclamation following strip mining also was accomplished several months after strip mining. While the damage was at its peak during the lag period, the intensity was greatly reduced by good soil management, good vegetation and level terrain resulting from complete reclamation. Complete reclamation concurrent with strip mining requires immediate reclamation. As a result, the peak damage accompanying a lag period was avoided. In addition the timing of reclamation, the retention of top soil and overall soil management provided the terrain and vegetation for a successful reclamation.

No reclamation after strip mining is a state occurring when coal companies foreclose before reclamation commences, or unreclaimed land that was mined before 1971. It exposes the land to intense or peak economic and environmental damage.

The quantitative and qualitative approach used is in accordance with the principles and standards established by the Water Resources Council. In its final adopted guidelines, the use of an environmental impact matrix is emphasized (53). The Water Resources Council, in its proposed water resource development guidelines to replace Senate Document No. 97 and in the Final Rule for National Economic Development (NED) has strongly endorsed the environmental impact matrix (54). The Soil Conservation Service of USDA has prepared a Draft Environmental Impact Statement for the Rural Abandoned Coal Mine Program (RAMP) where the impacts of alternative funding strategies for reclamation are analyzed (55). Studying cotton production in Southwestern Oklahoma, Richardson and Badger developed an environmental impact matrix to analyze alternative pest control strategies. The matrix was used to determine the socially desirable pest control strategy for cotton production (56).

Parameter Framework

Three main parameters, economic, environmental, and social well-being, were developed for the alternative strip mining and reclamation strategies (Table XIII). The economic impact parameter included all the components considered to affect economic well-being. The environmental impact parameter embraces those components considered to affect the environment vis-a-vis the quality of lakes/streams and habitat. The social well-being parameter encompasses those components that could impinge on the social life of residents of the area. The components of each of the three main parameters were developed from the review of relevant coal mining reclamation literature, the survey format, and the Draft Environmental Impact Statements mentioned above. The phrase "change in" used in the parameter elements indicate the change in the parameter element from the benchmark period to the present required strategy (complete reclamation concurrent with strip mining). For example, the parameter element, "change in land value" evaluates the land values for each alternative strategy from the benchmark, if only coal activity is considered to influence land values. Following the guidelines of the Water Resources Council in policy decisions regarding resource use, equal weights of 10.0 points were assigned to each of the main parameters because Federal Government regulations generally require that each parameter be given equal weight in making decisions on resource use. The weight of 10.0 was then distributed to each of the elements of the parameters according to average aggregate scores arrived at from analyzing the responses from all survey categories. Weights for each of the parameter elements were assigned to qualitative and quantitative issues as follows:

TABLE XIII

ENVIRONMENTAL IMPACT MATRIX FOR COAL MINING AND RECLAMATION IN EASTERN OKLAHOMA

Parameter	Parameter Weights	Alternative Strip Mining and Reclamation Strategies	
		Raw Score	Weighted Score
1. Economic Impact	10.00		
a. Change in School Enrollment	0.05		
b. Change in Land Values	2.00		
c. Change in Land Tax Rate	0.05		
d. Change in Farm Employment	0.50		
e. Change in Regional Employment	1.30		
f. Change in Valuation of Coal Equipment	1.50		
g. Change in Acreage Farmed	1.65		
h. Change in Population Mix	0.20		
i. Change in Roads	1.30		
j. Change in Public Services	0.05		
k. Change in Regional Income Distribution	1.40		
Net Economic Impact			
2. Environmental Impact	10.00		
Pollution			
a. Change in Stream and Lake Pollution from			
i) acid mine drainage	0.75		
ii) spoil bank erosion	0.75		
b. Change in Dust Pollution	1.70		
c. Change in Noise Pollution	0.80		
Terrestrial and Aquatic Habitat			
d. Change in Acres of Vegetation for Wildlife	1.35		
e. Change in Safety for Wildlife	0.60		
f. Change in Number of Streams and Lakes for Aquatic Habitat	1.35		
g. Change in Safety of Aquatic Habitat	1.00		
h. Change in Food and Cover	0.60		
i. Change in Grazing Livestock	1.10		
Net Environmental Impact			
3. Social Well-Being Impact	10.00		
a. Safety of Human Life and Health			
i) Change in car wrecks from coal trucks, bad roads, dust	0.40		
ii) Change in land slides	0.05		
iii) Change in soil subsidence	0.05		
iv) Change in fatal explosions	0.05		
v) Change in fire outbreaks from coal refuse	0.05		
vi) Change in anxiety from coal traffic on roads	0.80		
b. Recreation			
i) Change in land-based recreation	0.50		
ii) Change in water-based recreation	1.00		
c. Conservation			
i) Change in green space	1.00		
ii) Change in archeological and historical sites	0.05		
d. Tourism			
i) Change in tourism	0.05		
e. Other Social Well-Being Considerations			
i) Change in aesthetic value of the land	2.00		
ii) Change in land ownership through trading	2.00		
iii) Change in option demand on land use	2.00		
Net Well-Being Impact			
TOTAL IMPACT	30.00		

Negligible impact	= 0.05
Slight impact	= 0.06 - 0.70
Average impact	= 0.71 - 1.35
Major impact	= 1.36 - 2.00

The benchmark of 1970 was assigned a value of zero.

The qualitative weights (raw scores) assigned to parameter elements were mainly obtained from qualitative portions of the surveys and other sources of published data. Annual representative soil erosion and water run-off estimates made by the Soil Conservations Service (SCS) of USDA in RAMP, were used as follows:

	Annual erosion rate per ton, per acre
Post reclamation land use (rangeland, cropland, and pastureland)	4 (average)
Partially reclaimed mine spoil	10
Unreclaimed mine spoil (unprotected and unvegetated)	75
Land intensively disturbed by strip mining including haul road, tipple sites, dumps, etc.	110 (midwest)

RAMP also estimated that storm run-off could be reduced by 40% after reclamation, from a rainfall event of 2.5 inches. Zero was assigned as an alternative's raw score if no change from the benchmark period to the present situation in the parameter element was expected.

A score range of -2.0 to +2.0 was used according to whether the parameter element was a cost (-) or benefit (+) to residents from the benchmark value. Each alternative's weighted score was obtained by multiplying the raw scores by their respective parameter weights. To obtain the net impact of each alternative, the weighted scores were summed for each parameter (economic, environmental, and social well-being). The sum of parameter net impacts for each alternative indicates the overall (total) impact on society. The alternative was then considered beneficial to society if the overall impact was positive. Conversely, an alternative with a negative overall impact was regarded as detrimental to society. All alternatives could then be ranked from highest to lowest or from greatest benefit to greatest cost.

Benefits and Costs of Water and Soil Conservation

Water and wind erosion are the major determinants of the many costs to society from strip mining of coal. Some water quality parameters such as physical, chemical, and biological properties are used to assess the intensity of coal mine drainage pollution. Commonly used physical and chemical parameters are measures of pH, acidity, alkalinity, sulfate, hardness, total iron, manganese, aluminium, suspended and dissolved solids. The acceptable pH range is between 6.0 and 8.5. Biological parameters used are observations and measurements of aquatic life to monitor damages inflicted on species of plants and animals.

Compared to other subtle forms of environmental pollution, the prediction of potential effects of mineral development activities on aquatic life is relatively easy. For example, a projected pH level of less than 5 is an indication that the water may not support aquatic life. Limited presence of biota is expected if there is suspended solids load of more than 400 mg/litre for a prolonged period (57).

The published and unpublished records of strip coal mining impacts to aquatic life and tolerance limits of species to different water quality parameters may be used to predict the impact of coal mining in aquatic environment. However, other methods such as bioassay (observational information to assess possible damage), modeling of the aquatic ecosystem have been used in circumstances where pH and suspended solids measures are inadequate (58). Two types of modeling could be used: statistical modeling and simulation modeling. The former is suited to short-term analysis while the latter is preferred for long-term projection of aquatic ecosystem. The short coming of simulation is the high cost arising from the enormous requirement of data and computer time.

Acid mine drainage from strip mining in other states may cause deterioration of surface water quality from reducing pH and alkalinity levels and increasing the hardiness of water and the presence of minerals. The resulting pollution of surface water lead to increased costs of additional treatment of water and early replacement of equipments in water treatment plants for local governments and industrial establishments. Early replacements of concrete, steel or iron structures and equipments on culverts, bridges, boat hulls, steel barges, pumps and condensers increase government costs. Other costs may shift to recreational and historical uses as esthetic values of land and water depreciate.

Sedimentation

Erosion is the major transporter of loose soils to streams/lakes and other locations. Soil is lost from coal haul roads, mine access roads, and mining operations. It is estimated that coal haul and mine access roads (excluding public roads) account for 10% of the total area directly used for strip mining. These roads may be poorly planned and constructed. Maintenance is irregular and deterioration is rapid especially in contour mining (hilly terrain) areas. In addition, there is the public nuisance of dust pollution, and driving hazards on rural roads from dust which limits visibility (59).

The costs of sedimentation are reduced carrying capacity of waterways, clogged reservoirs, and destruction of habitat for fish and other aquatic life. Top soil on arable land is gradually lost to erosion. This loss gradually lowers the productivity of the soil. The Soil Conservation Service (SCS) of USDA has estimated in the RAMP study that society stands to gain from the reclamation of rural abandoned mine lands. It indicates that under a given funding strategy, reclamation will increase availability of cropland by 2%, pastureland by 5%, rangeland by 0%, forest land by 3% and will decrease all other land by 10% for every 10 acres reclaimed in the midwest which includes Oklahoma. In addition, soil erosion, surface run-off and sedimentation would be reduced.

Timmons (60) has compared the erosion of soil and the extraction of petroleum. Excessive erosion predisposes the soil to an exhaustible, non-renewable natural resource, similar to petroleum. With good soil management, the product of the soil--food can be derived and consumed without exhausting the soil resource. Petroleum on the other hand, has to be exhausted as society extrasts and consumes its product--energy. Herein lies the vital provision of the soil as the major source of human sustenance whose depletion must be avoided.

Summary of the Environmental Impacts

An analysis of the environmental impact matrix of alternative reclamation strategies evaluates the economic and environmental consequences of strip coal mining on residents of the area (Table XIV). The net economic impact of the four alternative strategies ranged from 0.05+ε for strategies 1 and 4, to 1.69+ε for strategy 3. The net environmental impact ranged from -5.53+ε for strategy 4, to -0.25+ε for strategies 2 and 3. The net social well being impact was about the same for each of the strategies.

The total net rankings from greatest benefit (positive value) to greatest cost (negative value) were as follows: strategy 3, complete reclamation concurrent with strip mining with a total weight of +1.52+2ε; strategy 2, complete reclamation following strip mining with a total weight of +0.80+ε; strategy 1, partial reclamation and active strip mining with a total weight of -1.57+ε; and strategy 4, no reclamation after strip mining with a total weight of -5.40+ε. The ε values could not be obtained because the specific parameter element is impacted by non-coal factors or the data are unavailable. As a result, the coal mining impact could not be isolated or estimated.

TABLE XIV

IMPACT ANALYSIS OF ALTERNATIVE STRIP COAL MINING AND RECLAMATION STRATEGIES IN EASTERN OKLAHOMA

		Strategies							
		1) Partial Reclamation and Active Strip Mining		2) Complete Reclamation Following Strip Mining		3) Complete Reclamation Concurrent with Strip Mining		4) No Reclamation After Strip Mining	
Parameter	Parameter Weight	Raw Score	Weighted Score	Raw Score	Weighted Score	Raw Score	Weighted Score	Raw Score	Weighted Score [a]
1. Economic Impact[a]	10.00								
a. Change in School Enrollment	0.05	0	0	0	0	0	0	0	0
b. Change in Land Values	2.00	0.50	1.00	0.60	1.20	0.60	1.20	0.50	1.00
c. Change in Land Tax Rate	0.05	0	0	0	0	0	0	0	0
d. Change in Farm Employment	0.50	0	0	0	0	0	0	0	0
e. Change in Regional Employment	1.30	ε[b]	ε	ε	ε	ε	ε	ε	ε
f. Change in Valuation of Coal Equipment	1.50	0.24	0.36	0.72	1.08	1.20	1.80	0.24	0.36
g. Change in Acreage Farmed	1.65	0	0	0	0	0	0	0	0
h. Change in Population Mix	0.20	-0.30	-0.06	-0.30	-0.06	-0.30	-0.06	-0.30	-0.05
i. Change in Roads	1.30	-1.50	-1.95	-1.50	-1.95	-1.50	-1.95	-1.50	-1.95
j. Change in Public Services	0.05	0.10	0.005	0.10	0.005	0.10	0.005	0.10	0.005
k. Change in Regional Income Distribution	1.40	0.50	0.70	0.50	0.70	0.50	0.70	0.50	0.70
Net Economic Impact			0.05+ε		0.97+ε		1.69+ε		0.05+ε
2. Environmental Impact[c]	10.00								
Pollution									
a. Change in Stream and Lake Pollution from									
i) acid mine drainage	0.75	-1.56	-1.17	-1.12	-0.84	-1.12	-0.84	-2.00	-1.50
ii) spoil bank erosion	0.75	-0.20	-0.15	-0.08	-0.06	-0.08	-0.06	-1.50	-1.13
b. Change in Dust Pollution	1.70	-1.0	-1.70	-1.0	-1.70	-1.00	-1.70	-1.0	-1.70
c. Change in Noise Pollution	0.80	0	0	0	0	0	0	0	0
Terrestrial and Aquatic Habitat									
d. Change in Acres of Vegetation for Wildlife	1.35	1.50	2.03	1.74	2.35	1.74+ε	2.35+ε	0.74	1.00
e. Change in Safety for Wildlife	0.60	ε	ε	ε	ε	ε	ε	ε	ε
f. Change in Number of Streams and Lakes for Aquatic Habitat	1.35	ε	ε	ε	ε	ε	ε	ε	ε
g. Change in Safety of Aquatic Habitat	1.00	0	0	0	0	0	0	0	0
h. Change in Food and Cover	0.60	-ε	-ε	-ε	-ε	-ε	-ε	-ε	-ε
j. Change in Grazing Livestock	1.10	-0.65	-0.72	0	0	0	0	-2.00	-2.20
Net Environmental Impact			-1.71+ε		-0.25+ε		-0.25+2ε		-5.53+ε
3. Social Well-Being Impact[d]									
a. Safety of Human Life and Health	10.00								
i) Change in car wrecks from coal trucks, bad roads, dust	0.40	0	0	0	0	0	0	0	0
ii) Change in land slides	0.05	0	0	0	0	0	0	0	0
iii) Change in soil subsidence	0.05	0	0	0	0	0	0	0	0
iv) Change in fatal explosions	0.05	0	0	0	0	0	0	0	0
v) Change in fire outbreaks from coal refuse	0.05	0	0	0	0	0	0	0	0
vi) Change in anxiety from coal traffic on roads	0.80	-ε	-ε	-ε	-ε	-ε	-ε	-ε	-ε
b. Recreation									
i) Change in land-based recreation	0.50	0.05	0.03	0.05	0.03	0.05	0.03	0.05	0.03
ii) Change in water-based recreation	1.00	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
c. Conservation									
i) Change in green space	1.00	ε	ε	ε	ε	ε	ε	ε	ε
ii) Change in archeological and historical sites	0.05	0	0	0	0	0	0	0	0
d. Tourism									
i) Change in tourism	0.05	0	0	0	0	0	0	0	0
e. Other Social Well-Being Considerations									
i) Change in aesthetic value of the land	2.00	-ε	-ε	-ε	-ε	-ε	-ε	-ε	-ε
ii) Change in land ownership through trading	2.00	ε	ε	ε	ε	ε	ε	ε	ε
iii) Change in option demand on land use	2.00	-ε	-ε	-ε	-ε	-ε	-ε	-ε	-ε
Net Well-Being Impact			0.08-ε		0.08-ε		0.08-ε		0.08-ε
TOTAL IMPACT			-1.57+ε		0.80+ε		1.52+2ε		-5.40+ε

[a]Raw scores for Economic Impact was compiled from the survey data as follows:

b) Δ in real estate tax assessment
f) Δ in the size of coal equipment (assessed value as a function of size)
h) Δ in age composition
i) Δ in quality of the roads
j) Δ in quality of public services
k) Δ in income redistribution to the poor

[b]ε indicates some positive value that is not estimated or is difficult to attribute solely to the strategies. −ε is some negative value of a similar description.

[c]Raw scores for environmental impact was compiled from secondary and primary data as follows:

a) (i) SCS representative data for annual rate of erosion (RAMP study (6))
   (ii) same data from RAMP (6) for surface run-off
b) Δ in # of coal operators and method of hauling coal (from survey)
d) proportion of unreclaimed, partly reclaimed and completely reclaimed land to total disturbed land (OK. Dept. of Mines; Chief Mines Inspector)
j) Δ in carrying capacity of the land (from survey)

[d]Raw scores for social well-being impact was computed from the survey as follows:

b) (i) Δ in quality of land-based recreation
   (ii) Δ in quality of water-based recreation

CHAPTER VIII

SUMMARY AND CONCLUSIONS

The role of coal development as an important source of energy in Oklahoma dates back to 1880, when the production of coal commenced at a commercial level. To help meet regional and national energy requirements, strip coal mining was initiated by removing outcropping seams from small hillsides by hand or with mules. Later, machinery was used to remove overburden and recover coal seams several feet deep. With the increased demand for coal the size of the machinery has increased, the acreage of land mined and disturbed has increased, and the environmental damage has increased.

Many land owners, pressure groups and policymakers concerned about the responsible use of the landscape, pressed for the regulations to properly reclaim the coal mined lands. In 1971, reclamation became mandatory with the Oklahoma Mining Lands Reclamation Act. The deficiencies in many state reclamation laws, including the Oklahoma act, culminated in the passage of a comprehensive national strip mining and reclamation law, PL95-87. This federal law was designed to return the reclaimed land to its pre-mining productivity potential. This reclamation program provides for concurrent reclamation and soil tests to limit the level of environmental damage.

This study addressed the problem of the economic and environmental consequences arising from the strip mining of coal in eastern Oklahoma.

The economic objective was to compare net returns from cattle ranching on three classes of land, and thence to project land owners' monetary benefits from coal mining and their opportunity costs from unsuccessful reclamation. The environmental objective was to estimate and compare enviro-economic indicators of quality of life under four alternative coal mining and reclamation strategies.

The economic objective was achieved by building and analyzing linear programming models from enterprise budgets and survey data. A static linear programming model was used to estimate and compare optimal net cash returns for one year on lands A, C, and D. Since land D was a higher quality reclaimed land than land C, the model was used to show that reclaiming coal lands under the new law could lead to increased cash returns. The model also indicated that net cash returns from reclamation efforts of the old law (land C) did not differ by much from returns on land A.

The linear programming model was expanded into a "dynamic" version to estimate and project the multi-period monetary benefits to land owners if they considered one or more of three alternative mineral rights transfer strategies. The three strategies are leasing, trading and/or selling coal land. Net cash returns and wealth from operating and owning land respectively were estimated and projected for 40 years assuming that lands A, B, and C were used in the ranch enterprise. Then the opportunity cost of operating on land C instead of land D was estimated and projected for 40 years. This was achieved by developing and analyzing two "dynamic" versions of the model. One model incorporates lands A, B, and C (low quality reclamation) and the other model includes lands A, B, and D (high quality reclamation) with each model assuming that only the coal land leasing alternative was available. Differences in objective function values between high and low quality reclamation were used to estimate costs associated with unsuccessful reclamation.

The environmental objective was met by building and analyzing an environmental impact matrix according to the principles and standards specified by the Water Resources Council. The matrix was used to estimate and rank economic, environmental and social well-being parameters under four alternative strip mining and reclamation strategies. The weighted score in each parameter category was obtained by multiplying parameter weights by raw scores. The parameter weights (also known as quantitative data) were developed from survey data. The raw scores (also known as qualitative data) were obtained from published data and survey questions which have qualitative sections. By summing the net impact of each parameter category under the designated reclamation strategies, the total or overall impact was obtained. This overall impact was then used to rank which of the four strategies had the least adverse consequences to society. This impact matrix was reinforced by the estimation of reclamation costs to society per ton of coal mined and per ton of soil saved from erosion for a specified time period.

Evaluation of Linear Programming Results

The results obtained in the static and dynamic versions of the model are compatible with results expected in the study area. They are based mainly on those aspects of the new strip mining and reclamation regulations necessary to achieve successful reclamation. Any additional technical and geological requirements needed to regulate the mining industry are omitted. The analysis of the results are therefore based on the improved surface soil management, concurrent reclamation, soil amendments, better supervision and the five-year "hold back" period after reclamation.

The results of the static linear programming analysis showed net cash returns of $13,224 from lands A and B; $13,936 from lands A and C; and $18,771 from lands A and D. The $4,835 difference in cash returns between lands A and D (new law) and lands A and C (old law) represents the opportunity cost of unsuccessful reclamation in a given year. In other words, the application of the new law would increase net cash income by $4,835 over the old law.

The results of the dynamic linear programming model to project intertemporal monetary benefits to coal land owners, indicate an increase in wealth from land and cattle of $19.5 million and a discounted net cash return of $319,000 for a 332 acre ranch. These substantial monetary benefits are realized if the land transaction was made with a reliable and financially sound coal company. Reclamation regulations which lead to restoration of land A to its former productive capacity enhances this personal monetary benefit. Such improved reclaimed land may sell for as much as land B per acre.

However, a high foreclosure rate for the smaller coal companies unable to cope with the new reclamation laws and unsuccessful/incomplete reclamation could jeopardize the basic livelihood of mineral right owners if the land was leased. A great advantage of trading over leasing and selling is the avoidance of capital gains tax and the higher price of replacing the land sold to the coal company. Land prices in the coal producing areas have been found to be higher than in the surrounding non-coal areas. As long as the larger coal companies have a backlog of their own reclaimed land to be traded, trading may be to the mutual benefit of buyer and seller.

The results of the "dynamic" linear programming models to project opportunity costs of quality changes in reclaimed land estimate a cost in wealth of $0.342 million and in discounted net cash return of $6,780. The results indicate that productivity losses from coal lands leased, mined, and reclaimed before 1978 lowered land values and net cash returns.

Successful reclamation of strip mines require that the land be returned to its pre-mining highest and best use. The marginal contributions (benefits) of improvements to the land have to be matched by the marginal burden (costs). Many of these costs are borne by the coal company operators while the benefits fall directly to surface/mineral right owners and indirectly to society. With the full implementation of the new federal strip mining and reclamation regulation, it is expected that operational and reclamation costs per acre would be increased for the coal companies.

Alternative surface and mineral right transfer strategies, such as trading coal for non-coal land, outright sale of coal land, and a surcharge for top soil loss have become widely used. These indicate new efforts by coal land owners to minimize or avoid economic losses. If for example, land A was out of production for four years (two years of mining and reclamation plus two years of post reclamation hold back), the land owner must earn enough income in royalty payments and pasture establishment benefits to stay ahead. Although he might earn over $200,000 (100 acres x $2,000 per acre) in royalty payments, the present value of his future income stream might be low if he was locked into unsuccessfully reclaimed land. If the quality of reclamation was based on the pre-mining productive potential of the reclaimed land, an opportunity exists to both sell the coal and increase long-run net returns to the agricultural enterprise.

Evaluation of Environmental Impact Results

The results of environmental impact matrix analysis indicate that strategy 3, reclamation concurrent with strip mining, was the best with a total positive impact of $1.52+2\varepsilon$. Strategy 4, no reclamation after atrip mining, was the worst with a total negative impact of $-5.40+\varepsilon$. Caution is suggested in interpreting the implication of these results. For example, the ratio of weights between one parameter element and another may not be synonymous with the weight society places on these elements. The weights provide a "modus operandi" for assigning merit and demerit value to rank the alternative reclamation strategies. The actual cost of reclamation per ton of coal mined was estimated at $.44 per ton. The cost of soil saved from erosion with successful reclamation was estimated at $.27 per ton of soil per acre to society.

Limitations

This study has shortcomings which could be traced to the conceptualization of the land ownership survey and the assumptions on the quality of reclaimed land and the labor requirements. The data on land owners was collected from a population of land owners who allowed their cattle to graze on reclaimed and unreclaimed land concurrently. It would have been ideal to collect the data from land owners who fenced their cattle to graze on reclaimed lands. However because of the size and nature of the operation, the cattle grazed on all types of land including the reclaimed land, so as to balance the supply and demand of pasture. The implication of this was that the carrying capacity of the reclaimed land may have been overestimated if the scanty pasture on land C force cattle to graze elsewhere.

Data to estimate the value of land D were not available. Theoretically land value may be estimated by the income generating capacity, the market value, or the cost approach. The value of land D in the study was determined from the values of lands B and C to be $450 per acre. This value may be overestimated if buyers have little confidence in the longevity of the productivity of land D.

The results and implications of the study were based on the quality of reclamation expected from and specified in the new federal law. The actual data on the carrying capacity or productivity potential of land reclaimed under this law will not be available until 1983. Because some concurrent reclamation has taken place in the study area, it was assumed that without major changes in the final form of the law, land D would meet the quality standards.

Unlike the static model, the dynamic LP model assumed the non-use of hired labor. Seasonal or short-run unemployment and long-run full employment in the area non-agricultural sector was assumed in the static and dynamic models respectively. This is consistent with the area labor market. Therefore in any given current period, land owners may hire additional labor to increase land utilization. The non-use of many acres of lands B, C, and D in the dynamic models is explained by the preference of area labor for higher paying jobs in the coal fields and ranchers holding off-farm jobs. The utilization of more acres of lands C and D (reclaimed lands) would have reflected more of the expected and foregone net cash returns associated with quality differences in reclaimed land.

The management of the livestock and pasture operations in the area are assumed to be "above average" in the budget preparation. Because of their part-time operation and increasing interest in coal transaction, the efficiency of operation of this group of land owners (ranchers) may actually be less than "above average".

Recommendations for Future Research

With the increase in coal activity and the possible involvement of many acres of good pastureland, there is the need for enterprise budgets developed mainly for reclaimed lands. This will resolve the problem of mixed grazing on reclaimed and unreclaimed land and reflect the actual efficiency expected of operators.

Since the soil texture and profile affect reclamation efforts, which in turn affect the quality level of reclaimed lands, enterprise budgets will vary according to the degree of stoniness of the soil after reclamation. The precision and applicability of such budgets would enhance the results obtained.

More study is needed to isolate and accumulate the data to replace the ε values in the environmental impact matrix. As the ε values indicate, data for those parameter elements are either intertwined with other non-coal sectors or unavailable for the area. The shortcomings, notwithstanding, the entire study has provided some essential answers to the question of the potential impacts of strip mining and reclamation interacting with agriculture and the environment in eastern Oklahoma.

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APPENDICES

APPENDIX A

SURVEY FORMS

CONFIDENTIAL CONFIDENTIAL

COAL MINING RECLAMATION SURVEY
FOR COUNTY COMMISSIONERS

Dept. of Agricultural Economics
Oklahoma State University
Stillwater, Oklahoma 74074

GENERAL INFORMATION

1. Name of Respondent: ______________________________ County: __________
2. Official position in community: ______________________________________
3. Permanent mailing address: ____
4. Period in Office: _____ years _____ months
5. Reriod of residence in community: _____ years _____ months

PERFORMANCE MEASURES

If we considered three stages of strip coal mining, namely:

STAGE I: Before 1970 or some othe base year (please indicate year _____ if applicable) when strip mining was less active.

STAGE II: Before 1970 or some other year after 1970 (please indicate year ______ if applicable) when coal companies started leasing and mining land.

STAGE III: Before 1970 or some other year after 1970 (please indicate year ______ if applicable) when coal mining slacked off and became less active.

During the three different stages of strip-mining, rank in ascending order (1st, 2nd, and 3rd) the relative importance of the following factors for each of these stages if appropriate:

	STAGES I	STAGES II	STAGES III
6. Road Maintenance	_____	_____	_____
Water supply repairs	_____	_____	_____
Water supply	_____	_____	_____
Police protection	_____	_____	_____
Crime rate	_____	_____	_____
Government services	_____	_____	_____
Public Utilities	_____	_____	_____
Agricultural land tax	_____	_____	_____
Community services	_____	_____	_____
Measures to present undesirable effects of strip mining	_____	_____	_____
Income transfer to low income families	_____	_____	_____
Wildlife habitat	_____	_____	_____
Aquatic habitat	_____	_____	_____
Water pollution	_____	_____	_____
Dust pollution	_____	_____	_____
Esthetic beauty	_____	_____	_____

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	STAGES		
	I	II	III
Sedimentation	_____	_____	_____
Air pollution	_____	_____	_____
Noise pollution	_____	_____	_____
Safety of human life	_____	_____	_____
Quality of life	_____	_____	_____
Natural resource preservation	_____	_____	_____
Water-based recreation	_____	_____	_____
Land-based recreation	_____	_____	_____
Tourism	_____	_____	_____

7. At what stage or stages do you feel community costs of providing needed services and preventing undesirable side effects resulting from coal development exceeded the total returns or benefits received? Please check:

   Stage I _____ Stage II _____ Stage III _____

8. Do you feel that strip-mining reclamation reduces some of the losses from an unexpected termination of coal development in your county?

   Yes _____ No _____ Please explain: ______________________________

   ____

   ____

9. Do you regard strip-mine reclamation as one of the ways to reduce some of the undesirable side effects from coal development in your county?

   Yes _____ No _____ Please explain: ______________________________

   ____

   ____

   If yes, hoe long would you prefer the reclamation process (land-filling and revegetation) to last? Please check:

   0-3 months _____
   3-6 months _____
   6-12 months _____
   12-18 months _____
   18-24 months _____
   over 24 months _____

10. Is there any abandoned coal mines and therefore some land unreclaimed in your administrative area (if same as county).

   Yes _____ No _____
   If yes, indicate: (a) Number of acres _______
   (b) Location of orphan land (abandoned land)

   ____

   ____

Do you feel reclamation of such abandoned land will do any of the following:

	Yes	No
a) Increase tourism in the area	____	____
b) Increase esthetic beauty	____	____
c) Increase wildlife habitat	____	____
d) Increase aquatic habitat	____	____
e) Increase recreation	____	____

11. If your answer to (10) is "No", do you feel it will be worth the while to reclaim such abandoned land:

    Yes ____ No ____ Please comment: ________________

12. Please give your general observations on reclamation of coal mined land in your county or area: ________________

13. General Comments: ________________

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COAL MINING RECLAMATION SURVEY
FOR LAND OWNERS/PRODUCERS

Department of Agricultural Economics
Oklahoma State University
Stillwater, Oklahoma 74074

GENERAL INFORMATION

1. Name of Respondent: ______________________________

2. Permanent Mailing Address: ______________________________
____

3. In which of the following counties do you live?

   Craig _____ Rogers _____ Nowata _____ Okmulgee _____

4. How long have you been a resident of this county?

   _____ years _____ months

5a. How long have you onwed the first property you purchased or inherited in this county? _____ years _____ months

b. Do you own other farmland in this county? Yes _____ No _____

   If yes, (i) How long have you owned this other land?

   _____ years _____ months

   (ii) Currently? Yes _____ No _____

c. How many acres of land do you own in total? _____ acres

6. Please describe the specific location of your land. ______________
____
____

7. Do you rent land in the county? Yes _____ No _____

   If yes, how many acres? _____ acres

8. Has any of your land been strip-mined for coal? Yes _____ No _____

   Acres _____

   If yes, when was it strip-mined? _______ year

9. Was the land reclaimed immediately after mining? Yes _____ No ____

10. Was the land reclaimed some months/years after mining? Yes __ No __

   If yes, how many months/years after it was mined?

   _____ years _____ months

11. Did you own the land before it was strip-mined? Yes _____ No _____

   If yes, under what arrangements did you allow the coal company to mine your land? Please check:

   a) Lease with provision to reclaim the land _____
   b) Lease without provision to reclaim the land _____
   c) Outright sale of land to the coal company _____
   d) Other (specify) ______________________________

12. Which coal company(s) did you transact with?

    Name ______________________ Location of Company ______________

    ____

    After you leased your land to the coal company did you:

    a) lease another person's land? Yes _____ No _____

    b) purchase another person's land? Yes _____ No _____

    If yes, for what purpose did you acquire additional land?

    a) Agricultural _____

    b) Non-Agricultural (specify) _____

    Estimate the number of acres a) leased acres _________

    b) purchased acres _________

13. If leasing arrangements are used which of the following factors are included in the lease? Please check:

    a) Specific location of coal deposit _______
    b) Quality of coal _______
    c) Estimated quantity of coal exploitable _______
    d) Depth of coal _______
    e) Time to initiate mining _______
    f) Length of mining _______
    g) Easement to haul coal _______
    h) Provision for reclamation _______
    i) Maximum time limit to complete reclamation _______
    j) Default provision in the lease _______
    k) Provide all state guarantees in writing _______
    l) Price escalator clause _______

14. Which of the following methods of royalty payment are used?

    a) Fixed price per ton of coal mined _______
    b) Variable price per ton of coal mined _______
    c) Minimum guaranteed payment regardless of coal production _______

15. If you bought the land after it was reclaimed, how much did you pay per acre? $_____/acre

16. How many acres of land did you buy? _____ acres

17. Estimate what percentage of the total land you own is land reclaimed after being mined for coal.

0%	_____	30-40%	_____
1-10%	_____	40-50%	_____
10-20%	_____	50-70%	_____
20-30%	_____	70-100%	_____

18. From whom did you buy this reclaimed land?

    a) Private individual ______________________
    b) Business firm ______________________
    c) Coal Company ______________________
    Name of Coal Company ______________________

19. What are the major soil classes in your land?

    Soil class: ____________ % of total land: ____________
    Soil class: ____________ % of total land: ____________
    Soil class: ____________ % of total land: ____________
    Soil class: ____________ % of total land: ____________

    What are the major soil types on your land?

    Sand ____________ % of total land: ____________
    Loam ____________ % of total land: ____________
    Clay ____________ % of total land: ____________

If we considered three major STAGES of strip-coal mining in this county, namely:

STAGE I: Before 1970, or some other base period (please indicate year _____, if applicable) when strip-mining was less active.

STAGE II: After 1970 or some other year (please indicate year _____) when coal companies started leasing most land and land was not of use.

STAGE III: After 1970 or some other year (please indicate year _____) when most reclamation was completed and land is back in agricultural and/or other use.

20. Indicate (by checking) how your land (owned and rented) was used during the major stages.

	Stages		
	I	II	III
a) Hay production	____	____	____
b) Pasture (grazing)	____	____	____
c) Hay and Pasture combination	____	____	____
d) Idle Land	____	____	____
e) Other (specify)	____	____	____

MANAGEMENT PRACTICES

21. Which of the following types of pasture did you establish on the land?

a) Native grass	____	____	____
b) Bermuda	____	____	____
c) Sudan	____	____	____
d) Fescue	____	____	____
e) Rye grass	____	____	____
f) Other (specify)	____	____	____

22. What is the rotation schedule (if any) for the pasture?

____
____
____

23. Has the rotation schedule changed in any of these stages?
Yes _____ No _____
If yes, please explain stage and nature of change:

____
____
____

24. How many months of grazing per year do you get from the land:

	Stages I	Stages II	Stages III
0 _____ 3 months	_____	_____	_____
4 _____ 6 months	_____	_____	_____
7 _____ 9 months	_____	_____	_____
10 _____ 12 months	_____	_____	_____

25. What type of beef cattle enterprise do you graze on the land?

	I	II	III
a) Cow-calf operation	_____	_____	_____
b) Stockers operation	_____	_____	_____

26. Estimate the carrying capacity or grazing rates for your cattle operation.

	I	II	III
1-5 acres per animal	_____	_____	_____
6-10 acres per animal	_____	_____	_____
11-15 acres per animal	_____	_____	_____
16-20 acres per animal	_____	_____	_____
21-25 acres per animal	_____	_____	_____
26-30 acres per animal	_____	_____	_____
Over 30 acres per animal	_____	_____	_____

27. Estimate the total numbers (head) of cattle on land.

	I	II	III
1-5 head	_____	_____	_____
6-10 head	_____	_____	_____
11-20 head	_____	_____	_____
21-30 head	_____	_____	_____
31-40 head	_____	_____	_____
41-50 head	_____	_____	_____
51-70 head	_____	_____	_____
71-90 head	_____	_____	_____
91-150 head	_____	_____	_____
151-300 head	_____	_____	_____
301-500 head	_____	_____	_____
Over 500 head	_____	_____	_____

28. Estimate the yield per acre from the following types of hay (mowed) (if any) you produce.

	Stage I yield/acre	Stage II yield/acre	Stage III yield/acre
a) Prairie hay	_____ ton	_____ ton	_____ ton
b) Bermuda hay	_____ ton	_____ ton	_____ ton
c) Sudan hay	_____ ton	_____ ton	_____ ton
d) Other (specify)	_____ ton	_____ ton	_____ ton
	_____ ton	_____ ton	_____ ton

29. Which of the following operating inputs do you use on your land?

	Stage I Quantity/acre	Stage II Quantity/acre	Stage III Quantity/acre
a) Nitrogen (N)	_______ lb.	_______ lb.	_______ lb.
b) Phosphorus (P205)	_______ lb.	_______ lb.	_______ lb.
c) Potash (K20)	_______ lb.	_______ lb.	_______ lb.
d) 18-46-0 fertilizer	_______ lb.	_______ lb.	_______ lb.
e) 2-4-D herbicide	_______ lb.	_______ lb.	_______ lb.
f) Other herbicide (specify)	_______ lb.	_______ lb.	_______ lb.
g) Lime	_______ lb.	_______ lb.	_______ lb.
h) Gypsum	_______ lb.	_______ lb.	_______ lb.

30. Indicate the types and quantity of seed you need in establishing your pasture.

	Stage I Quantity/acre	Stage II Quantity/acre	Stage III Quantity/acre
a) Rye seed	______ cwt.	______ cwt.	______ cwt.
b) Oat seed	______ bu.	______ bu.	______ bu.
c) Bermuda seed	______ lb.	______ lb.	______ lb.
d) Native grass seed	______ lb.	______ lb.	______ lb.
e) Sudan seed	______ lb.	______ lb.	______ lb.
f) Fescue seed	______ lb.	______ lb.	______ lb.
g) Other (specify)	______ lb.	______ lb.	______ lb.
	______ lb.	______ lb.	______ lb.
	______ lb.	______ lb.	______ lb.

31. Estimate the labor requirements for your farm operation.

	Stage I	Stage II	Stage III
Hired Labor:			
a) Number of hours worked per year	_____ hr.	_____ hr.	_____ hr.
b) Months hired labor required (Jan., Feb., Mar., ..., Dec.)	_____	_____	_____

Family Labor:	Stage I	Stage II	Stage III
Number of hours worked on farm per year	_____ hr.	_____ hr.	_____ hr.
Months of family labor required (Jan., Feb., Mar., ..., Dec.)	_____	_____	_____
Months Family works off the farm	_____	_____	_____
If family works off farm, please indicate the following:			
Location of off farm job	_______	_______	_______
Distance from farm	_____ mi.	_____ mi.	_____ mi.

32. General comments on land management at the three different stages.

____
____
____

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LAND USE INVENTORY:

1. What is the length of time between leasing and selling the land and the coal company moving in to do strip-mining?

   a) 0-1 month ____
   b) 1-3 months ____
   c) 3-6 months ____
   d) 6-9 months ____
   e) Other (specify) ______________________________

2. Estimate the approximate date for the following event:

   a) Date lease signed with coal company ____________
   b) Date cattle removed from land ____________
   c) Date coal company began mining ____________
   d) Date coal company completed mining ____________
   e) Date coal company began reclamation ____________
   f) Date you began to use land for grazing after reclamation ____________
   g) Date land returned officially to original owner or resold to other farmer (if different from above) ____________

3. If cattle are removed from land preparatory to strip-mining, how are cattle managed? (Check appropriate answer.)

   a) Sold ____
   b) Moved to other grazing area ____
   c) Left to graze on remainder of land strip-mined ____

4. Did strip-mining lead to reduction of number of cattle in herd?

   Yes ____ No ____

NET RETURNS FOR LEASING COAL MINING RIGHTS OR SELLING LAND TO COAL COMPANY:

1. Which of the following methods of royalty payment apply to your coal lands? Please check.

   a) Fixed price per ton of coal mined ______
   b) Variable price per ton of coal mined ______
   c) Minimum guaranteed payment regardless of coal production _____

2. How is the royalty payment disbursed?

   a) Part payment on commencement of strip-mining: _____
   (Please estimate amount paid): ____________________
   b) Monthly payment: _____
   (Estimate amount paid): ____________________
   c) Other payment arrangement: _______
   (Estimate amount paid): ____________________

3. Estimate of the total of all the above royalty payments in dollars per ton of coal mined?

   a) __________/ton mined
   b) Estimate of these royalty payments per acre of land mined:
   __________ dollars/acre

4. Do you have any knowledge of the tons of coal mined weekly, monthly (or other period) per acre of your land?

   Yes _____ No _____

5. If yes, how many tons per week/month or other period?

   a) __________ tons/week/month (   ).

LABOR INPUT:

6. Do you or any member of your family work for a coal company?

   Yes ______ No ______

7. If yes, is it a full-time or part-time job?

   Full-time _____ Part-time _____

LAND SWAP DEALS:

8. If you swapped your coal-land for other land provided by coal company, what other compensations did you get for your land?

   a) Better grazing land ___________
   b) Cash (Estimate amount per acre): ______________
   c) Option to buy back original land after mining and reclamation _________________
   d) Work for coal company ___________
   e) Other gains or losses ____

   ____

9. a) How many acres of coal land did you trade? ____________ acres
   b) Did you or the coal company choose the land you received in exchange for your coal land? _____ self _____ coal company
   c) For which of the following reasons did you make the choice of land to receive in exchange:

      (i) More productive land _____
      (ii) More acres of land _____
      (iii) Historical importance _____
      (iv) Location _____
      (v) Other reason _____

10. How many acres did you receive in exchange? ____________ acres

11. Estimate of the distance between your original coal land and the land received in exchange.

    a) 0-5 miles _______
    b) 5-10 miles _______
    c) 10-15 miles _______
    d) Over 15 miles _______

12. Did the coal company offer any land that has been mined and reclaimed as part of the land in the trade?

    Yes _______ No ________

    If yes, how many acres of the land received in exchange was reclaimed? ____________ acres

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STRIP COAL MINING RECLAMATION SURVEY
FOR PROFESSIONALS

Department of Agricultural Economics
Oklahoma State University
Stillwater, Oklahoma 74074

GENERAL INFORMATION

1. Name of Respondent: ______________________ County: __________
2. Professional position in community and permanent mailing address:
____
____
____
3. Professional experience: _____ years _____ months
4. Period of residence in community: _____ years _____ months

PERFORMANCE MEASURES

If we considered three stages of strip mining namely:

STAGE I: Before 1970 or some other base year (please indicate year _____ if applicable) when strip mining was less active.
STAGE II: Before 1970 or some other year after 1970 (please indicate year _____ if applicable) when coal companies started leasing and mining land.
STAGE III: Before 1970 or some other year after 1970 (please indicate year _____ if applicable) when coal mining slacked off and/or some mine land was reclaimed.

CHANGE IN PERFORMANCE MEASURES FROM PERIOD I THROUGH PERIOD III:

Please indicate changes by showing appropriate periods (I, II, III).

	Increase	Decrease	Same as 1970 or Chosen Base Period
5. Population Characteristics:			
a) Area population	____	____	________
b) Migration into area	____	____	________
c) Migration out of area	____	____	________
d) Age composition	____	____	________
e) Employment of women	____	____	________
6. Housing:			
a) Quantity of housing	____	____	________
b) Quality of housing	____	____	________

	Increase	Decrease	Same as 1970 or Chosen Base Period
7. Transportation/Communications:			
a) Quantity of roads			
b) Quality of roads			
c) Modes of communication (road, rail, air, telephone, etc.)			
8. General Employment:			
a) Agricultural employment			
b) Mining employment			
c) Manufacturing employment			
d) Contract construction			
e) Other employment			

Please comment on the type of other employment:

____

	Increase	Decrease	Same as 1970 or Chosen Base Period
9. School Enrollment:			
a) Grade school			
b) High school			
10. Public Services:			
a) Quantity of p. utilities			
b) Quality of p. utilities			
c) Quantity of govt. serv.			
d) Quality of govt. serv.			
e) Quantity of comm. serv.			
f) Quality of comm. serv.			

Please comment on any of these services:

____

____

	Increase	Decrease	Same as 1970 or Chosen Base Period
11. Taxes:			
a) Property taxes			
b) Other taxes			

Please comment on type of other taxes:

____

____

Standard of Life and Environmental Quality:

	Increase	Decrease	Same as 1970 or Chosen Base Period
12. Income Distribution:			
a) Average family income			
b) Income transfer to low income family			
c) Job opportunities to low income family			

	Increase	Decrease	Same as 1970 or Chosen Base Period
13. Pollution:			
a) Stream and Lake Pollution			
i. From acid mine damage	______	______	______
ii. From soil erosion from spoil banks	______	______	______
b) Air pollution other than dust	______	______	______
c) Dust pollution	______	______	______
d) Noise pollution	______	______	______
14. Animal and Aquatic Habitat:			
a) # of acres of vegetation for wildlife	______	______	______
b) Safety for wildlife	______	______	______
c) # of streams and lakes available for aquatic animals	______	______	______
d) Safety of aquatic animals	______	______	______
15. Safety of Human Life and Health:			
a) Security of life from explosions	______	______	______
b) Security of life from car wrecks	______	______	______
c) Security of life from flooding	______	______	______
d) Security of life from other hazards	______	______	______
e) Security of life from land slides	______	______	______
f) Security of life from soil subsidence	______	______	______
16. Preservation of Natural Resources:			
a) Conservation of green space	______	______	______
b) Conservation of historical site	______	______	______
c) Quantity of water based recreation	______	______	______
d) Quality of water based recreation	______	______	______
e) Quality of land based recreation	______	______	______
f) Quantity of land based recreation	______	______	______
g) Amount of Tourists	______	______	______

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PERFORMANCE EVALUATION:

If the different periods of strip mining used above are defined as Period I (less active strip mining), Period II (leased land and active strip mining), and Period III (land reclamation completed and/or coal mining slacked off):

Rank period according to:	1st	2nd	3rd
a) Increase in cost of living	___	___	___
b) Increase in income distribution	___	___	___
c) Increase in farm employment	___	___	___
d) Increase in non-farm employment	___	___	___
e) Increase in population	___	___	___
f) Increase in all taxes	___	___	___
g) Increase in noise problem	___	___	___
h) Increase in dust problem	___	___	___
i) Increase is risks to life from accidents	___	___	___
j) Increase in cultural values	___	___	___
k) Increase in esthetic beauty	___	___	___
l) Increase in sedimentation of lakes and streams	___	___	___

After strip-mining in earlier years, some of the land was abandoned and not reclaimed. Do you feel that these abandoned lands should now be reclaimed? Please check:

Yes _____ No _____

What reasons have you considered in choosing your answer? Please check.

High Cost	Yes _____	No _____
Low Productivity	Yes _____	No _____
High Productivity	Yes _____	No _____
More Land	Yes _____	No _____
Esthetic Beauty	Yes _____	No _____

General Comments: ____

____

____

____

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COAL MINING RECLAMATION SURVEY
FOR COUNTY ASSESSORS AND
TREASURERS

Dept. of Agricultural Economics
Oklahoma State University
Stillwater, Oklahoma 74074

GENERAL INFORMATION

1. Name of respondent: ______________________ County: __________
2. Official position in community: ______________________________
3. Permanent mailing address: __________________________________
4. Period in office: _____ years _____ months
5. Period of residence in community: _____ years _____ months

PERFORMANCE MEASURES

If we considered three stages of strip coal mining namely:

STAGE I: Before 1970 or some other base year (please indicate year _____ if applicable) when strip mining was less active.
STAGE II: Before 1970 or some other year after 1970 (please indicate year _____ if applicable) when coal companies started le leasing and mining land.
STAGE III: Before 1970 or some other year after 1970 (please indicate year _____ if applicable) when coal mining stacked off and became less active.

6. Estimate the assessed value on coal and trucking companies operating in your administrative area:

	Name of Coal or Trucking Company	Address	Year	Assessed Valuation ($)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				

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Estimate (by checking):	Stages I	II	III
7. Tax assessments on real estate			
$ 0-$ 9,999	___	___	___
$ 10,000-$ 19,999	___	___	___
$ 20,000-$ 49,999	___	___	___
$ 50,000-$ 99,999	___	___	___
$100,000-$499,999	___	___	___
$500,000-$999,999	___	___	___
$1,000,000 and over	___	___	___
8. Tax collections from real estate			
$ 0-$ 9,999	___	___	___
$ 10,000-$ 19,999	___	___	___
$ 20,000-$ 49,999	___	___	___
$ 50,000-$ 99,999	___	___	___
$100,000-$499,999	___	___	___
$500,000-$999,999	___	___	___
$1,000,000 and over	___	___	___
9. Tax collections from strip-mining activities (equipment, trucks, etc.)			
$ 0-$ 9,999	___	___	___
$ 10,000-$ 19,999	___	___	___
$ 20,000-$ 49,999	___	___	___
$ 50,000-$ 99,999	___	___	___
$100,000-$499,999	___	___	___
$500,000-$999,999	___	___	___
$1,000,000 and over	___	___	___

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REAL ESTATE TAX AND STRIP-MINING:

1. What is the assessed value of agricultural land per acre in the county?

   a) __________ dollars/acre

   b) Other (specify) _______________

2. How is land assessed after it is strip-mined for coal?

   a) __________ dollars/acre

   b) Other (specify) ____

3. Who pays taxes on the mined land when it is out of agricultural production?

   a) Land owner _____

   b) Coal company _____

   c) Other (specify) ____

4. After reclamation, how is the land assessed?

   a) $ ____________ /acre

   b) Is this a higher or lower assessment on the land than before it was mined?

      Higher _____ Lower _____ Same _____

5. How does the county make up for lost tax revenues on abandoned mines and/or before mines are reclaimed? Explain.

   ____
   ____
   ____

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COAL MINING RECLAMATION SURVEY FOR COAL COMPANIES

Department of Agricultural Economics
Oklahoma State University
Stillwater, Oklahoma 74074

GENERAL INFORMATION

1. Name of Company: ______________________________

2. Permanent Mailing Address: ______________________________

____

3. Has your coal company strip-mined coal in any of the counties listed? Please check.

   Craig _____ Rogers _____ Nowata _____ Okmulgee _____

4a. During what period(s) was the strip-mining of coal done in Oklahoma? (Please check.)

	Craig	Rogers	Nowata	Okmulgee
Before 1970	_____	_____	_____	_____
1970-1974	_____	_____	_____	_____
1975-Present	_____	_____	_____	_____

b. What has been the total acreage mined up to January 1, 1978?

   Craig _____ acres Rogers _____ acres
   Nowata _____ acres Okmulgee _____ acres

5a. Do you have any mine site now in operation in Oklahoma?

   If yes, in which counties? ______________________________

b. How many acres are being mined this year? ______________________________

6a. How many different coal mine sites has your company operated, or is now operating, between 1968 and 1978 in the counties indicated?

Number of Sites	Craig	Rogers	Nowata	Okmulgee
0	_____	_____	_____	_____
1-3	_____	_____	_____	_____
4-5	_____	_____	_____	_____
6-7	_____	_____	_____	_____
8-9	_____	_____	_____	_____
10 and over	_____	_____	_____	_____

b. How do you haul the coal mined?

% hauled by road	_____	_____	_____	_____
% hauled by rail	_____	_____	_____	_____

c. Do you own the trucks used to haul the coal?

Yes _____ No _____

(i) If yes, how many tons of coal can each truck haul per trip? _____ tons

(ii) If no, who hauls your coal? Name of company: ______________
Address of company: ______________
____

7. The major type of strip-mining involved is:

	Craig	Rogers	Nowata	Okmulgee
a) Area strip-mining	____	____	____	____
b) Contour strip-mining	____	____	____	____

MINERAL RIGHTS

8. Under which of the following arrangements does your company own rights to mine the land? Please check.

	Craig	Rogers	Nowata	Okmulgee
a) Leased land				
b) Purchased land				
c) Originally owned land before 1970				

9. Estimate acreage returned to land owner(s):

	Craig	Rogers	Nowata	Okmulgee
a) Before 1970	____ acres	____ acres	____ acres	____ acres
b) 1970 to present	____ acres	____ acres	____ acres	____ acres

10. If leasing arrangements are used which of the following factors are included in the lease? Please check.

a) Specific location of coal deposits ____
b) Quality of coal ____
c) Estimated quantity of coal exploitable ____
d) Depth of coal ____
e) Time to initiate mining ____
f) Length of mining ____
g) Easement to haul coal ____
h) Provision for reclamation ____
i) Maximum time limit to complete reclamation ____
j) Default provision in the lease ____
k) Provide all stated guarantees in writing ____
l) Price escalator clause ____

11. Which of the following methods of royalty payment are used?

a) Fixed price per ton ot coal mined ____
b) Variable price per ton of coal mined ____
c) Minimum guaranteed payment regardless of coal production ____

RECLAMATION

12a. Do you pre-plan reclamation before the actual reclamation process?

Yes _____ No _____

b. If yes, does pre-planning reclamation make the actual reclamation less costly?

Yes _____ No _____

c. If yes, please explain what type of pre-planning you do?

____

____.

13. Which of the following factors do you consider in pre-planning reclamation? Please check.

a) Physical (mining technique for spoil separation and placement including grading and erosion control) _____
b) Chemical (acidity and salt content of spoil) _____
c) Biologic (plant and animal life) _____
d) Spoil color _____
e) Stoniness (stone and boulders) _____
f) Texture (particle size, distribution of sand, silt, and clay in spoil) _____
g) Nutrient level in mine spoil _____
h) Slope and aspect (direction of slope) _____

14. In pre-planning revegetation which of the following do you consider? Please check.

a) Seeding time _____
b) Plant species to use _____
c) Mulch _____
d) Lime _____
e) Fertilizer _____
f) Fly ash _____
g) Manure _____

15. What is the ultimate purpose of reclaiming the land? Please check.

a) Fulfill an obligation _____
b) Return land to <u>former</u> productive use _____
c) Return land to <u>other</u> productive use _____

16. What is the average period between strip-mining and initiation of reclamation? Please check.

0 months _____
1-3 months _____
4-6 months _____
7-12 months _____
13 months and over _____

17. What is the average period between backfilling and grading?

0 months	______
1-3 months	______
4-6 months	______
7-12 months	______
13 months and over	______

18. What is the average period between grading and revegetation?

0 months	______
1-3 months	______
4-6 months	______
7-12 months	______
13 months and over	______

19. If the land is not owned by the company, how long does the company hold the land after revegetation (when reclamation is completed) before the land is turned over to the owners?

	Period	Craig	Rogers	Nowata	Okmulgee
0 years	______	______	______	______	______
1-3 years	______	______	______	______	______
4-6 years	______	______	______	______	______
7-9 years	______	______	______	______	______
10 years and over	______	______	______	______	______

20a. If land is company owned, when does the company start using land for agricultural purposes after revegetation or when reclamation is otherwise completed?

0 years	______	______	______	______	______
1-3 years	______	______	______	______	______
4-6 years	______	______	______	______	______
7-9 years	______	______	______	______	______
10 years and over	______	______	______	______	______

b. When does the company start using the company owned land for non-agricultural purposes, after reclamation is completed?

0-3 months	______
4-6 months	______
7-12 months	______
13-24 months	______
25-36 months	______
37-48 months	______
49 months and over	______

21. What type of reseeding practices does the company use?

Seed mixture: What type? ______________________________
Plant species: a) Native vegetation: Yes _____ No _____
b) Non-native: Yes _____ No _____
Fertilizer application: What type(s)? ______________________
Analysis: ______________________________
Quantity/acre: ______________________________
Lime use: What type? ______________________________
Quantity/acre: ______________________________
Other inputs: (Specify) ______________________________
Quantity/acre: ______________________________

22a. As you are probably aware, some abandoned mines have not been reclaimed. Do you think these abandoned mines need reclaiming now?
Yes _____ No _____

b. Please explain reason for answer: ______________________________
____
____

23. Estimate the average cost per acre of reclaiming the land.

	Craig Yr.	Rogers Yr.	Nowata Yr.	Okmulgee Yr.
a) Av. Cost/acre	_____ ___	_____ ___	_____ ___	_____ ___
b) Was the land returned to its former use?	_____ ___	_____ ___	_____ ___	_____ ___
c) Indicate former use	_____ ___	_____ ___	_____ ___	_____ ___

d) If the land was not returned to its former use, please indicate use after reclamation.
Land use: _________ _________ _________ _________

24. General comments on Strip Mining and Strip Mining Reclamation (benefits and costs, other).

____
____
____
____

CO/DDB/kmw
7/6/78
25

APPENDIX B

ENTERPRISE BUDGETS

LAND A

COW CALF COST & RETURNS PER COW, 100 COW UNIT — 11351830
FALL CALVING / DRY GRASS — 01/10/79
NORTHEAST

LIVESTOCK INVESTMENT	UNITS	SIZE	NUMBER	VALUE/UNIT	VALUE	YOUR VALUE
BEEF COW	HD.	1.00	1.00	250.000	250.00	250.00
BEEF BULL	HD.	1.00	0.04	950.000	38.00	38.00
BEEF HEIFER	HD.	1.00	0.12	275.000	33.00	33.00
TOTAL LIVESTOCK INVESTMENT					321.00	321.00

PRODUCTION	UNITS	QUANTITY	WEIGHT	PRICE	VALUE/UNIT	VALUE	YOUR VALUE
STR CALV(3-5) CH	CWT.	0.45	4.60	80.000	368.00	165.60	165.60
HFR CALV(3-5) CH	CWT.	0.33	4.30	71.500	307.45	101.46	101.46
CULL COWS	CWT.	0.09	9.50	44.500	422.75	39.05	38.05
TOTAL RECEIPTS						305.11	305.11

OPERATING INPUTS	UNITS	RATE PER UNIT	NUMBER OF UNITS	TOTAL UNITS	PRICE	VALUE	
41-45% PRO. SUP.	LBS.	375.00	1.12	420.000	0.11	44.10	44.10
BERMUDA HAY	TONS	0.75	1.12	0.840	45.00	37.80	0.0
SALT & MIN.	LBS.	24.00	1.12	26.880	0.04	1.08	1.08
VET & MED.	DOL.	1.00	1.00	1.000	4.25	4.25	4.25
HAULING & MKTG.	HD.	1.00	1.00	1.000	5.00	5.00	5.00
PERSONAL TAXES	HD.	1.00	1.03	1.030	3.00	3.09	3.09
SUPPLIES & UTILI	HD.	1.00	1.00	1.000	3.25	3.25	3.25
MACH. FUEL & LUBE						3.48	3.48
MACHINERY REPAIR COST						2.39	2.39
EQUIPMENT REPAIR						3.64	3.64
TOTAL OPERATING COST						108.08	70.28

RETURNS TO LAND,LABOR,CAPITAL,MACHINERY,OVERHEAD,RISK AND MANAGEMENT — 197.03 — 231.83

CAPITAL COST	PRICE	AMOUNT	VALUE	YOUR VALUE
ANNUAL OPERATING CAPITAL	0.100	71.179	7.12	
MACHINERY INVESTMENT	0.100	16.250	1.63	
EQUIPMENT INVESTMENT	0.100	75.300	7.53	
LIVESTOCK INVESTMENT	0.100	321.000	32.10	
TOTAL INTEREST CHARGE			48.37	

RETURNS TO LAND,LABOR,MACHINERY,OVERHEAD,RISK AND MANAGEMENT — 148.66

OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)			
MACHINERY	DOL.	1.79	1.79
EQUIPMENT	DOL.	7.48	7.48
TOTAL OWNERSHIP COST		9.27	9.27

RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT — 139.38 — 222.56

LABOR COSTS	PRICE	HOURS		
MACHINERY LABOR	3.000	2.640	7.92	
EQUIPMENT LABOR	3.000	3.600	10.80	
LIVESTOCK LABOR	3.000	5.800	17.40	
TOTAL LABOR COST		12.040	36.12	

RETURNS TO LAND,OVERHEAD,RISK AND MANAGEMENT — 103.26

PASTURE CHARGES	UNITS	TOTAL UNITS	PRICE		
PASTURE, SUMMER	AUMS	9.46	5.33	50.44	
PASTURE, WINTER	AUMS	6.50	5.33	34.62	
TOTAL PASTURE CHARGES				85.07	

RETURNS TO OVERHEAD,RISK AND MANAGEMENT — 18.20

NATIVE OR BERMUDA PASTURES - 90% CALF CROP — HUDGINS,SELK
HAY 9% C.P. OR BETTER
SUPPLEMENT IS COTTONSEED CAKE — 12/20/78 — 0110000000

PROCESSED BY DEPT. OF AGRI. ECON. - OKLAHOMA STATE UNIVERSITY
PROGRAM DEVELOPED BY DEPT. OF. AGRI. ECON. OKLAHOMA STATE UNIVERSITY

LAND A

BUDGET IDENTIFICATION NUMBER 11351030151313 ANNUAL CAPITAL MONTH 7 BUDGET RECORD NUMBER 35
BUDGET FILE 1

COW CALF COST & RETURNS PER COW, 100 COW UNIT 11351030
FALL CALVING / DRY GRASS 01/10/79
NORTHEAST

LINE / PRODUCTION (NUMBER OF UNITS)	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	10 OCT	11 NOV	12 DEC	13 PRICE	14 WEIGHT	15 UNIT CODE	16 ITEM CODE	17 TYPE	18 CONT
1 STR CALV(3-5) CW	0.0	0.0	0.0	0.0	0.0	0.0	0.45	0.0	0.0	0.0	0.0	0.0	-1.000	4.600	16.	13.	2.	0.
2 HFR CALV(3-5) CW	0.0	0.0	0.0	0.0	0.0	0.0	0.33	0.0	0.0	0.0	0.0	0.0	-1.000	4.300	16.	12.	2.	0.
3 CULL COWS	0.04	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.05	0.0	0.0	0.0	-1.000	9.500	16.	10.	2.	0.

OPERATING INPUTS (RATE/UNIT)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	PRICE	NUMBER UNITS	UNIT CODE	ITEM CODE	TYPE	CONT
11 41-45% PRO. SUP.	60.00	60.00	60.00	45.00	0.0	0.0	0.0	0.0	0.0	30.00	60.00	60.00	-1.000	1.120	12.	115.	3.	0.
13 BERMUDA HAY	0.15	0.15	0.15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.15	0.15	-1.000	1.120	3.	83.	3.	0.
14 PASTURE, SUMMER	0.0	0.0	0.0	0.45	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	5.330	1.120	10.	150.	3.	0.
15 PASTURE, WINTER	1.00	1.00	1.00	1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.90	0.90	5.330	1.120	10.	155.	3.	0.
16 SALT & MIN.	10.00	0.0	0.0	4.00	0.0	0.0	10.00	0.0	0.0	0.0	0.0	0.0	0.080	1.120	12.	103.	3.	0.
17 VET & MED.	0.0	0.25	0.0	0.0	0.0	0.50	0.0	0.0	0.0	0.0	0.25	0.0	4.250	1.000	15.	416.	3.	0.
18 HAULING & MKTG.	0.0	0.25	0.0	0.0	0.0	0.0	0.50	0.0	0.0	0.25	0.0	0.0	5.000	1.000	1.	405.	3.	0.
19 PERSONAL TAXES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	3.000	1.030	1.	442.	3.	0.
20 SUPPLIES & UTILI	0.0	0.0	0.25	0.0	0.0	0.25	0.0	0.0	0.25	0.0	0.0	0.25	3.250	1.000	1.	417.	3.	0.

MACHINERY REQUIREMENTS (HOURS)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	XXXXX	XXXXX	POWER UNIT	MACH CODE	TYPE	CONT
26 PICKUP	0.20	0.20	0.20	0.20	0.10	0.10	0.20	0.10	0.10	0.15	0.20	0.20	0.0	0.0	0.	11.	4.	0.
27 G-NECK TRAILER	0.0	0.05	0.0	0.05	0.0	0.0	0.10	0.0	0.0	0.05	0.0	0.0	0.0	0.0	11.	90.	4.	0.

EQUIPMENT REQUIREMENTS	NUMBER UNITS	PROPORT OF COST	XXX	EQUIP CODE	TYPE	XXXX
38 4-WIRE FENCE	5.000	0.010	0.	1.	5.	0.
39 CORRALS	160.000	0.010	0.	2.	5.	0.
LIVESTOCK INVESTMENT						
40 BEEF COW	1.000	1.000	0.	51.	5.	0.
41 BEEF BULL	0.040	1.000	0.	53.	5.	0.
42 BEEF HEIFER	0.120	1.000	0.	52.	5.	0.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
69 LIVESTOCK LABOR	0.50	0.50	0.50	0.40	0.40	0.40	0.80	0.40	0.40	0.50	0.50	0.50

MONTHLY SUMMARY OF RECEIPTS AND EXPENDITURES

CATEGORY	YEAR	UNIT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
TOTAL RECEIPTS	1	DOL.	16.91	0.0	0.0	0.0	0.0	0.0	267.06	0.0	21.14	0.0	0.0	0.0	305.11
TOTAL VARIABLE COST	1	DOL.	21.84	21.90	22.20	15.13	6.52	9.46	10.12	6.52	7.34	11.63	27.82	30.66	193.24
ANNUAL CAPITAL	1	DOL.	6.25	8.25	10.10	11.36	11.90	12.49	0.0	0.54	0.0	0.97	3.29	5.84	71.18

LABOR REQUIREMENTS

CATEGORY	YEAR	UNIT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
MACHINERY LABOR	1	HOUR	0.24	0.30	0.24	0.30	0.12	0.12	0.36	0.12	0.12	0.24	0.24	0.24	2.64
LIVESTOCK LABOR	1	HOUR	0.50	0.50	0.50	0.40	0.40	0.40	0.80	0.40	0.40	0.50	0.50	0.50	5.80
EQUIPMENT LABOR	1	HOUR	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	3.60
TOTAL LABOR	1	HOUR	1.04	1.10	1.04	1.00	0.82	0.82	1.46	0.82	0.82	1.04	1.04	1.04	12.04

MACHINERY REQUIREMENTS BY MONTH

		UNIT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
PICKUP		HOUR	0.20	0.25	0.20	0.25	0.10	0.10	0.30	0.10	0.10	0.20	0.20	0.20	2.20
G-NECK TRAILER	(0.2)	HOUR	0.0	0.05	0.0	0.05	0.0	0.0	0.10	0.0	0.0	0.05	0.0	0.0	0.25

MONTHLY EQUIPMENT REQUIREMENTS AS A PROPORTION OF THE ITEMS WHOLE FARM USE

	NO.		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
4-WIRE FENCE	5.0	1 MILE	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0100
CORRALS	****	1 FEET	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0100
BEEF COW	1.0	1 HD.	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	1.0000
BEEF BULL	0.0	1 HD.	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	1.0000
BEEF HEIFER	0.1	1 HD.	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	1.0000

THE FINAL ENTRY IN EACH ROW REPRESENTS THE PROPORTION OF THE ITEMS TIME ALLOCATED TO THE BUDGET UNIT

MACHINERY FIXED AND VARIABLE COST PER HOUR

MACHINE	CODE	DEPR	INSUR.	TAX	TOTAL FIXED	REPAIR	FUEL	LUB.	TOTAL VARIABLE	INT.	HR/TIME
PICKUP	11	0.43	0.03	0.06	0.53	0.92	1.38	0.21	2.50	0.55	1.00
G-NECK TRAILER	90	2.12	0.10	0.27	2.50	1.50	0.0	0.0	1.50	1.69	1.00

ANNUAL COST SUMMARY FOR EQUIPMENT AND LIVESTOCK

LINE NO.	ITEM	SIZE	UNIT	LIST PRICE	DEPRECIATION	INTEREST	INSURANCE	TAXES	REPAIRS	FUEL AND LUBE	HOURS LABOR	TOT OWNERSHP/YR	TOT OPERATING/YR
1	4-WIRE FENCE	1.00	MILE	2500.00	100.00	125.00	7.50	12.50	60.00	0.0	2.00	120.00	60.00
2	CORRALS	1.00	FEET	16.00	0.80	0.80	0.05	0.08	0.40	0.0	0.30	0.93	0.40
51	BEEF COW	1.00	HD.	250.00	0.0	25.00	0.0	0.0	0.0	0.0	2.28	0.0	0.0
53	BEEF BULL	1.00	HD.	950.00	0.0	95.00	0.0	0.0	0.0	0.0	10.00	0.0	0.0
52	BEEF HEIFER	1.00	HD.	275.00	0.0	27.50	0.0	0.0	0.0	0.0	3.00	0.0	0.0

ANNUAL CHARGES MADE IN THIS BUDGET FOR EQUIPMENT AND LIVESTOCK

LINE NO.	ITEM	SIZE	UNIT	NUMBER ITEMS	PROPOR. CHARGED	OWNERSHP CHARGES	OPERATING CHARGES	INTERST CHARGES	LABOR HOURS CHANGED
1	4-WIRE FENCE	1.00	MILE	5.00	0.01	6.00	3.00	6.25	0.10
2	CORRALS	1.00	FEET	160.00	0.01	1.48	0.64	1.28	0.48
51	BEEF COW	1.00	HD.	1.00	1.00	0.0	0.0	25.00	2.26
53	BEEF BULL	1.00	HD.	0.04	1.00	0.0	0.0	3.80	0.40
52	BEEF HEIFER	1.00	HD.	0.12	1.00	0.0	0.0	3.30	0.36

COLUMN NAME OF MACHINE	1 CODE	2 WIDTH (FEET)	3 INITIAL LIST PRICE	4 SPEED (MPH)	5 FIELD EFFICIENCY	6 RC1	7 RC2	8 RC3	9 HOURS USED ANNUALLY	10 YEARS OWNED	11 RFV1	12 RFV2	13 PURCHASE PRICE	14 FUEL TYPE	15 HOURS OF LIFE	16 HP
PICKUP	11.	0.5	7500.	20.0	0.88	0.60	0.001585	1.40	600.	4.0	0.600	0.885	3800.	1.	4000.	1.
G-NECK TRAILER	90.	20.0	3000.	20.0	0.90	0.50	0.002510	1.30	100.	10.0	0.635	0.895	2750.	0.	1080.	0.

COLUMN--- ITEM NAME	1 CODE	2 SIZE	3 UNIT	4 TYPE	5 LIST PRICE	6 PURCHASE PRICE	7 YEARS LIFE	8 SALVAGE PROP OF LIST	9 REPAIR PROP OF LIST	10 FUEL & LUB AS PROP	11 ANNUAL HOURS LABOR
4-WIRE FENCE	1.	1.00	15.	2.00	2500.00	2500.00	25.00	0.0	0.600	0.0	2.00
CORRALS	2.	1.00	19.	2.00	16.00	16.00	20.00	0.0	0.500	0.0	0.30
BEEF COW	51.	1.00	1.	1.00	250.00	250.00	6.00	1.000	0.0	0.0	2.26
BEEF HEIFER	52.	1.00	1.	1.00	275.00	275.00	8.00	1.000	0.0	0.0	3.00
BEEF BULL	53.	1.00	1.	1.00	950.00	950.00	5.00	1.000	0.0	0.0	10.00

NATIVE OR BERMUDA PASTURES - 90% CALF CROP HUDGINS,SELK MACHINERY COMPLEMENT 13
HAY 9% C.P. OR BETTER EQUIPMENT COMPLEMENT 13
SUPPLEMENT IS COTTONSEED CAKE 12/20/78 0110000000 PRICE VECTOR 3

LAND B (LAND D)

COW CALF COST & RETURNS / PER COW, 100 COW UNIT — 11371630
FALL CALVING / FESCUE PASTURE — 08/01/79
PASTURE CHARGE INCLUDED — NORTHEAST

LIVESTOCK INVESTMENT	UNITS	SIZE	NUMBER	VALUE/UNIT	VALUE	YOUR VALUE
BEEF COW	CWT.	9.50	1.00	425.000	425.00	425.00
BEEF BULL	CWT.	16.00	0.04	950.000	38.00	38.00
BEEF HEIFER	CWT.	8.00	0.12	275.000	33.00	33.00
TOTAL LIVESTOCK INVESTMENT					496.00	496.00

PRODUCTION	UNITS	QUANTITY	WEIGHT	PRICE	VALUE/UNIT	VALUE	YOUR VALUE
STR CALV(3-5) CH	CWT.	0.45	4.75	105.000	498.75	224.44	224.44
HFR CALV(3-5) CH	CWT.	0.33	4.45	95.000	422.75	139.51	139.51
COWS-COMMERCIAL	CWT.	0.09	9.50	59.000	560.50	50.44	50.44
TOTAL RECEIPTS						414.39	414.39

OPERATING INPUTS	UNITS	RATE PER UNIT	NUMBER OF UNITS	TOTAL UNITS	PRICE	VALUE	
41-45% PRO. SUP.	LBS.	60.00	1.12	67.200	0.12	7.73	7.33
BERMUDA HAY	TONS	0.13	1.12	0.146	47.00	6.84	0.0
SALT & MIN.	LBS.	24.00	1.12	26.880	0.07	1.88	1.88
VET & MED.	DOL.	1.00	1.00	1.000	5.00	5.00	5.00
HAULING & MKTG.	DOL.	1.00	1.00	1.000	5.00	5.00	5.00
PERSONAL TAXES	DOL.	1.00	1.03	1.030	3.00	3.09	3.09
SUPPLIES & UTLI	DOL.	1.00	1.00	1.000	3.25	3.25	3.25
MACH. FUEL & LUBE						4.24	4.24
MACHINERY REPAIR COST						2.63	2.63
EQUIPMENT REPAIR						3.92	3.92
TOTAL OPERATING COST						43.98	36.74

RETURNS TO LAND,LABOR,CAPITAL,MACHINERY,OVERHEAD,RISK AND MANAGEMENT — 370.41 — 377.65

CAPITAL COST	PRICE	AMOUNT	VALUE	YOUR VALUE
ANNUAL OPERATING CAPITAL	0.110	63.521	6.99	
MACHINERY INVESTMENT	0.110	20.539	2.26	
EQUIPMENT INVESTMENT	0.110	142.500	15.67	
LIVESTOCK INVESTMENT	0.110	496.000	54.56	
TOTAL INTEREST CHARGE			79.48	

RETURNS TO LAND,LABOR,MACHINERY,OVERHEAD,RISK AND MANAGEMENT — 291.32

OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)	UNITS	VALUE	YOUR VALUE
MACHINERY	DOL.	3.39	3.39
EQUIPMENT	DOL.	20.61	20.61
TOTAL OWNERSHIP COST		24.00	24.00

RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT — 267.32 — 353.65

LABOR COSTS	PRICE	HOURS	VALUE	
MACHINERY LABOR	3.000	2.44-	7.33	
EQUIPMENT LABOR	3.000	0.530	1.59	
LIVESTOCK LABOR	3.000	5.800	17.40	
TOTAL LABOR COST		8.790	26.37	

RETURNS TO LAND,OVERHEAD,RISK AND MANAGEMENT — 240.95

PASTURE CHARGES	UNITS	TOTAL UNITS	PRICE	VALUE	
PASTURE	AUMS	13.44	10.00	134.40	
TOTAL PASTURE CHARGES				134.40	

RETURNS TO OVERHEAD,RISK AND MANAGEMENT — 106.55

FERTILIZED BERMUDA & FESCUE PASTURE UTILIZED — HUDGINS,SELK
80-40-40 ACTUAL NUTRIENTS APPLIED
3 ACRES PER COW AT $16.00 PER ACRE - RENTAL RA-E — 06/08/79 — 00100000--
PROCESSED BY DEPT. OF AGRI. ECON. - OKLAHOMA STATE UNIVERSITY
PROGRAM DEVELOPED BY DEPT. OF. AGRI. ECON. OKLAHOMA STATE UNIVERSITY

BUDGET IDENTIFICATION NUMBER 113716303131313 ANNUAL CAPITAL MONTH 7 BUDGET RECORD NUMBER 365
BUDGET FILE 1

LAND B (LAND D)

COW CALF COST & RETURNS / PER COW, 100 COW UNIT 11371630
FALL CALVING / FESCUE PASTURE 08/01/79
PASTURE CHARGE INCLUDED NORTHEAST

LINE	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	10 OCT	11 NOV	12 DEC	13 PRICE	14 WEIGHT	15 UNIT CODE	16 ITEM CODE	17 TYPE	18 CONT
PRODUCTION					NUMBER OF UNITS													
1 STR CALVES-51 CH	0.0	0.0	0.0	0.0	0.0	0.0	0.45	0.0	0.0	0.0	0.0	0.0	-1.000	4.750	16.	13.	2.	0.
2 HFR CALVES-51 CH	0.0	0.0	0.0	0.0	0.0	0.0	0.33	0.0	0.0	0.0	0.0	0.0	-1.000	4.450	16.	12.	2.	0.
3 COWS-COMMERCIAL	0.0	0.02	0.0	0.0	0.0	0.03	0.0	0.04	0.0	0.0	0.0	0.0	-1.000	9.500	16.	18.	2.	0.
OPERATING INPUTS					RATE/UNIT								PRICE	NUMBER UNITS	UNIT CODE	ITEM CODE	TYPE	CONT
11 41-45% PRO. SUP.	0.0	30.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.00	0.0	-1.000	1.120	12.	115.	3.	0.
13 BERMUDA HAY	0.03	0.03	0.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.02	0.03	-1.000	1.120	3.	83.	3.	0.
14 PASTURE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	10.000	1.120	10.	150.	3.	0.
15 SALT & MIN.	10.00	0.0	0.0	4.00	0.0	0.0	10.00	0.0	0.0	0.0	0.0	0.0	-1.000	1.120	12.	103.	3.	0.
16 VET & MED.	0.0	0.25	0.0	0.0	0.0	0.0	0.50	0.0	0.0	0.0	0.25	0.0	5.000	1.000	15.	416.	3.	0.
17 HAULING & MKTG.	0.0	0.25	0.0	0.0	0.0	0.0	0.50	0.0	0.0	0.25	0.0	0.0	5.000	1.000	1.	485.	3.	0.
18 PERSONAL TAXES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	3.000	1.000	1.	442.	3.	0.
19 SUPPLIES & UTIL	0.0	0.0	0.25	0.0	0.0	0.25	0.0	0.0	0.25	0.0	0.0	0.25	3.250	1.000	1.	417.	3.	0.
MACHINERY REQUIREMENTS						HOURS							XXXXX	XXXXX	POWER UNIT	MACH CODE	TYPE	CONT
26 PICKUP	0.15	0.15	0.15	0.20	0.10	0.10	0.20	0.10	0.10	0.15	0.20	0.20	0.0	0.0	0.	11.	4.	0.
27 STOCK TRAILER	0.0	0.05	0.0	0.05	0.0	0.0	0.10	0.0	0.0	0.05	0.0	0.0	0.0	0.0	11.	99.	4.	0.
EQUIPMENT REQUIREMENTS													NUMBER UNITS	PROPORT OF COST	XXX	EQUIP CODE	TYPE	XXXX
38 4-WIRE FENCE													5.000	0.010	0.	1.	5.	0.
39 LOT FENCE													160.000	0.010	0.	2.	5.	0.
LIVESTOCK INVESTMENT																		
40 BEEF COW													1.000	1.000	0.	51.	5.	0.
41 BEEF BULL													0.040	1.000	0.	53.	5.	0.
42 BEEF HEIFER													0.120	1.000	0.	52.	5.	0.
49 LIVESTOCK LABOR	0.50	0.50	0.50	0.40	0.40	0.40	0.80	0.40	0.40	0.50	0.50	0.50						

MONTHLY SUMMARY OF RECEIPTS AND EXPENDITURES

CATEGORY	YEAR	UNIT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
TOTAL RECEIPTS	1	DOL.	0.0	11.21	0.0	0.0	0.0	16.81	363.94	22.42	0.0	0.0	0.0	0.0	414.39
TOTAL VARIABLE COST	1	DOL.	14.37	20.17	13.87	12.79	11.85	12.66	18.40	11.85	12.66	13.68	18.33	17.65	177.98
ANNUAL CAPITAL	1	DOL.	6.37	7.12	8.29	5.36	10.32	9.98	0.0	0.0	1.05	2.18	3.71	5.18	63.52
LABOR REQUIREMENTS															
MACHINERY LABOR	1	HOUR	0.18	0.24	0.18	0.30	0.12	0.12	0.36	0.12	0.12	0.24	0.24	0.24	2.46
LIVESTOCK LABOR	1	HOUR	0.50	0.50	0.50	0.40	0.40	0.40	0.80	0.40	0.40	0.50	0.50	0.50	5.80
EQUIPMENT LABOR	1	HOUR	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.53
TOTAL LABOR	1	HOUR	0.72	0.78	0.72	0.74	0.56	0.56	1.20	0.56	0.56	0.78	0.78	0.78	8.79
MACHINERY REQUIREMENTS BY MONTH															
PICKUP		HOUR	0.15	0.20	0.15	0.25	0.10	0.10	0.30	0.10	0.10	0.20	0.20	0.20	2.05
STOCK TRAILER	(0.2)	HOUR	0.0	0.05	0.0	0.05	0.0	0.0	0.10	0.0	0.0	0.05	0.0	0.0	0.25

MONTHLY EQUIPMENT REQUIREMENTS AS A PROPORTION OF THE ITEMS WHOLE FARM USE

ITEM	NO.	UNIT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
4-WIRE FENCE	5.0	1 MILE	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0100
LOT FENCE	****	1 FEET	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0008	0.0100
BEEF COW	1.0	1 CWT.	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	[illegible]
BEEF BULL	0.0	1 CWT.	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	1.0000
BEEF HEIFER	0.1	1 CWT.	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	1.0000

THE FINAL ENTRY IN EACH ROW REPRESENTS THE PROPORTION OF THE ITEMS TIME ALLOCATED TO THE BUDGET UNIT

MACHINERY FIXED AND VARIABLE COST PER HOUR

MACHINE	CODE	DEPR.	INSUR.	TAX	TOTAL FIXED	REPAIR	FUEL	LUB.	TOTAL VARIABLE	INT.	HR/TIME
PICKUP	11	1.20	0.05	0.11	1.38	1.13	1.83	0.27	3.20	0.90	1.00
STOCK TRAILER	99	1.91	0.09	0.24	2.24	1.30	0.0	0.0	1.30	1.65	1.00

ANNUAL COST SUMMARY FOR EQUIPMENT AND LIVESTOCK

LINE NO.	ITEM	SIZE	UNIT	LIST PRICE	DEPREC-IATION	INTEREST	INSUR-ANCE	TAXES	REPAIRS	FUEL AND LUBE	HOURS LABOR	TOT OWN-ERSHIP/YR	TOT OPER-ATING/YR
1	4-WIRE FENCE	1.00	MILE	2500.00	100.00	137.50	7.50	12.50	25.00	0.0	1.00	120.00	25.00
2	LOT FENCE	100.00	FEET	100.00	8.33	5.50	0.30	0.50	1.67	0.0	0.30	9.13	1.67
51	BEEF COW	9.50	CWT.	425.00	0.0	46.75	0.0	0.0	0.0	0.0	0.0	0.0	0.0
53	BEEF BULL	16.00	CWT.	950.00	0.0	104.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	BEEF HEIFER	8.00	CWT.	275.00	0.0	30.25	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ANNUAL CHARGES MADE IN THIS BUDGET FOR EQUIPMENT AND LIVESTOCK

LINE NO.	ITEM	SIZE	UNIT	NUMBER ITEMS	PROPOR. CHARGED	OWNERSHP CHARGES	OPERATING CHARGES	INTEREST CHARGES	LABOR HOURS CHARGED
1	4-WIRE FENCE	1.00	MILE	5.00	0.01	6.00	1.25	6.87	0.05
2	LOT FENCE	100.00	FEET	160.00	0.01	14.61	2.67	8.80	0.48
51	BEEF COW	9.50	CWT.	1.00	1.00	0.0	0.0	46.75	0.0
53	BEEF BULL	16.00	CWT.	0.04	1.00	0.0	0.0	4.18	0.0
52	BEEF HEIFER	8.00	CWT.	0.12	1.00	0.0	0.0	3.63	0.0

COLUMN / NAME OF MACHINE	1 CODE	2 WIDTH (FEET)	3 INITIAL LIST PRICE	4 SPEED (MPH)	5 FIELD EFFIC-ENCY	6 RC1	7 RC2	8 RC3	9 HOURS USED ANNUALLY	10 YEARS OWNED	11 RFV1	12 RFV2	13 PURCHASE PRICE	14 FUEL TYPE	15 HOURS OF LIFE	16 HP
PICKUP	11.	0.5	7500.	20.0	0.88	0.60	0.001585	1.40	500.	8.0	0.600	0.885	6500.	1.	4000.	1.
STOCK TRAILER	99.	16.0	2600.	20.0	0.90	0.53	0.002510	1.30	100.	10.0	0.635	0.895	2450.	0.	1000.	0.

COLUMN--- / ITEM NAME	1 CODE	2 SIZE	3 UNIT	4 TYPE	5 LIST PRICE	6 PURCHASE PRICE	7 YEARS LIFE	8 SALVAGE PROP OF LIST	9 REPAIR PROP OF LIST	10 FUEL & LUB AS PROP	11 ANNUAL HOURS LABOR
4-WIRE FENCE	1.	1.00	18.	2.00	2500.00	2500.00	25.00	0.0	0.250	0.0	1.00
LOT FENCE	2.	100.00	19.	2.00	100.00	100.00	12.00	0.0	0.200	0.0	0.30
BEEF COW	51.	9.50	16.	1.00	425.00	425.00	5.00	1.000	0.0	0.0	0.0
BEEF HEIFER	52.	8.00	16.	1.00	275.00	275.00	6.00	1.000	0.0	0.0	0.0
BEEF BULL	53.	16.00	16.	1.00	950.00	950.00	6.00	1.000	0.0	0.0	0.0

FERTILIZED BERMUDA & FESCUE PASTURE UTILIZED HUDGINS,SELK MACHINERY COMPLEMENT 13
80-40-40 ACTUAL NUTRIENTS APPLIED EQUIPMENT COMPLEMENT 13
3 ACRES PER COW AT $15.00 PER ACRE - RENTAL RATE 06/08/79 0010000000 PRICE VECTOR 3

LAND C

COW CALF COST & RETURNS / PER COW, 100 COW UNIT — 11371600
FALL CALVING / FESCUE PASTURE — 08/01/79
PASTURE CHARGE INCLUDED — NORTHEAST

LIVESTOCK INVESTMENT	UNITS	SIZE	NUMBER	VALUE/UNIT	VALUE	YOUR VALUE
BEEF COW	CWT.	9.50	1.00	425.000	425.00	425.00
BEEF BULL	CWT.	16.00	0.04	950.000	38.00	38.00
BEEF HEIFER	CWT.	8.00	0.12	275.000	33.00	33.00
TOTAL LIVESTOCK INVESTMENT					496.00	496.00

PRODUCTION	UNITS	QUANTITY	WEIGHT	PRICE	VALUE/UNIT	VALUE	YOUR VALUE
STR CALV(3-5) CH	CWT.	0.45	4.75	105.000	498.75	224.44	224.44
HFR CALV(3-5) CH	CWT.	0.33	4.45	95.000	422.75	139.51	139.51
COWS-COMMERCIAL	CWT.	0.09	9.50	59.000	560.50	50.44	50.44
TOTAL RECEIPTS						414.39	414.39

OPERATING INPUTS	UNITS	RATE PER UNIT	NUMBER OF UNITS	TOTAL UNITS	PRICE	VALUE	
41-45% PRO. SUP.	LBS.	60.00	1.12	67.200	0.12	7.73	7.73
BERMUDA HAY	TONS	0.13	1.12	0.146	47.00	6.84	0.0
SALT & MIN.	LBS.	24.00	1.12	26.880	0.07	1.88	1.88
VET & MED.	DOL.	1.00	1.00	1.000	5.00	5.00	5.00
HAULING & MKTG.	HD.	1.00	1.00	1.000	5.00	5.00	5.00
PERSONAL TAXES	HD.	1.00	1.00	1.000	3.09	3.09	3.09
SUPPLIES & UTIL	DOL.	1.00	1.00	1.000	3.25	3.25	3.25
MACH. FUEL & LUBE						4.24	4.24
MACHINERY REPAIR COST						2.63	2.63
EQUIPMENT REPAIR						3.92	3.92
TOTAL OPERATING COST						43.58	36.74

RETURNS TO LAND,LABOR,CAPITAL,MACHINERY,OVERHEAD,RISK AND MANAGEMENT — 370.81 — 377.65

CAPITAL COST	PRICE	AMOUNT	VALUE	YOUR VALUE
ANNUAL OPERATING CAPITAL	0.110	63.521	6.99	
MACHINERY INVESTMENT	0.110	20.539	2.26	
EQUIPMENT INVESTMENT	0.110	142.500	15.67	
LIVESTOCK INVESTMENT	0.110	496.000	54.56	
TOTAL INTEREST CHARGE			79.48	

RETURNS TO LAND,LABOR,MACHINERY,OVERHEAD,RISK AND MANAGEMENT — 291.32

OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)			
MACHINERY	DOL.	3.39	3.39
EQUIPMENT	DOL.	20.61	20.61
TOTAL OWNERSHIP COST		24.00	24.00

RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT — 267.32 — 353.65

LABOR COSTS	PRICE	HOURS		
MACHINERY LABOR	3.000	2.450	7.38	
EQUIPMENT LABOR	3.000	0.530	1.59	
LIVESTOCK LABOR	3.000	5.800	17.40	
TOTAL LABOR COST		8.790	26.37	

RETURNS TO LAND,OVERHEAD,RISK AND MANAGEMENT — 240.95

PASTURE CHARGES	UNITS	TOTAL UNITS	PRICE		
PASTURE	AUMS	13.44	10.00	134.40	
TOTAL PASTURE CHARGES				134.40	

RETURNS TO OVERHEAD,RISK AND MANAGEMENT — 106.55

FERTILIZED BERMUDA & FESCUE PASTURE UTILIZED — HUDGINS,SELK
80-40-40 ACTUAL NUTRIENTS APPLIED
3 ACRES PER COW AT $10.00 PER ACRE - RENTAL RATE — 06/08/79 — 0010000011
PROCESSED BY DEPT. OF AGRI. ECON. - OKLAHOMA STATE UNIVERSITY
PROGRAM DEVELOPED BY DEPT. OF. AGRI. ECON. OKLAHOMA STATE UNIVERSITY

BUDGET IDENTIFICATION NUMBER 113716303131313 ANNUAL CAPITAL MONTH 7 BUDGET RECORD NUMBER 365
BUDGET FILE 1

LAND C

COW CALF COST & RETURNS / PER COW, 100 COW UNIT 11371630
FALL CALVING / FESCUE PASTURE 08/01/79
PASTURE CHARGE INCLUDED NORTHEAST

LINE	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	10 OCT	11 NOV	12 DEC	13 PRICE	14 WEIGHT	15 UNIT CODE	16 ITEM CODE	17 TYPE	18 CONT
PRODUCTION					NUMBER OF UNITS													
1 STR CALVE3-5 CH	0.0	0.0	0.0	0.0	0.0	0.0	0.45	0.0	0.0	0.0	0.0	0.0	-1.000	4.750	16.	13.	2.	0.
2 HFR CALVE3-5 CH	0.0	0.0	0.0	0.0	0.0	0.0	0.33	0.0	0.0	0.0	0.0	0.0	-1.000	4.450	16.	12.	2.	0.
3 COWS-COMMERCIAL	0.0	0.02	0.0	0.0	0.0	0.01	0.0	0.04	0.0	0.0	0.0	0.0	-1.000	9.500	16.	18.	2.	0.

OPERATING INPUTS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	PRICE	NUMBER UNITS	UNIT CODE	ITEM CODE	TYPE	CONT
					RATE/UNIT													
11 41-45% PRO. SUP.	0.0	30.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.00	0.0	-1.000	1.120	12.	115.	3.	0.
13 BERMUDA HAY	0.03	0.03	0.02	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.02	0.03	-1.000	1.120	3.	85.	3.	0.
14 PASTURE	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	10.000	1.120	10.	150.	3.	0.
15 SALT & MIN.	10.00	0.0	0.0	4.00	0.0	0.0	10.00	0.0	0.0	0.0	0.0	0.0	-1.000	1.120	12.	103.	3.	0.
16 VET & MED.	0.0	0.25	0.0	0.0	0.0	0.0	0.50	0.0	0.0	0.0	0.25	0.0	5.000	1.000	15.	416.	3.	0.
17 HAULING & MKTG.	0.0	0.25	0.0	0.0	0.0	0.0	0.50	0.0	0.0	0.25	0.0	0.0	5.000	1.000	1.	485.	3.	0.
18 PERSONAL TAXES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	1.000	1.030	1.	442.	3.	0.
19 SUPPLIES & UTLI	0.0	0.0	0.25	0.0	0.0	0.25	0.0	0.0	0.25	0.0	0.0	0.25	3.250	1.000	1.	417.	3.	0.

MACHINERY REQUIREMENTS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	XXXXX	XXXXX	POWER UNIT	MACH CODE	TYPE	CONT
						HOURS												
26 PICKUP	0.15	0.15	0.15	0.20	0.10	0.10	0.20	0.10	0.10	0.15	0.20	0.20	0.0	0.0	0.	11.	4.	0.
27 STOCK TRAILER	0.0	0.05	0.0	0.05	0.0	0.0	0.10	0.0	0.0	0.05	0.0	0.0	0.0	0.0	11.	99.	4.	0.

EQUIPMENT REQUIREMENTS	NUMBER UNITS	PROPORT OF COST	XXX	EQUIP CODE	TYPE	XXXX
38 4-WIRE FENCE	5.000	0.010	0.	1.	5.	0.
39 LOT FENCE	160.000	0.010	0.	2.	5.	0.
LIVESTOCK INVESTMENT						
40 BEEF COW	1.000	1.000	0.	51.	5.	0.
41 BEEF BULL	0.040	1.000	0.	53.	5.	0.
42 BEEF HEIFER	0.120	1.000	0.	52.	5.	0.

49 LIVESTOCK LABOR 0.50 0.50 0.50 0.40 0.40 0.40 0.80 0.40 0.40 0.50 0.50 0.50

MONTHLY SUMMARY OF RECEIPTS AND EXPENDITURES

CATEGORY	YEAR UNIT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
TOTAL RECEIPTS	1 DOL.	0.0	11.21	0.0	0.0	0.0	16.81	363.96	22.42	0.0	0.0	0.0	0.0	414.39
TOTAL VARIABLE COST	1 DOL.	14.37	20.17	13.87	12.73	11.85	12.66	18.40	11.85	12.66	13.48	18.33	17.65	177.98
ANNUAL CAPITAL	1 DOL.	6.37	7.12	8.29	9.34	10.32	9.99	0.0	0.0	1.05	2.18	3.71	5.18	63.52
LABOR REQUIREMENTS														
MACHINERY LABOR	1 HOUR	0.18	0.24	0.18	0.30	0.12	0.12	0.36	0.12	0.12	0.24	0.24	0.24	2.46
LIVESTOCK LABOR	1 HOUR	0.50	0.50	0.50	0.40	0.40	0.40	0.80	0.40	0.40	0.50	0.50	0.50	5.80
EQUIPMENT LABOR	1 HOUR	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.53
TOTAL LABOR	1 HOUR	0.72	0.78	0.72	0.74	0.56	0.56	1.20	0.56	0.56	0.78	0.78	0.78	8.79
MACHINERY REQUIREMENTS BY MONTH														
PICKUP	HOUR	0.15	0.20	0.15	0.25	0.10	0.10	0.30	0.10	0.10	0.20	0.20	0.20	2.05
STOCK TRAILER	1 0.21HOUR	0.0	0.05	0.0	0.05	0.0	0.0	0.10	0.0	0.0	0.05	0.0	0.0	0.25

MONTHLY EQUIPMENT REQUIREMENTS AS A PROPORTION OF THE ITEMS WHOLE FARM USE

	NO.														
4-WIRE FENCE	5.0	1 MILE	0.0038	0.0008	0.0008	0.0008	0.0004	0.0008	0.0008	0.0008	0.0004	0.0004	0.0008	0.0018	0.0100
LOT FENCE	****	1 FEET	0.0033	0.0008	0.0008	0.0008	0.0008	0.0008	0.0004	0.0008	0.0004	0.0008	0.0008	0.0008	0.0100
BEEF COW	1.0	1 CWT.	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	1.0000
BEEF BULL	0.0	1 CWT.	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	1.0000
BEEF HEIFER	0.1	1 CWT.	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	0.0833	1.0000

THE FINAL ENTRY IN EACH ROW REPRESENTS THE PROPORTION OF THE ITEMS TIME ALLOCATED TO THE BUDGET UNIT

MACHINERY FIXED AND VARIABLE COST PER HOUR

MACHINE	CODE	DEPR.	INSUR.	TAX	TOTAL FIXED	REPAIR	FUEL	LUB.	TOTAL VARIABLE	INT.	HR/TIME
PICKUP	11	1.20	0.05	0.13	1.38	1.13	1.83	0.27	3.20	0.90	1.00
STOCK TRAILER	99	1.91	0.09	0.24	2.24	1.30	0.0	0.0	1.30	1.65	1.00

ANNUAL COST SUMMARY FOR EQUIPMENT AND LIVESTOCK

LINE NO.	ITEM	SIZE	UNIT	LIST PRICE	DEPREC-IATION	INTEREST	INSUR-ANCE	TAXES	REPAIRS	FUEL AND LUBE	HOURS LABOR	TOT OWN-ERSHIP/YR	TOT OPER-ATING/YR
1	4-WIRE FENCE	1.00	MILE	2500.00	100.00	137.50	7.50	12.50	25.00	0.0	1.00	120.00	25.00
2	LOT FENCE	100.00	FEET	100.00	8.33	5.50	0.30	0.50	1.67	0.0	0.30	9.13	1.67
51	BEEF COW	9.50	CWT.	425.00	0.0	46.75	0.0	0.0	0.0	0.0	0.0	0.0	0.0
53	BEEF BULL	16.00	CWT.	950.00	0.0	104.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	BEEF HEIFER	8.00	CWT.	275.00	0.0	30.25	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ANNUAL CHARGES MADE IN THIS BUDGET FOR EQUIPMENT AND LIVESTOCK

LINE NO.	ITEM	SIZE	UNIT	NUMBER ITEMS	PROPOR. CHARGED	OWNERSHIP CHARGES	OPERATING CHARGES	INTEREST CHARGES	LABOR HOURS CHARGED
1	4-WIRE FENCE	1.00	MILE	5.00	0.01	6.33	1.25	6.87	0.05
2	LOT FENCE	100.00	FEET	160.00	0.01	14.61	2.67	8.80	0.48
51	BEEF COW	9.50	CWT.	1.00	1.00	0.0	0.0	46.75	0.0
53	BEEF BULL	16.00	CWT.	0.04	1.00	0.0	0.0	4.18	0.0
52	BEEF HEIFER	8.00	CWT.	0.12	1.00	0.0	0.0	3.63	0.0

COLUMN NAME OF MACHINE	1 CODE	2 WIDTH (FEET)	3 INITIAL LIST PRICE	4 SPEED (MPH)	5 FIELD EFFIC-ENCY	6 RC1	7 RC2	8 RC3	9 HOURS USED ANNUALLY	10 YEARS OWNED	11 RFV1	12 RFV2	13 PURCHASE PRICE	14 FUEL TYPE	15 HOURS OF LIFE	16 HP
PICKUP	11.	0.5	7500.	20.0	0.85	0.63	0.001585	1.40	500.	8.0	0.600	0.885	6502.	1.	4000.	1.
STOCK TRAILER	99.	16.0	2600.	20.0	0.70	0.53	0.002510	1.30	100.	10.0	0.635	0.895	2450.	0.	1000.	0.

COLUMN--- ITEM NAME	1 CODE	2 SIZE	3 UNIT	4 TYPE	5 LIST PRICE	6 PURCHASE PRICE	7 YEARS LIFE	8 SALVAGE PROP OF LIST	9 REPAIR PROP OF LIST	10 FUEL & LUB AS PROP	11 ANNUAL HOURS LABOR
4-WIRE FENCE	1.	1.00	18.	2.00	2500.00	2500.00	25.00	0.0	0.250	0.0	1.00
LOT FENCE	2.	100.00	19.	2.00	100.00	100.00	12.00	0.0	0.200	0.0	0.30
BEEF COW	51.	9.50	16.	1.00	425.00	425.00	5.00	1.000	0.0	0.0	0.0
BEEF HEIFER	52.	8.00	16.	1.00	275.00	275.00	6.00	1.000	0.0	0.0	0.0
BEEF BULL	53.	16.00	16.	1.00	950.00	950.00	6.00	1.000	0.0	0.0	0.0

FERTILIZED BERMUDA & FESCUE PASTURE UTILIZED HUDGINS,SELK MACHINERY COMPLEMENT 13
80-40-40 ACTUAL NUTRIENTS APPLIED EQUIPMENT COMPLEMENT 13
3 ACRES PER COW AT $15.00 PER ACRE - RENTAL RATE 06/08/79 0010000300 PRICE VECTOR 3

LAND A

NATIVE GRASS PASTURE
DEFERRED GRAZING, GOOD TO EXCELLENT RANGE CONDITIONS

85300006
01/10/79
NORTHEAST

CATEGORY	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
PRODUCTION:					
PASTURE, SUMMER	AUMS	0.0	1.210	0.0	0.0
TOTAL RECEIPTS				0.0	0.0
OPERATING INPUTS:					
2-4-D	LBS.	3.500	0.330	1.15	1.15
TOTAL OPERATING COST				1.15	1.15
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-1.15	-1.15
CAPITAL COST:					
ANNUAL OPERATING CAPITAL		0.100	0.289	0.03	
TRACTOR INVESTMENT		0.100	0.0	0.0	
EQUIPMENT INVESTMENT		0.100	0.0	0.0	
TOTAL INTEREST CHARGE				0.03	
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-1.18	
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)					
TRACTOR	HR.			0.0	
EQUIPMENT	HR.			0.0	
TOTAL OWNERSHIP COST				0.0	
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-1.18	
LABOR COST:					
MACHINERY LABOR	HR.	3.000	0.0	0.0	0.0
TOTAL LABOR COST			0.0	0.0	0.0
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-1.18	-1.15
LAND CHARGE OR RENT:					
LAND INVESTMENT	ACRE	0.0	0.0	0.0	
LAND TAXES	ACRE			0.0	
TOTAL LAND CHARGE				0.0	
RETURNS TO OVERHEAD, RISK AND MANAGEMENT				-1.18	

GRAZING DEFERRED UNTIL JULY, BERMUDA UTILIZED IN SPRING
3/4 LB. 2,4-D APPLIED EVERY THIRD YEAR

HODGINS,ROMMANN

12/20/78   0010000000

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PROGRAM DEVELOPED BY DEPT. OF. AGRI. ECON. OKLAHOMA STATE UNIVERSITY

LAND A

BUDGET IDENTIFICATION NUMBER 853000000130153 | ANNUAL CAPITAL MONTH 7 | BUDGET RECORD NUMBER 127
BUDGET FILE 1

NATIVE GRASS PASTURE
DEFERRED GRAZING, GOOD TO EXCELLENT RANGE CONDITIONS

85300006
01/10/79
NORTHEAST

LINE	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	10 OCT	11 NOV	12 DEC	13 PRICE	14 WEIGHT	15 UNIT CODE	16 ITEM CODE	17 TYPE	18 CONT
PRODUCTION					NUMBER OF UNITS													
1 PASTURE, SUMMER	0.10	0.10	0.10	0.0	0.0	0.0	0.30	0.30	0.15	0.0	0.0	0.16	0.0	0.0	10.	150.	2.	0.
OPERATING INPUTS					RATE/UNIT								PRICE	NUMBER UNITS	UNIT CODE	ITEM CODE	TYPE	CONT
11 2-4-D	0.0	0.0	0.0	0.33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.500	0.0	12.	251.	3.	0.
MACHINERY REQUIREMENTS					TIMES OVER								XXXXX	XXXXX	POWER UNIT	MACH CODE	TYPE	CONT

MONTHLY SUMMARY OF RECEIPTS AND EXPENSES

CATEGORY	UNIT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
TOTAL RECEIPTS	ACRE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL EXPENSES	ACRE	0.0	0.0	0.0	1.15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.15
RETURNS TO LAND, LABOR, CAPITAL, MACHINERY, OVERHEAD, RISK, AND MANAGEMENT														-1.15
ANNUAL CAPITAL	DOL.	0.0	0.0	0.0	0.10	0.10	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.29
LABOR REQUIREMENTS BY MONTH														
MACHINERY LABOR	HR.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

MACHINERY FIXED AND VARIABLE COSTS PER HOUR

MACHINE	CODE	DEPR	INSUR.	TAX	TOTAL FIXED	REPAIR	FUEL	LUB.	TOTAL VARIABLE	INT.	HR/TIME

OPERATION	ITEM NO.	DATE	TIMES OVER	LABOR HOURS	MACHINE HOURS	FUEL,OIL,LUB., REPAIR PER ACRE	FIXED COSTS PER ACRE
TOTAL				0.0	0.0	0.0	0.0

COLUMN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
NAME OF MACHINE	CODE	WIDTH (FEET)	INITIAL LIST PRICE	SPEED (MPH)	FIELD EFFIC-IENCY	RC1	RC2	RC3	HOURS USED ANNUALLY	YEARS OWNED	RFV1	RFV2	PURCHASE PRICE	FUEL TYPE	HOURS OF LIFE	HP

GRAZING DEFERRED UNTIL JULY, BERMUDA UTILIZED IN SPRING | HUDGINS,BOSMANN | MACHINERY COMPLEMENT 13
3/4 LB. 2,4-D APPLIED EVERY THIRD YEAR | | EQUIPMENT COMPLEMENT 13
12/20/78 | 0010000000 | PRICE VECTOR 3

BREAKEVEN PRICES
IF 1.21 AUMS PASTURE, SUMMER ARE PRODUCED:

TO COVER VARIABLE INPUTS	0.955
TO COVER VARIABLE INPUTS AND INTEREST	0.978
TO COVER VARIABLE INPUTS AND LABOR	0.955
TO COVER VARIABLE INPUTS INTEREST AND LABOR	0.978
TO COVER ALL COSTS EXCEPT LAND OVERHEAD RISK AND MANAGEMENT	0.978

LAND B (LAND D)

FESCUE & BERMUDA COMBINATION HAY & PASTURE — 84150002
CUSTOM HARVEST — 01/10/79
NORTHEAST

CATEGORY	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
PRODUCTION:					
HAY	TONS	35.000	0.500	17.50	0.0
GRAZING	AUMS	0.0	7.900	0.0	0.0
TOTAL RECEIPTS				17.50	0.0
OPERATING INPUTS:					
NITROGEN (N)	LBS.	0.170	160.000	27.20	27.20
PHOSPH (P2O5)	LBS.	0.140	40.000	5.60	5.60
POTASH (K2O)	LBS.	0.070	40.000	2.80	2.80
1/10 ESTB CHG	ACRE	10.000	1.000	10.00	0.0
SWATHE & BALE	TONS	12.750	0.500	6.38	6.38
TRACTOR FUEL & LUBE	ACRE			0.57	0.57
TRACTOR REPAIR COST	ACRE			0.32	0.32
TOTAL OPERATING COST				52.87	42.87
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-35.37	-42.87
CAPITAL COST:					
ANNUAL OPERATING CAPITAL		0.100	16.896	1.69	
TRACTOR INVESTMENT		0.100	4.144	0.41	
EQUIPMENT INVESTMENT		0.100	0.0	0.0	
TOTAL INTEREST CHARGE				2.10	
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-37.47	
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)					
TRACTOR	HR.			0.48	0.48
EQUIPMENT	HR.			0.0	0.0
TOTAL OWNERSHIP COST				0.48	0.48
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-37.95	-43.35
LABOR COST:					
MACHINERY LABOR	HR.	3.000	0.450	1.35	
TOTAL LABOR COST			0.450	1.35	
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-39.30	
LAND CHARGE OR RENT:					
LAND INVESTMENT	ACRE	0.0	0.0	0.0	
LAND TAXES	ACRE			0.0	
TOTAL LAND CHARGE				0.0	
RETURNS TO OVERHEAD, RISK AND MANAGEMENT				-39.30	

ESTABLISHMENT COST PRORATED OVER 10 YEARS — HUGGINS,ROHMANN

12/20/78 0010000000

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PROGRAM DEVELOPED BY DEPT. OF. AGRI. ECON. OKLAHOMA STATE UNIVERSITY

LAND B (LAND D)

BUDGET IDENTIFICATION NUMBER 043900020130311 ANNUAL CAPITAL MONTH 8 BUDGET RECORD NUMBER 78
BUDGET FILE 1

FESCUE & BERMUDA COMBINATION HAY & PASTURE 04350002
CUSTOM HARVEST 01/10/78
NORTHEAST

LINE	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	10 OCT	11 NOV	12 DEC	13 PRICE	14 WEIGHT	15 UNIT CODE	16 ITEM CODE	17 TYPE	18 CONT
PRODUCTION					NUMBER OF UNITS													
1 HAY	0.0	0.0	0.0	0.0	0.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.000	0.0	3.	80.	2.	0.
2 GRAZING	0.20	0.20	0.50	1.00	1.00	1.00	0.75	0.75	1.00	0.80	0.50	0.20	-1.000	0.0	10.	89.	2.	0.
OPERATING INPUTS					RATE/UNIT								PRICE	NUMBER UNITS	UNIT CODE	ITEM CODE	TYPE	CONT
11 NITROGEN (N)	0.0	40.00	0.0	0.0	40.00	0.0	40.00	0.0	40.00	0.0	0.0	0.0	-1.000	0.0	12.	211.	3.	0.
12 PHOSPH (P2O5)	0.0	0.0	0.0	0.0	40.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.000	0.0	12.	214.	3.	0.
13 POTASH (K2O)	0.0	0.0	0.0	0.0	40.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.000	0.0	12.	216.	3.	0.
15 1/10 ESTB CHG	1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.000	0.0	7.	417.	3.	0.
18 SWATHE & BALE	0.0	0.0	0.0	0.0	0.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.000	0.0	3.	309.	3.	0.
MACHINERY REQUIREMENTS					TIMES OVER								XXXXX	XXXXX	POWER UNIT	MACH CODE	TYPE	CONT
38 DRY FERT SPREAD	0.0	1.00	0.0	0.0	1.00	0.0	1.00	0.0	1.00	0.0	0.0	0.0	0.0	0.0	2.	71.	4.	0.

MONTHLY SUMMARY OF RECEIPTS AND EXPENSES

CATEGORY	UNIT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
TOTAL RECEIPTS	ACRE	0.0	0.0	0.0	0.0	17.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.50
TOTAL EXPENSES	ACRE	10.00	7.70	0.0	0.0	22.67	0.0	7.70	0.0	7.70	0.0	0.0	0.0	52.87
RETURNS TO LAND, LABOR, CAPITAL, MACHINERY, OVERHEAD, RISK, AND MANAGEMENT														-35.37
ANNUAL CAPITAL	DOL.	2.12	2.76	2.76	2.76	0.0	0.0	0.64	0.64	1.28	1.28	1.28	1.28	16.81

LABOR REQUIREMENTS BY MONTH

MACHINERY LABOR	HR.	0.0	0.11	0.0	0.0	0.11	0.0	0.11	0.0	0.11	0.0	0.0	0.0	0.45

MACHINERY FIXED AND VARIABLE COSTS PER HOUR

MACHINE	CODE	DEPR	INSUR.	TAX	TOTAL FIXED	REPAIR	FUEL	LUB.	TOTAL VARIABLE	INT.	HR/TIME
TRACTOR(2)	2	0.97	0.04	0.15	1.16	0.79	1.21	0.18	2.19	1.01	1.09
DRY FERT SPREAD	71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.09

OPERATION	ITEM NO.	DATE	TIMES OVER	LABOR HOURS	MACHINE HOURS	FUEL,OIL,LUB., REPAIR PER ACRE	FIXED COSTS PER ACRE
DRY FERT SPREAD	2,71	JUL	1.00	0.112	0.093	0.22	0.22
DRY FERT SPREAD	2,71	SEP	1.00	0.112	0.093	0.22	0.22
DRY FERT SPREAD	2,71	FEB	1.00	0.112	0.093	0.22	0.22
DRY FERT SPREAD	2,71	MAY	1.00	0.112	0.093	0.22	0.22
TOTAL				0.450	0.372	0.90	0.90

COLUMN NAME OF MACHINE	1 CODE	2 WIDTH (FEET)	3 INITIAL LIST PRICE	4 SPEED (MPH)	5 FIELD EFFIC-IENCY	6 RC1	7 RC2	8 RC3	9 HOURS USED ANNUALLY	10 YEARS OWNED	11 RFV1	12 RFV2	13 PURCHASE PRICE	14 FUEL TYPE	15 HOURS OF LIFE	16 HP
TRACTOR(2)	2.	50.0	10700.	4.5	0.66	1.35	0.000631	1.60	600.	10.0	0.680	0.920	9000.	3.	12000.	5*
DRY FERT SPREAD	71.	25.0	0.	5.3	0.67	0.0	0.0	0.0	50.	10.0	0.0	0.0	0.	0.	1000.	0.

ESTABLISHMENT COST PRORATED OVER 10 YEARS HUDGINS,NORMAN MACHINERY COMPLEMENT 13
EQUIPMENT COMPLEMENT 13
12/20/78 0010000000 PRICE VECTOR 3

BREAKEVEN PRICES
IF 0.50 TONS HAY ARE PRODUCED:

TO COVER VARIABLE INPUTS	105.741
TO COVER VARIABLE INPUTS AND INTEREST	109.911
TO COVER VARIABLE INPUTS AND LABOR	108.440
TO COVER VARIABLE INPUTS INTEREST AND LABOR	112.610
TO COVER ALL COSTS EXCEPT LAND OVERHEAD RISK AND MANAGEMENT	113.599

LAND C

FESCUE & BERMUDA COMBINATION HAY & PASTURE 84350002
CUSTOM HARVEST 01/10/79
NORTHEAST

CATEGORY	UNITS	PRICE	QUANTITY	VALUE	YOUR VALUE
PRODUCTION:					
HAY	TONS	35.000	0.28	9.80	0.0
GRAZING	AUMS	0.0	4.41	0.0	0.0
TOTAL RECEIPTS				9.80	0.0
OPERATING INPUTS:					
NITROGEN (N)	LBS.	0.170	160.000	27.20	27.20
PHOSPH (P2O5)	LBS.	0.140	40.000	5.60	5.60
POTASH (K2O)	LBS.	0.070	40.000	2.80	2.80
1/10 ESTB CHG	ACRE	10.000	1.000	10.00	0.0
SWATHE & BALE	TONS	12.750	0.500	6.38	6.38
TRACTOR FUEL & LUBE	ACRE			0.57	0.57
TRACTOR REPAIR COST	ACRE			0.32	0.32
TOTAL OPERATING COST				52.47	42.82
RETURNS TO LAND,LABOR,CAPITAL,MACHINERY, OVERHEAD,RISK,AND MANAGEMENT				-35.37	-42.82
CAPITAL COST:					
ANNUAL OPERATING CAPITAL		0.100	16.806	1.68	
TRACTOR INVESTMENT		0.100	4.144	0.41	
EQUIPMENT INVESTMENT		0.100	0.0	0.0	
TOTAL INTEREST CHARGE				2.10	
RETURNS TO LAND, LABOR, MACHINERY, OVERHEAD, RISK AND MANAGEMENT				-37.47	
OWNERSHIP COST: (DEPRECIATION, TAXES, INSURANCE)					
TRACTOR	HR.			0.48	0.48
EQUIPMENT	HR.			0.0	0.0
TOTAL OWNERSHIP COST				0.48	0.48
RETURNS TO LAND, LABOR, OVERHEAD, RISK AND MANAGEMENT				-37.95	-43.35
LABOR COST:					
MACHINERY LABOR	HR.	3.000	0.450	1.35	
TOTAL LABOR COST			0.450	1.35	
RETURNS TO LAND, OVERHEAD, RISK AND MANAGEMENT				-39.30	
LAND CHARGE OR RENT:					
LAND INVESTMENT	ACRE	0.0	0.0	0.0	
LAND TAXES	ACRE			0.0	
TOTAL LAND CHARGE				0.0	
RETURNS TO OVERHEAD, RISK AND MANAGEMENT				-39.30	

ESTABLISHMENT COST PRORATED OVER 10 YEARS HUDGINS,ROHMANN

12/20/78 0010000000

PROCESSED BY DEPT. OF AGRI. ECON. - OKLAHOMA STATE UNIVERSITY
PROGRAM DEVELOPED BY DEPT. OF. AGRI. ECON. OKLAHOMA STATE UNIVERSITY

LAND C

BUDGET IDENTIFICATION NUMBER 04350002013031? ANNUAL CAPITAL MONTH 5 BUDGET RECORD NUMBER 58
BUDGET FILE 1

FESCUE & BERMUDA COMBINATION HAY & PASTURE
CUSTOM HARVEST

04350002
01/10/79
NORTHEAST

LINE	1 JAN	2 FEB	3 MAR	4 APR	5 MAY	6 JUN	7 JUL	8 AUG	9 SEP	10 OCT	11 NOV	12 DEC	13 PRICE	14 WEIGHT	15 UNIT CODE	16 ITEM CODE	17 TYPE	18 CONT
PRODUCTION					NUMBER OF UNITS													
1 HAY	0.0	0.0	0.0	0.0	0.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.000	0.0	3.	80.	2.	0.
2 GRAZING	0.20	0.20	0.50	1.00	1.00	1.00	0.75	0.75	1.00	0.80	0.50	0.20	-1.000	0.0	10.	89.	2.	0.
OPERATING INPUTS					RATE/UNIT								PRICE	NUMBER UNITS	UNIT CODE	ITEM CODE	TYPE	CONT
11 NITROGEN (N)	0.0	40.00	0.0	0.0	40.00	0.0	40.00	0.0	40.00	0.0	0.0	0.0	-1.000	0.0	12.	211.	3.	0.
12 PHOSPH (P2O5)	0.0	0.0	0.0	0.0	40.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.000	0.0	12.	214.	3.	0.
13 POTASH (K2O)	0.0	0.0	0.0	0.0	40.30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.000	0.0	12.	216.	3.	0.
15 1/10 ESTB CHG	1.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.000	0.0	7.	417.	3.	0.
16 SWATHE & BALE	0.0	0.0	0.0	0.0	0.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.000	0.0	3.	309.	3.	0.
MACHINERY REQUIREMENTS						TIMES OVER							XXXXX	XXXXX	POWER UNIT	MACH CODE	TYPE	CONT
38 DRY FERT SPREAD	0.0	1.00	0.0	0.0	1.00	0.0	1.00	0.0	1.00	0.0	0.0	0.0	0.0	0.0	2.	71.	6.	0.

MONTHLY SUMMARY OF RECEIPTS AND EXPENSES

CATEGORY	UNIT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
TOTAL RECEIPTS	ACRE	0.0	0.0	0.0	0.0	17.50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.50
TOTAL EXPENSES	ACRE	10.00	7.70	0.0	0.0	22.47	0.0	7.70	0.0	7.70	0.0	0.0	0.0	52.87
RETURNS TO LAND, LABOR, CAPITAL, MACHINERY, OVERHEAD, RISK, AND MANAGEMENT														-35.37
ANNUAL CAPITAL	DOL.	2.12	2.76	2.76	2.76	0.0	0.0	0.64	0.64	1.20	1.20	1.20	1.20	16.01
LABOR REQUIREMENTS BY MONTH														
MACHINERY LABOR	HR.	0.0	0.11	0.0	0.0	0.11	0.0	0.11	0.0	0.11	0.0	0.0	0.0	0.45

MACHINERY FIXED AND VARIABLE COSTS PER HOUR

MACHINE	CODE	DEPR	INSUR.	TAX	TOTAL FIXED	REPAIR	FUEL	LUB.	TOTAL VARIABLE	INT.	HR/TIME
TRACTOR(2)	2	0.97	0.06	0.15	1.18	0.79	1.21	0.18	2.19	1.01	1.00
DRY FERT SPREAD	71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.09

OPERATION	ITEM NO.	DATE	TIMES OVER	LABOR HOURS	MACHINE HOURS	FUEL,OIL,LUB., REPAIR PER ACRE	FIXED COSTS PER ACRE
DRY FERT SPREAD	2,71	JUL	1.00	0.112	0.093	0.22	0.22
DRY FERT SPREAD	2,71	SEP	1.00	0.112	0.093	0.22	0.22
DRY FERT SPREAD	2,71	FEB	1.00	0.112	0.093	0.22	0.22
DRY FERT SPREAD	2,71	MAY	1.00	0.112	0.093	0.22	0.22
TOTAL				0.450	0.372	0.90	0.90

COLUMN / NAME OF MACHINE	1 CODE	2 WIDTH (FEET)	3 INITIAL LIST PRICE	4 SPEED (MPH)	5 FIELD EFFICIENCY	6 RC1	7 RC2	8 RC3	9 HOURS USED ANNUALLY	10 YEARS OWNED	11 RFV1	12 RFV2	13 PURCHASE PRICE	14 FUEL TYPE	15 HOURS OF LIFE	16 HP
TRACTOR(2)	2.	50.0	10700.	4.5	0.80	1.35	0.000631	1.60	600.	10.0	0.000	0.920	9000.	1.	12000.	95.
DRY FERT SPREAD	71.	25.0	0.	5.5	0.67	0.0	0.0	0.0	50.	10.0	0.0	0.0	0.	0.	1000.	0.

ESTABLISHMENT COST PRORATED OVER 10 YEARS HUDGINS,NORMANN MACHINERY COMPLEMENT 13
EQUIPMENT COMPLEMENT 13
12/20/78 0010000000 PRICE VECTOR 3

BREAKEVEN PRICES
IF 0.50 TONS HAY ARE PRODUCED

TO COVER VARIABLE INPUTS	105.741
TO COVER VARIABLE INPUTS AND INTEREST	109.931
TO COVER VARIABLE INPUTS AND LABOR	108.440
TO COVER VARIABLE INPUTS INTEREST AND LABOR	112.630
TO COVER ALL COSTS EXCEPT LAND OVERHEAD RISK AND MANAGEMENT	113.999

APPENDIX C

SURVEY SUMMARY--PROFESSIONALS, COAL COMPANY OPERATORS AND LOCAL GOVERNMENT OFFICIALS

TABLE XV

SUMMARY OF RESPONSES FROM THE PROFESSIONALS SURVEY ON CHANGES IN SELECTED INDICATORS FROM 1970 BASE DUE TO COAL MINING[a]

Indicators	Coal Mining Impact on Selected Indicators			
	None	Slight	Moderate	Major
Population Mix	9	10	2	0
Housing, Quantity	18	3	0	0
Housing, Quality	5	8	8	0
Roads, Quantity	5	6	10	0
Roads, Quality	2	5	6	8
Employment, Agriculture	3	18	0	0
Employment, Mining	0	5	6	10
School Enrollment	18	3	0	0
Public Services	17	4	0	0
Taxes, Real Estate	2	16	3	0
Taxes, Agriculture	20	1	0	0
Taxes, Coal Equipment	0	1	8	12
Income Distribution	0	5	15	1
Pollution, Lakes and Streams	5	4	12	0
Pollution, Dust	0	0	7	14
Pollution, Noise	6	9	6	0
Habitat, Animal	8	8	5	0
Habitat, Aquatic	8	7	6	0
Safety, Human	12	8	1	0
Safety, Wildlife	8	10	3	0
Recreation, Quantity	2	14	5	0
Recreation, Quality	3	18	0	0
Conservation, Greenspace	5	15	1	0
Conservation, Sites	18	3	0	0
Esthetic Value, Land	0	0	3	18
Trading Land	0	1	5	15
Landuse Option	0	0	2	19

[a]Changes in Indicators from the baseline period, 1970 (lull in coal activity) to 1974 (moderate coal activity) and to 1977-1979 (active coal activity).

TABLE XVI

SUMMARY OF RESULTS FROM COAL COMPANY OPERATORS SURVEY

County	No. Acres Mined	Shipping		Coal Lease Rating[a]	Reclamation	
		Method	Tons/Trip		Type	Cost/Acre
Craig	132	Road	25	Good	Complete	NA[b]
Craig	200	Road/Rail	23/75	Good	Complete	$1,000
Craig	200	Road	25	Fair	Complete	$1,000
Craig	70	Road	25	Fair	Complete	$1,000
Craig	400	Road/Rail	30/80	Fair	Complete	$700
Craig	1,500	Road/Rail	30/80	Excellent	Complete	$1,500
Rogers	68	Road	25	Fair	Complete	NA
Rogers	80	Road/Rail	20	Excellent	Complete	NA
Rogers	700	Road/Rail	23	Good	Complete	$1,000
Rogers	2,000	Road/Rail	30/80	Excellent	Complete	$1,500
Nowata	70	Road/Rail	20/70	Excellent	Complete	NA
Nowata	20	Road	20	Good	Complete	$800
Nowata	500	Road/Rail	30/80	Excellent	Complete	$1,500
Okmulgee	80	Road	25	Good	Complete	$500
Okmulgee	30	Road/Rail	20/70	Fair	Complete	$1,000
Okmulgee	200	Road	25	Excellent	Complete	$500-$1,500

[a]Rating of Coal Lease was based on individual operators responses. Excellent, indicates the lease included all essential items in writing; Good, indicates some essential items were omitted in the lease; and Fair, indicates missing items and verbal guarantees.

[b]NA means cost data were not provided.

TABLE XVII

SUMMARY OF RESPONSES FROM LOCAL GOVERNMENT OFFICIALS SURVEY ON CHANGES IN SELECTED INDICATORS FROM 1970 BASE DUE TO COAL MINING[a]

Indicators	None	Slight	Moderate	Major
Tax, Reclaimed Land	16	0	0	0
Tax, Real Estate	0	14	2	0
Tax, Agricultural Land	12	4	0	0
Tax, Coal Equipment	0	0	3	12

[a]Changes in Indicators from the baseline period, 1970 (lull in coal activity) to 1974 (moderate coal activity) and to 1977-1979 (active coal activity).

VITA

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