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Cross-Compliance Between Soil Conservation
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INSTITUTIONAL INNOVATION IN SOIL CONSERVATION POLICY: CROSS-COMPLIANCE BETWEEN SOIL CONSERVATION AND AGRICULTURAL ASSISTANCE PROGRAMS

By

Stephen John Dinehart

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ABSTRACT

INSTITUTIONAL INNOVATION IN SOIL CONSERVATION POLICY:
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AND AGRICULTURAL ASSISTANCE PROGRAMS

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Federal soil conservation programs have been criticized for their performance and lack of cost-effectiveness. Current conservation policy provides an insufficient incentive to participate in conservation programs. The property rights of agriculture can be altered to create additional incentives for conservation.

An alternative conservation policy --cross-compliance--alters the property rights of agriculture. This policy would require a farmer to participate in soil conservation programs in order to receive benefits from specified federal agricultural assistance programs.

The impacts of this policy are examined utilizing data on participation in soil conservation and agricultural assistance programs by 390 farmers between 1977 and 1979. It is concluded from these data that a cross-compliance policy should increase the participation in soil conservation programs by increasing the incentive for conservation. The cost of the policy to the federal government should be minimal; however, this policy reduces the flexibility of agricultural production control programs.

to jennifer

my friend

my love

my joy

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Chapter I

INTRODUCTION AND OVERVIEW

Agriculture is a culture. A society developes behavioral patterns for the relationship between man and the natural environment. These patterns may be formulated in response to a variety of factors. Geographical boundaries-- whether circumscribed by nature, other cultures, or ignorance-- impose limits. Limits imply physical scarcity since the land resource is finite. The land within those limits may be improved in quality, but can never increase in quantity.

The technology of a society also alters the opportunity set land has defined. A society's prime concern is the flow of goods received from that land not the physical quantity of land available. Technology changes the productivity of a fixed land base. One set of technology defines one production set for a given land base, another technology defines a different production set. Technological innovation creates flexibility in production sets, although a society remains constrained by biological and physical limits. Technology has not been a major factor in much of history. Two or three million years passed before John Deere's sodbuster was introduced. Yet over the past fifty years technology has been introduced at an increasing rate; capital substitution for land and labor has expanded production possibilities.

A society's philosophical foundations and social institutions are additional factors in defining a society's relation to the land. One who views the earth as subservient to the species will exhibit different behavior from one who considers the species as one with the earth. Furthermore, one who claims ownership to the land acts differently from one who rents or uses the land. The ties that bind one to the land again differ where the fruits of the land are shared. How the land resource and its fruits are allocated, and the view which one has of one's relationship as a species to the earth, will effect land use.

A society's primary objective in the utilization of a land resource for agriculture is the production of a particular commodity or set of commodities. The land use practices employed to meet this objective, however, may produce other less desirable products. One such less desirable product is soil erosion.

Soil Erosion

Soil erosion is an omnipresent force, but a controlled one. Vegetation blankets the soil, holding and protecting it from the ravages of erosion in the guise of wind and water. Unfortunately, soil in such a state is only marginally useful to mankind. For the productivity of the earth to be fully realized, man the agrarian must systematize nature. To improve the productivity of this natural endowment, ironically, soil must be exposed to possible destruction. Systematization removes the vegetation from the soil and exposes the resource to potential destruction through erosion.

Soil erosion's effects are both on the site of the erosion and off the site. Erosion's on-site effect is the reduction of soil productivity. Off-site effects result from eroded soil entering the water system. These effects, depending on the type of soil, may be felt in both the long and short run, or only in the long run.

Erosion reduces soil productivity by removing essential nutrients and decreasing the organic composition of a soil resource. An agricultural producer can partially compensate for this reduction of productivity by restoring lost nutrients. However, some productivity loss may not be avoidable. Langdale calculated that in one study area 5.8 bushels of corn per acre were lost for every inch of top soil loss.[1]

1. G.W.Langdale et al., "Corn Yield Reduction on Eroded Southern Piedmont Soils," Journal of Soil and Water Conservation, 34(5) (1979): pp.226-28.

Agronomists are divided as to whether soil productivity is a fixed or renewable resource. Some agronomists feel that soil may be replenished only at geological rates.[2] If this is true then for policy relevant planning periods soil resources are fixed. Conventional wisdom holds that soil is renewable. The universal soil loss equation (USLE) is designed to estimate the soil loss that can be sustained by a land unit without decreasing its productivity.[3] Erosion reduction practices are designed to limit soil loss to this threshold level, with erosion rates above this threshold considered excessive. Although the nature of soil productivity remains debatable, and resolution to this debate is vital for estimating the true cost of soil erosion, in the context of this study such a resolution is inconsequential. Rather than estimating the cost of soil erosion, this study is premised on the fact that soil conservation is a legislated goal regardless of the uncertainty surrounding the cost of erosion. When necessary, however, this study assumes that soil productivity is renewable. Conclusions which hold in the renewable case also hold in the case of a non-renewable

2. F.N.Swader, "Soil Productivity and the Future of American Agriculture," in The Future of American Agriculture as a Strategic Resource, ed. Sandra Batie and Robert Healy, (Washington,D.C.:Conservation Foundation,1980), p.1.

3. The Universal Soil Loss Equation estimates the average rate of soil loss on a particular parcel by integrating management practices (contour farming, minimum tillage, etc.) with the parcel's physical characteristics (rainfall, slope length, grade, etc.).

resource.

The off-site effects of soil erosion result from eroded soil entering the water system. A variety of problems arise off-site as a result of this soil transport. Nutrients and organic material transported by soil erosion enhance entrophication. Pesticides harm aquatic life and terrestrial life which feed on these aquatic forms. Sediment increases water turbidity and fills navigation channels, thereby increasing costs for water users. These off-site effects impose major costs and should not be ignored in erosion studies. Nevertheless, since soil conservation policies have traditionally concentrated on on-site effects, this study narrows its focus to erosion and soil productivity.

Erosion is a ubiquitous phenomenon. A recent report estimated that sheet and rill erosion averages 4.8 tons per cropland acre annually in the United States. Soil loss ranges from one ton per acre in the western United States to 40.6 tons in the Caribbean area. Over one third of the nation's cropland had excessive erosion in 1977.[4] The problem of erosion arises not from the loss of means, that is, productivity; but from the loss of ends, that is, agricultural production. This loss is exacerbated by an increasing world population and its need for food.

4. United States Department of Agriculture, Soil and Water Resources Conservation Act, Program Report, 1980, Draft Review, (Washington,D.C.: Department of Agriculture, 1980).

Conservation

One solution to the erosion problem lies in conservation of the resource. Various definitions of conservation exist. Scott defines conservation as "public policy which seeks to increase future supplies of a natural resource by present action."[5] Ciriacy-Wantrup sees conservation as a change in intertemporal use, a redistribution of use to the future.[6] Timmons defined conservation without explicit recognition of its intertemporal nature. Conservation is "an investment in (1) – maintaining productive potential, (2) – decreasing the productivity deterioration or (3) – enhancing the productivity potential."[7] Implicit in the above definitions is the assumption that soil productivity has value and as such should not be wasted. In this light, the goal of conservation is to achieve the maximum economic yield from a soil productivity resource. This goal, however, is to be evaluated across all prospective uses of the resource, both those in the present, as well as, those in the future.

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5. Anthony Scott, Natural Resources, the Economics of Conservation, (Toronto: Canadian Publishers, 1973), p.26.

6. S.V.Ciriacy-Wantrup, Resource Conservation, Economics and Policies, (Berkeley: University of California Press, 1952), p.51.

7. Committee on Soil and Water Conservation of the Agricultural Board, "Principles of Resource Conservation Policy," Readings in Natural Resource Economics, (New York: MSS Information Corporation, 1961), p.113.

Conservation is implemented through the adoption of appropriate management practices by land users. Soil conservation policy attempts to provide incentives for this adoption.

Soil Conservation Policy in the United States

Federal soil conservation policy dates from the 1930's. This policy was formulated with the explicit goal of conservation; however, a variety of other goals were also served. For example, the Civilian Conservation Corps provided needed employment and some conservation programs provided a control mechanism for agricultural production. The oldest conservation institution is the Soil Conservation Service (SCS). SCS was instituted by the Soil Conservation Act of 1935 as an expansion of the Soil Erosion Service. This agency provides technical expertise to farmers for conservation efforts. SCS and its clientele have become closely associated through the Soil and Water Conservation Districts (SWCD). The SWCD's are local entities of state government which encourage implementation of federal conservation policies at the county level. SCS and its clientele constitute the oldest political base for the conservation movement in the United States.

Federal conservation policy in the United States has evolved over the last 45 years into over 35 programs administered by various agencies in the United States

Department of Agriculture. This policy was designed to provide financial incentives and technical assistance to landowners, who volunteer to participate in conservation programs. In 1977 Congress mandated a re-examination of this policy.

The Soil And Water Resource Conservation Act

The Soil and Water Resource Conservation Act of 1977 (RCA) was designed to improve the national soil and water conservation program. The act originated in the desire of conservation interests to increase public awareness of conservation, to provide greater coordination among federal conservation programs, and to provide for a larger congressional role in conservation policy. The National Association of Conservation Districts (NACD) provided major input into the writing of the bill. Simultaneously, conservation programs came under increasing scrunity for their apparent lack of cost effectiveness. Both Congress and the Office of Management and the Budget in Washington, D.C. pressed their demands for greater evidence of the payoff from conservation investments.[8] For example, in 1977 the General Accounting Office (GAO)

8. Lawrence Libby and John Okay,"National Soil and Water Conservation Policy: An Economic Perspective," Journal of the Northeastern Agricultural Economics Council, VIII(2) (1979): pp. 313-323.

released a study which concluded that SCS and the Agricultural Stabilization and Conservation Service (ASCS) were "not as effective as they could be in establishing enduring soil conservation practices and reducing erosion to tolerable levels."[9] Subsequent to this study, a requirement for cost-benefit evaluations of conservation practices was integrated into RCA.

RCA is to provide institutional momentum to the conservation program. The self examination and Congressional oversight it provides are attempt to free the program from the doldrums of the preceding decade.

RCA's implementation calls for three major activities:

1) A continuing appraisal of the soil and water resource base of the United States is to be made. A physical description of the qualities, quantities, capabilities and limitations of this base is to be undertaken. Data on the costs and benefits of conservation, and on institutions and trends relating to the use and development of soil and water resources, are to be collected. The appraisal is to identify areas of concern and the role of government in conservation. The appraisal is to be conducted every five years.

2) A national soil and water conservation

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9. United States General Accounting Office, <u>To Protect Tomorrow's Food Supply Soil Conservation Needs Priority Attention</u>, (Washington, D.C.: United States Government Printing Office, 1977).

program is to be established setting forth direction for conservation efforts based on the above appraisal. The program is to analyze our resource problems and evaluate the effectiveness of existing conservation programs. Alternative methods of conservation are to be identified and evaluated. Recommendations are to be made on the preferred alternatives. The program plan is to be updated every five years.

3) Congress is to receive the appraisal and a detailed policy statement regarding soil and water conservation. Starting in September 1982, an annual report, expressing the extent to which programs and policies projected in the budget meet the statement of policy, is to be submitted by the President to Congress.

Study Objectives

Current soil conservation programs, as formulated by the federal government, are criticized by some as inadequate to address the soil erosion in the United States which is considered to be occurring at excessive rates. Furthermore, the current returns from these soil conservation programs are perceived as too small relative to their cost.

In recognition of the need for continuing evaluation of the soil conservation programs, Congress mandated in RCA, "identification and evaluation of alternative methods for the conservation, protection, environmental improvement and enhancement of soil and water resources."[10] In response, the RCA Program Report, 1980 Draft Review, proposed seven alternative strategies for conservation program development.[11] One of the more controversial of these proposals was a proposal to increase the effectiveness of federal soil conservation programs by requiring cross-compliance among USDA programs. Specifically, this program alternative would require an agricultural producer to participate in soil conservation programs in order to participate in federal agricultural assistance programs.

This policy proposal has drawn considerable debate on its probable effectiveness and costs. Little analysis, however, has been conducted as to how effective such a program might be in practice. Such analyses are necessary, if policymakers are to evaluate this alternative. This study is an attempt to evaluate the impacts of instituting a cross-compliance program between soil conservation and agricultural assistance programs in order to bring more focus into the debate.

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10. United States Congress, Public Law 95-192, (Washington,D.C.:1977).

11. United States Department of Agriculture, Soil and Water Resources Conservation Act, Program Report, 1980, Draft Review, (Washington, D.C.: Department of Agriculture, 1980).

The studies major objectives are:

1) An evaluation of the impact of a cross-compliance policy on the soil erosion problem.

2) An evaluation of the distributive impacts of such a policy.

Overview of the Thesis

Soil conservation practices appear to be uneconomic in the context of the neo-classical economic paradigm. It may be economic, under the assumptions of price theory, to mine a parcel of land until its soil's productivity is depleted. Apparently, given current conservation performance and as supported by price theory, the incentives for conservation are insufficient to elicit appropriate levels of conservation. In order to change these incentives, the institutional structure of the agriculture must be altered. By altering this structure, the incentives for conservation or the disincentives for erosion can be increased.
A cross-compliance policy may provide a vehicle for such a change.

Chapter Two examines the relationship between land in the transition of agriculture and the cost of soil erosion. The economics of soil conservation in the context of price theory are discussed. Finally, problems which provide a basis for criticizing soil conservation as uneconomic are explored.

Chapter Three examines soil erosion from an institutional perspective. It looks at the institutional foundations for soil erosion and policy response.

Chapter Four examines institutional innovation in soil conservation. It discusses the incentives for and the methods of alternative conservation policies. An overview of previous soil conservation studies is presented. Finally, the design of a cross-compliance policy is suggested.

Chapter Five discusses this study's empirical evaluation of a cross-compliance policy. The study's methodology is presented and an analysis of the study's results is given.

Chapter Six presents the study's summary and conclusions.

Chapter II

SOIL CONSERVATION AND PRICE THEORY

Economics is generally defined as a science concerned with the allocation of scarce resources. In particular, price theory, as defined by the neo-classical economic paradigm, states that if individuals are permitted to maximize their welfare in a structure of competitive markets, resource allocation will be efficient. Efficient resource allocation means that the welfare of any one individual cannot be improved without a reduction in welfare for one or more other individuals. Within the analytic construct of neo-classicism, individual economic actors are viewed as profit maximizers. The actor's preference set and the institutional environment are considered exogenous to the system. Given this paradigm, soil resources should be allocated efficiently when agricultural producers exhibit profit maximizing behavior. Any soil erosion which occurs at this point cannot be considered uneconomic.

This chapter examines soil erosion in the context of neoclassical price theory. The chapter discusses the relationship of land to agriculture in agriculture's transition from the 1850 to today. The costs of soil erosion are explored as well as the neo-classical paradigm's approach to soil conservation. Finally, criticisms of that approach are discussed to explain why soil conservation seems to be uneconomic when the conservation decision is dependent on the neo-classical assumptions of the profit maximizing behavior of the agricultural producer.

Land and the Transformation of Agriculture

The agricultural production process has three major inputs; land, labor, and capital. Although these inputs are usually present in the agricultural production process, the mix of these inputs has changed dramatically over the last 150 years. A major impetus for this change was the increasing scarcity of prime cropland. This has resulted in fundamental changes in land resource use in American agriculture since the 19th century. Agriculture in the 19th century was an extensive system involving large areas of land with a minimum of labor and capital. Cochrane, in the Development of American Agriculture states:

> "In the second half of the nineteenth century, when a system of transport had been developed and pioneer farmers had access to commercial markets, farming itself became commercialized. That is farmers became interested in producing a surplus for sale. But because cheap or free land was available, the commercial farm operation remained an extensive farm operation.

Labor was scarce, capital was expensive, but land was cheap. Thus farmers sought to produce a surplus by combining large amounts of the cheap resource, land, with limited amounts of labor and capital. The land was not worked intensively, and yields per acre did not increase. The commercial farmer produced his surplus by expanding the number of acres that he cultivated, as yields held constant or perhaps even declined."[1]

Land was inexpensive and available for expansion in the nineteenth century as Cochrane notes; however, such expansion was difficult in the twentieth as the most accessible land had been placed into production. For example total farmland rose from 879 million acres in 1910 to 1,030 million acres in 1978, a 17 percent increase for the period.[2] However, farmland used for crops only increased 9 percent in that period from 330 million acres in 1910 to 361 million acres in 1978.[3] Moreover, the increasing scarcity of cropland resulted in a rise in its economic value. For example, the USDA's index of the average value of farm real estate rose from its depression low of 16 in 1933 to 308 in 1978 (1967 equals 100), almost a

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1. Willard Cochrane, The Development of American Agriculture, (Minneapolis: University of Minnesota Press, 1979), p. 184.

2. United States Department of Agriculture, Agricultural Statistics, (Washington, D.C.: United States Department of Agriculture, various years).

3. Ibid.

2000 percent increase.[4] In contrast, the Consumer Price Index rose only about 500 percent in the same period from 38.8 in 1933 to 195.4 in 1978 (1967 equals 100).[5] The increasing physical scarcity of new cropland and the resultant rise in the economic value of existing acreage produced a shift in agriculture from an extensive production system to a system characterized as intensive. Under an intensive production system, the preferred method of increasing production was no longer increased crop acreage. Rather, due to changes in the relative prices of land, labor, and capital, production increases were realized through increased crop yields on a given production unit.

Cochrane states that as the price of land rose relative to other agricultural inputs, farmers altered their input mix in order to contain their cost of production.[6] Initially, horsepower and associated machinery were substituted for labor. In the 1930's, new animal breeds and plant varieties were introduced. After World War II, substantial capital in labor- and land-saving forms was shifted into agricultural production with increased use of machinery, fertilizers and chemicals.

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4. Ibid.

5. Council of Economics Advisers, Economic Report of the President, (Washington, D.C.: United States Government Printing Office, 1981), p. 289.

6. Willard Cochrane, The Development of American Agriculture, (Minneapolis: University of Minnesota Press, 1979), p. 185-186.

As agriculture shifted from an extensive to an intensive system, farming itself evolved from a lifestyle to a business. Paarlberg notes that farming evolved from a closed system, where most inputs were farm produced, to an open system where purchased inputs account for 80 percent of the value of products sold.[7] Paarlberg argues that this evolution has resulted in agriculture losing its uniqueness as embodied in the concept of agarianism. With agriculture's transition, the distinction between the farm and non-farm sector and the associated agrarian ideal of the farmer were lost. The farmer became an entrepreneur with substantial capital invested in both machinery and human skills as well as land.

The farmer as an entrepreneur may be considered a profit maximizer; although, the agricultural producer faces greater uncertainty in product prices and other market conditions then does his counterpart in the industrial sector. Within this context the farmer as an agribusinessman can increase profits by more efficient resource allocation in the production process and/or by increasing productivity.

7. Donald Paarlberg, "Agriculture Loses Its Uniqueness," American Journal of Agricultural Economics, 60(5) (1978): pp. 769-776.

Land Cost and Soil Erosion

Agricultural producers have attempted to lower per unit production cost in order to increase the efficiency of agricultural production, thereby raising profits. The cost of a particular production process is the sum of its input costs and one of its major inputs is land.

Neo-classical economics, traditionally, has treated land as Ricardian land. Ricardo viewed a land's quality to be indestructible.[8] Ricardo argued that rent accrues to land due to its fertility relative to the least productive land planted. Price is equated with cost of production on the marginal lands. Since costs of production are less on more fertile lands the difference between this cost of production and price is the rent accruing to the land due to its fertility. Given Ricardo's theory, the cost of land can be equated only with the opportunity cost of the land's value. Land in the Ricardian model cannot depreciate no matter how it is used.

Juxtaposed to Ricardo's assumption of the indestructibility of fertility, most agronomists view soil productivity as a flow resource, that is exhaustible, but capable of regeneration albeit at a limited rate. The

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8. Raleigh Barlowe, Land Resource Economics, (Englewood Cliffs: Prentice-Hall, 1958), pp. 152-156.

capacity of agricultural lands for offsetting soil productivity lost via soil erosion is defined by a "T value" or tolerance level. The T value for a particular land parcel is defined not only by the soil, but by the management techniques applied on the parcel.[9] The T value is nominally referenced at five tons per acre per year. This figure is based on data which suggest that on well-managed cropland soil can be formed at the rate of an inch every 30 years. Since one inch of soil weighs approximate 150 tons for an acre, five tons per acre per year is considered an acceptable loss.[10] Although this study assumes that soil is renewable and that T values properly measure a soil's regenerative capacity, it should be noted that agronomists are unclear if soil is fully regenerative (of particular concern is the rooting depth of a soil). It has been suggested that root-zone formation may only be .5 ton per acre per year.[11]

Of further concern is the relationship between soil erosion, i.e., soil productivity losses, and crop

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9. F. N. Swader, "Soil Productivity and the Future of American Agriculture," in The Future of American Agriculture as a Strategic Resource, ed. Sandra Batie and Robert Healy, (Washington, D.C.: The Conservation Foundation, 1980), p. 12.

10. Donald McCormack and W. E. Larson, "A Values Dilemma: Standards for Soil Quality Tomorrow", in Economics-Ethics-Ecology, Roots of Productive Conservation, ed. Water Jeske, (Ankeny, Iowa: Soil Conservation Society of American, 1981), p. 396.

11. Ibid, p. 396.

yields. No general theory of the interaction between erosion and crop yields has been developed. Langdale calculated yield reductions for Southern Piedmont non-irrigated corn production at 5.8 bushels per acre for each inch of eroded topsoil.[12] Adams on Cecil soil in Georgia found that 2.7 bushels of corn per acre were lost for each inch of eroded topsoil.[13]

Although the precise relationship is not known, evidence suggests that erosion does have a substantial impact on crop yields. These studies suggest that land on which soil erosion is in excess of its established "T" value must be considered a wasting asset. Therefore, the cost of this land in the production process is the opportunity cost of the land plus depreciation. Depreciation of the parcel equals the income foregone due to fertility losses.

The Economics of Soil Conservation

Soil erosion and, therefore, land cost are a function of the cultural practices employed by an agricultural producer. Land cost can be offset by adopting soil conservation practices. These conservation practices

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12. F. N. Swader, "Soil Productivity and the Future of American Agriculture," in The Future of American Agriculture as a Strategic Resource, eds. Sandra Batie and Robert Healey, (Washington, D.C.: The Conservation Foundation, 1980), p. 17.

13. Ibid, p. 17.

may require alternative production practices, capital investment to change the physical characteristics of the land, or a combination of the two.

Neo-classical price theory states that an investment will be made by a profit maximizing producer if the marginal revenue product of the investment equals or exceeds the cost of that investment. A economically rational producer will, invest in, or adopt, a conservation practice if the discounted expected net returns are higher with than without the conservation practice and, assuming scarce capital, if the practice provides the greatest net return relative to other investment.[14] More explicitly for the adoption of a conservation practicethe marginal factor cost of a practice must be less than or in the limit equal to the marginal revenue product of the practice.

Two types of costs are associated with a conservation practice. First, the direct costs of the practice which arise from installation and maintenance. For example, a terrace system which includes terraces, seeded slopes, a drainage system and waterways needs to be built and also maintained. Second, additional costs are incurred

14. Wesley Seitz, Michael Sands, and Robert Spitze, Evaluation of Agricultural Policy Alternatives to Control Sedimentation, Water Resources Center Research Report No. 99, (Urbana, Illinois: University of Illinois, 1975), p.11.

due to increased production time and the opportunity cost of land, which is lost to production --such as terrace points and waterways. Other costs may arise from reduced revenue due to changing rotation practices. The marginal factor cost of a practice equals the present value of all costs associated with that practice.

The revenue associated with the installation of a conservation practice is also twofold. First, a conservation practice, by limiting soil losses, may increase the projected revenue stream to a farmer. This revenue would have been forgone due to soil productivity losses if the practice was not installed. Second, a conservation practice can reduce input costs by providing increased retention of fertilizer and chemical applicants, which normally would have been lost through runoff. The marginal revenue product of a practice is the present value of increased production and reduced input costs from a conservation practice.

A large portion of the costs associated with a conservation practice are incurred in the present period, whereas the benefits from the practice are received in the future. Therefore, present value is a critical concept for conservation. Present value is the discounted value of a projected stream of future income or costs. The discount rate, represents the producer's time preference. Time preference is the willingness of an individual, group or society, to forgo a unit of consumption today, for additional consumption at some time in the future. A stream of income or costs in the future is discounted according to the number of years in the planning period, N, and the value of the discount rate. If C_t equals income or costs in year t,

$$\text{Present Value} = \sum C_t / (1+i)^t$$

The higher the discount rate the lower the present value of income or costs in the future.

A number of studies have examined the economics of soil conservation practices. Seitz et al., in an analysis of erosion control policies examined the benefits of conservation policy. The analysis indicated that "even though all "A horizon" soil will be lost from more than half the watershed in 100 years, the farmers will not use erosion control techniques to maintain the productivity of their land unless they have a very low discount rate and a long planning horizon."[15] In this study, apparently for profit maximizing farmers conservation does not pay, it is not profitable within their time horizon.

15. Wesley Seitz et al., "Economic Impacts of Soil Erosion Control," Land Economics, 55(1)(1979): p. 41.

Oscar Burt has suggested that soil conservation can be modeled using optimal control theory.[16] Under such a model, a farmer is viewed as maximizing net returns to an acre of land (R) over time. This objective function is subject to two constraints; one, net returns are a function of the percentage of land planted (P) and of soil productivity (SP) and, two, soil productivity in a period is a function of soil productivity in the previous period minus annual soil loss for the previous period (SL). In equation form,

$$\max \sum R/_{(1+r)}{}^{t}$$

$$\text{s.t. } R_t = f(P_t, SP_t)$$

$$SP_t = SP_{t-1} - SL_{t-1}$$

Conservation practices enter Burt's model in two ways. First, conservation practices have a direct impact on soil loss which effects soil productivity in subsequent periods. Second, conservation practices may result in a smaller percentage of land being planted which directly effects returns. Overall, Burt's results suggested that current cultural practices with their associated losses of soil and nutrients, were economic in the long- and short-run

16. Oscar Burt, "Farm Level Economics of Soil Conservation in the Palouse Area of the Northwest," American Journal of Agricultural Economics, 63(1)(1981): pp. 83-91.

in the Palouse area of Washington, due in a large part to the deep soils in the study area.

Why Isn't Conservation Economic

Although admittedly narrow in scope, Burt's and Seitz's studies suggest that the legislated goal of reducing soil erosion will not be achieved if soil conservation is to be realized solely through the profit maximizing behavior of the agricultural producer. A number of possible reasons may explain why conservation is not economic under the assumptions of neo-classical price theory.

Pierre Crosson has suggested five reasons why the market may be undervaluing land as measured by the adoption of soil conservation practices.

> "(1) a general lack of knowledge of the effects of erosion on future yields resulting in a systematic underestimate of the effects; (2) the market misjudges the strength of forces affecting the future demand for food and fiber and underestimates future prices; (3) the market overestimates the rate of emergence of economical land-saving technologies; (4) the social costs of investments in erosion control measures are less than the private costs; (5) the market gives less weight than society to maintenance of the

> productivity of the land as a hedge against future demand for food and fiber."[17]

Crosson notes that the first three sources of error "arise because of ignorance among those in society who make the market for agricultural land." For example, farmers may well overestimate the emergence of land-saving technologies. From historical perspective farmers should perhaps expect a continued agricultural revolution on a scale similar to that experienced as agriculture became an intensive production process, especially given the yield increases realized since World War II. Yet, recent data do not suggest that outlook for productivity growth will match recent history.

A recent study on productivity growth in U.S. agriculture reported that, the growth rate for U.S. agricultural productivity through the year 2000 may equal the historical rate if research and extension (R&E) investment increases and unprecedented technologies develop.[18]

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17. Pierre Crosson, "Diverging Interests in Soil Conservation and Water Quality: Society vs. the Farmer," in _Perceptions, Attitudes and Risk: Overlooked Variables in Formulating Public Policy on Soil Conservation and Water Quality - An Organized Symposium_, ed. Lee Christensen, ERS Staff Report No. AGES 820129, (Washington, D.C.: U.S. Department of Agriculture, 1982).

18. Yao-chi Lu, Philip Cline and Leroy Quance, _Prospects for Productivity Growth in U.S. Agriculture_, Agricultural Economics Report No. 435, (Washington, D.C.: U.S. Department of Agriculture, 1979).

Another productivity study reports that government research funding has been declining, and considering the lag time necessary for research to have an impact, it concluded that productivity growth will be approximately half the rate we have experienced.[19]

Not only may the development and adoption of new land-saving technologies be slow, but existing land-saving technologies could become uneconomical. Earlier, it was mentioned that capital technologies were adopted due to their decreasing price relative to labor and land. These relative prices were established under an inexpensive energy supply. The recent change in energy costs is resulting in a shift in the relative prices of agricultural inputs. Agricultural applicants, fertilizers and machinery are all energy intensive. Higher real prices for energy may result in a drop in use of such land-substituting capital.[20] Similarly, rising real energy prices may result in an increased demand for soil productivity. The opportunity cost of soil erosion will increase, providing a greater incentive for erosion control.

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19. Vernon Ruttan, "Agricultural Research and the Future of American Agriculture," in The Future of American Agriculture as a Strategic Resource, eds. Sandra Batie and Robert Healey, (Washington, D.C.: The Conservation Foundation, 1980.)

20. Earl O. Heady, "The Adequacy of Agricultural Land: A Demand-Supply Perspective," in The Cropland Crisis- Myth or Reality ?, ed. Pierre R. Crosson, (Washington, D.C.: Johns Hopkins University Press, 1982), p.50.

If the market feels that losses of soil productivity will be offset by land-saving technologies, it is expressing a view similar to Robert Solow. Solow holds that production can be maintained by substituting capital for natural resources. He feels that as the price of an input rises relative to other inputs, due to scarcity, substitution will occur; and therefore, natural resources are not a restraint.[21] Soil conservation need not be a concern by this analysis. However, Georgescu-Roegen criticizes this view saying that such a theoretical analysis ignores fundamental laws of physics. Material cannot be created only transformed; natural resources are the sap of the economic process.[22]

The last two sources of market undervaluation listed by Crosson are diversion of private and societal demands. For example, society does give considerable weight to the maintenance of soil productivity. This social concern manifests itself in the numerous soil conservation programs which have been instituted at the state and federal levels. However, apparently the market does not place the same weight on the maintenance of soil productivity. Held

21. Robert Solow, "The Economics of Resources or the Resources of Economics," American Economic Review, 64(2)(1974):pp. 1-14.

22. Nicholas Georgescu-Roegen, "Comments on the Papers by Daly and Stiglitz", in Scarcity and Growth Reconsidered, ed. V. Kerry Smith, (Washington, D.C.: Johns Hopkins University Press, 1979).

and Clawson, for example, found that land prices are insensitive to the state of conservation on a piece of land.[23]

Apart from Crosson's observations on the sources of market undervaluation for land, there may be structural faults in the market which result in the inefficient use of soil resources. Given the assumptions of price theory, soil resources should theoretically be allocated efficiently over time. That is, the present discounted value of the marginal revenue product should be equal at all periods of time. Unfortunately, the probability is low that soil resources are being optimally allocated. The disparity between allocation in theory and allocation in practice is the result of deficiencies in existing market structures and in the assumptions of price theory.

Baumol and Oates argue that the price system cannot be expected to allocate sufficient resources for tomorrow when there is disparity between social and private costs. They name four sources of this disparity; differences in risk, externalities inherent in provision for the future (why should one bear the costs of others option demands), imperfect knowledge and inappropriate types of government interference (price controls on scarce resources,

23. R. Burnell Held and Marion Clawson, Soil Conservation in Perspective, (Washington, D.C.: Johns Hopkins Universtiy Press, 1965), pp. 95-105.

public projects)—all destroy the ability of the price system to allocate intertemporally.[24]

Dasgupta and Heal note that the probability of "an intertemporal competitive equilibrium of a private ownership economy" being adequate is slight due to three reasons. First, a complete set of futures markets for all goods and services for any future date does not exist. Second, if planning is for any horizon beyond the short term, many of the participants in the economy do not presently exist let alone participate in the economy. Third, the model has a budget constraint that the present value of receipts and purchases be non-negative. Therefore, perfect capital markets must be assumed to exist where it is possible to borrow against future earnings.[25]

Intertemporal equity is a prime concern of critics of price theory. The problem lies in the present value criterion. Present value is the static valuation of a dynamic future. The time preference which it reflects is the time preference of one set of resource users at one point in time. For soil conservation this means that the rate of erosion is articulated by the present generation but

24. William Baumol and Warren Oates, "Conservation of Resources and the Price System," in Economics of Resources, (New York: Cyrco Press, 1976).

25. P. S. Dasgupta and G. M. Heal, Economic Theory and Exhaustible Resources, (Cambridge: Cambridge University Press, 1979), pp. 107-111.

the effects of that erosion rate are felt by future generations. An intertemporal externality arises in soil resource allocation due to the independence of future and present generations' utility functions. That is, the time preference used in the present value criterion reflects society's existing utility function. Future generations are unable to effect this utility function by articulating their present true preference. Page suggests that a "fair" criterion would require that the time preference for resource allocation account for present and all future users. This fairness can be achieved by keeping the resource base essentially intact, providing fair use of the resource base.[26]

Other market imperfections make discounting difficult. For example, capital markets are imperfect. There is not one single rate of interest. No market interest rate reflects the time preference for all of society. Time preferences, desired and available, vary between individuals. Wealth, risk aversion, and taxation all have distorting effects in the capital markets. The question of what is the appropriate rate of discount is widely debated and exerts a great influence on resource allocation.

26. Talbot Page, Conservation and Economic Efficiency, (Washington, D.C.: Johns Hopkins University Press, 1977).

Furthermore, Sandler and Smith state that Pareto efficiency conditions are not satisfied by markets when there are external effects associated with the resources. Market signals may not convey sufficient information to assure that a reshuffling of the resources from the market attained pattern will improve any individual's position while still leaving all others unaffected.[27] In this context, market transactions in corn or soybeans cannot be relied upon to reflect the side effects on the common property resources; such as eroded soil in the water system or diminution of the country's soil resource base.

In addition to market deficiencies, the neo-classical assumptions of rationality and profit maximizing behavior by an economic actor may be unacceptable for examination of the soil erosion problem. Simon has proposed an alternative to the neo-classical assumption of rationality.

Simon suggests individuals have bounded rationality. An individual's rationality is bounded by imperfect knowledge of alternatives, uncertainty about exogenous events, and inability to calculate

27. Todd Sandler and V. Kerry Smith, "Intertemporal and Intergenerational Pareto Efficiency Revisited," Journal of Environmental Economics and Management, 4(1977): pp. 252-257.

consequences.[28] Farmers display bounded rationality in erosion and conservation problems. The agronomic community has not been able to present to the farmer information which he can use to estimate the costs of erosion. As a result, the farmer is unable to calculate the consequence of erosion of conservation with any certainty.

Related to Simon's notion of bounded rationality is his alternative to maximizing behavior, satisficing behavior. Satisficing behavior occurs when an individual chooses the first alternative which fulfills one's expectation rather than searching for the optimum alternative. In this vein, Ciriacy-Wantrup suggests that many farmers use a production process out of habit rather than due to analysis. Habit patterns as well as economic calculation have to be taken into account when planning public policy. Habit may be responsible for a higher or lower level of conservation than would occur with an economic calculation.[29]

To summarize, soil conservation may not be economic in the context of neo-classical price theory for a variety of reasons. Agricultural market imperfections such

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28. Herbert Simon, "Rational Decision Making in Business Organization," American Economic Review, 69(4) (1979):pp. 493-515.

29. S. V. Ciriacy-Wantrup, Resource Conservation, Economics and Policies, (Berkeley: University of California Press, 1952),p. 51.

as imperfect market information or a diversion of private and social demands may result in an undervaluation of the land resource base. General intratemporal market deficiencies such as disparity between social and private costs, or incomplete markets may result in soil resources not being allocated properly.

Furthermore, in capital theory, the value of soil productivity as an asset is equal to the present value of the expected net future revenues. However, the pitfalls of the present value criterion are many. The goal of conservationist to achieve the maximum economic yield (MEY) of soil productivity, but MEY has to be evaluated from the prospective of all users.

Whether it be due to imperfect knowledge, incomplete markets, or underlying assumptions, given the present institutional framework profit maximizing farmers do not practice conservation. Under the present institutional structure it may be economic to the mine land for its productive value, i.e., continuing soil losses over time until soil productivity is depleted. However, by altering institutional structure, an alternative outcome may be realized. The next chapter examines the erosion problem from this view through another paradigm that of institutional economics.

Chapter III

THE INSTITUTIONAL DIMENSIONS OF EROSION

A number of problems which deter the achievement of a socially acceptable level of soil erosion within the context of the neo-classical paradigm were noted in the previous chapter. This chapter examines soil erosion in the alternative paradigm of institutional economics. The chapter presents an overview of the institutional paradigm, discusses how the institutional environment can affect erosion, notes how the current institutional environment may be encouraging erosion, and suggests a basis for altering this environment. The performance of federal soil conservation policy's attempt to alter erosive production practices is evaluated. Finally, the chapter suggests what factors should be considered in formulating alternative soil conservation policies.

Erosion in the Context of Institutional Economics

The neo-classical paradigm holds institutional variables to be exogenous in economic analysis. The paradigm of institutional economics, however, considers these variables to be endogenous. Maurice Kelso elaborated on the distinction between these two paradigms in his 1977 Fellow's Lecture to the American Agricultural Economics Association.

> " Conventional economic intellectuality posits individual units as producers and as consumers acting within a system constrained by conventional economic institutions of which the market, competition, prices, and individualized property are the principal elements. That conventional intellectuality sees as its objective function the maximization of income, of throughput, per capita per unit of opportunity cost. In that conventional intellectual construct, the preference sets of individualized actors and the environment of institutions that constrain and direct their actions are posited as exogenous constraints. ... Imposing the structure of ideas that is natural resource economics upon conventional economic analytical requires that preference sets and the institutional environment of the conventional wisdom be transposed from exogenous analytical constraints to endogenous variables, that problem resolving analyses focus on the means whereby purposeful change can be effected in those preference sets and in that institutional environment, that research, education, and technology increasingly deal with the structure and role of relevant institutions, and the means of their purposeful reformulation that will guide 'as by an invisible hand' improvement in the well-being state of the system."[1]

Kelso terms the resultant of the imposition of natural resource economics upon the conventional economic analytical construct, applied institutional economics.

1. M.M.Kelso, "Natural Resource Economics: The Upsetting Discipline," American Journal of Agricultural Economics, 59(5)(1977): pp.818-19.

The paradigm of institutional economics views a society's laws, regulations, social institutions and other social constructs as composing a set of property rights available to an individual in that society. This set of property rights forms the basis of relationships between the individual and the society. Thus, a society, through negotiation among its members, institutes and sanctions a particular set of property rights in order to achieve a standard of performance from individuals in the society and from the society as a whole. For society, property rights are a means of control, order and conflict resolution. For an individual, property rights circumscribe his/her opportunity set within the society.[2] Property rights, by circumscribing the opportunity set of an individual, define the options which are available to the individual, the costs the individual must be subject to, and the costs the individual can create for others.

Given the institutional paradigm, the actions of an individual are seen as a function of a particular set of property rights. Altering this set of property rights will result in alternative actions by the individual. Hence, when a society perceives the actions of an individual to be incompatible with the society's standards of performance, society can alter the existing set of property rights to

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2. A.Allan Schmid, Property, Power, and Public Choice; An Inquiry into Law and Economics, (New York: Praeger Publishers, 1978),p.6.

affect that individual's actions.

An analysis of soil erosion, in the context of the institutional paradigm should focus on the structure and role of institutions (*i.e.* property rights) in the erosion problem, and, to paraphrase Kelso, "the means for their purposeful reformulation that will guide 'as by an individual hand' improvement in the well-being state of the system," [3] that is, result in a reduction of erosion.

The Institutional Environment as a Determinant of Erosion

To understand the role of institutions in soil erosion, one should view the agricultural production process as producing a bundle of goods. But, food is not the sole product of this production process; residuals are also produced. For example, erosion, saline water, and livestock waste are all components of agriculture's product bundle. The component mix of this bundle is a function of the methods employed in production. A profit- maximizing producer will choose the least cost method of production resulting in a specific mix of product and residuals. Since costs are defined by the opportunity set facing a producer, this opportunity set will define the methods of production

3. M.M.Kelso, "Natural Resource Economics: The Upsetting Discipline," *American Journal of Agricultural Economics*, 59(5)(1977): p.819.

employed by a producer. Therefore, by defining a set of property rights which circumscribes a producer's opportunity set, the institutional environment can influence or constrain the component mix of goods produced in the agricultural production process.

Soil erosion is a function of specific agricultural production methods being used on a soil. For example, for a given soil, farming a slope on the contour produces less erosion than straight rows parallel to the slope. For a specific product on a particular soil, a variety of production methods can be employed to meet the physical and biological requirements of the product. Assuming profit maximization, a producer uses the least cost mix of methods for that product's production. Since a producer's opportunity set, by defining costs, determines least cost production methods and since erosion is a function of these production methods, erosion can be seen as a function of a producer's opportunity set. Moreover, given that agriculture's institutional environment defines a set of property rights which circumscribe a producer's opportunity set, erosion can be ultimately seen as a function of agriculture's institutional environment. Therefore, if erosion is perceived to be a problem, although the agricultural sector is exhibiting profit maximizing behavior, the causes and solution to the erosion problem lie within the institutional framework of agriculture.

The Institutional Foundation for Erosion

Property rights established by agricultural institutions affect the adoption of production methods by an agricultural producer. Specifically, a property right and its associated impact on cost distribution either provides an incentive, a disincentive, or is neutral to the employment of a particular production method by an agricultural producer. For example, decontrol of natural gas prices provides a disincentive for use of grain drying systems fueled by natural gas; however, it provides an incentive to adopt solar grain drying systems. Similarly, the existing body of property rights influences production methods and, subsequently, soil erosion.

The most fundamental set of property rights influencing soil erosion are the rights accorded to the ownership of landed property. Land ownership rights define the privileges and responsibilities associated with the use and/or possession of land. These rights are established by society and have evolved through time. The largest bundle of rights which can be purchased with land in the United States is ownership in fee simple.[4] Fee simple conveys the right to possess property and use it as desired, even to destroy the property. Due to the vesting of fee simple

4. William Baumol and Warren Oates, The Theory of Environmental Policy, (Englewood Cliffs, New Jersey: Prentice-Hall,1975).

rights into the ownership of landed property, production methods employed by an agricultural producer are generally chosen based only on costs incurred by the producer. Production methods are considered to be the discretion of the producer. Traditionally, interdependencies --which imposed costs on others besides the producer as a result of employment of a particular set of production methods-- were uncompensated and, therefore, not considered in a producer's choice of production methods.

Interdependencies occur when an individual's actions result in costs or benefits which accrue to another individual. Interdependency can lead to conflict between individuals, especially when interdependence results in uncompensated costs. The state maintains the right to resolve such conflict. Specifically, when the use right of one individual conflicts with another's rights, the state can use its police power to resolve the conflict by restricting the rights of one or both of the parties. Even fee simple property rights, although conveying exclusive rights, do not convey absolute rights. The rights of taxation, eminent domain and police power remain vested in the sovereign with the fee simple purchase of property. [5]

One of the interdependencies resulting from a

5. Raleigh Barlow, Land Resource Economics, (Englewood Cliffs: Prentic-Hall, 1958), p.339.

producer's choice of production methods is erosion. The erosion interdependency is actuated in two ways. First, in the conveyance of eroded soil, and secondly in the depletion of the productive quality of the soil.

The conveyance of eroded soil is through either wind or water. The dust storms of the 1930s were a testament to the externality of erosion. The effects of erosion on our water system were described in the introduction. The water system is perceived to have qualities of a common property resource and the Congress has responded to its degradation by soil erosion's offsite effects. Section 208 of the Federal Water Pollution Control Act (PL 92-500) specifically addresses the erosion problem, by requiring that states plan for the control of non-point sources of water pollution and include plans for reducing the level of agricultural pollutants.

The second concern is the depletion of soil productivity. Agriculture has become increasingly concentrated in this century. Today over 95 percent of the population is detached from the primary production process of its most basic need, food. A society, in which its citizens are self-sufficient in basic needs, can offer autonomy to its citizens in their relationship to the production process. However, this autonomy is a luxury in a society where a majority of the citizens rely on a few to produce these needs. Increased concentration in production leads to many being isolated from the means to produce their basic needs; the result is interdependence and altered risk perception from reduced information flow. These changes manifest themselves in the realization that goods assigned private property rights have increasing characteristics of common property resources.

The depletion of soil on a finite land base and the concern for an adequate food supply in the future have resulted in a perceived interest in the use value of agricultural lands by non-producers. A farmer's production process may result in soil being an incompatible use good. The farmer utilizing the soil to maximize profits may be in conflict with consumers' desire for a secure food source. This conflict is pronounced when production results in high erosion rates. To resolve this conflict, between the use right of ownership and the right to a secure food source, the institutional environment of agriculture has evolved in the last 50 years. This evolution has emphasized the creation of new property rights rather than the alteration of existing property rights. The rights endowed in a fee simple purchase of agricultural land have remained unchanged. The agricultural producer is still able to create costs for others through erosion. Society has posited new property rights into the agricultural environment which are designed to encourage the incentives for conservation by offsetting the costs associated with conservation. Federal soil conservation policy has been the vehicle through which these new property rights have been established.

The Focus of Conservation Programs

The focus of conservation policy since the 1930s, to provide positive reinforcements or incentives for conservation, has aimed at encouraging the voluntary adoption of soil conservation practices. Incentive programs have been developed to counter three basic disincentives for conservation.

First, information costs are a disincentive for conservation. The problems of some forms of erosion are obvious such as gully erosion. However, some forms are not apparent, even if they are visible, the magnitude of the problem may not be realized. Until a problem and its magnitude are perceived, a solution will not be sought. After a problem is perceived, a solution cannot be implemented until the cause of the problem is known and alternative solutions are evaluated. The information needed to perceive an erosion problem and to formulate a solution is not costless and substantial information costs can be a disincentive for conservation. To counter this disincentive, the Soil Conservation Service (SCS) was instituted. SCS has reduced information costs to the farmer by providing technical assistance for identification and evaluation of erosion problems.

Second, the financial cost of erosion control is the largest disincentive for conservation. A plethora of conservation programs are targeted to reducing this disincentive. This programs fall into three categories, cost sharing, loan programs, and tax incentives.[6] Cost sharing, the largest program, has been provided since 1936. The Agricultural Conservation Program (ACP) administered by the Agricultural Stabilization Conservation Service (ACSC) provides cost sharing to farmers for installation of conservation practices. The program provides a subsidy of up to 80 percent of installation costs. The exact size of the subsidy is determined by county committees who are allocated a budget on the basis of their conservation needs and the county's crop acreage.

The Rural Clean Water Program, passed in 1977, is also designed to provide cost sharing to farmers for Best Management Practices. These practices are conservation practices designed to fulfill a state's water quality plan. Unlike ACP, funding is targeted specifically to areas considered to have an erosion problem.

6. I.C.Moore et al., "Financial Incentives to Control Agricultural Nonpoint-Source Pollution," Journal of Soil and Water Conservation, 34(2)(1979): pp.60-64.

Conservation loans are available from the Farmer's Home Administration (FmHA) and the Small business Administration. To quality for both loans, a farmer must show need for a conservation practice and meet other stipulations such as an income requirement. The bulk of loans are made at or just below commercial rates.

Tax incentives are also provided by the Internal Revenue Service. The investment tax credit which is available for all farm capital investment can be used for conservation. A soil and water conservation deduction can be taken for non-depreciable items used in conservation.

The third major disincentive for conservation is contractual costs. Contractual costs are the costs of reaching an agreement with another party. [7] For example, the costs for a farmer to obtain cost sharing under ACP are contractual costs. The USDA has developed an extensive system for minimizing these costs. County level farmer committees participate in the implementation of programs at the county level in SCS, ASCS, and FmHA. These committees provide an interface between potential participants and the federal county level offices.

7. A.Allan Schmid, Property, Power, and Public Choice; An Inquiry into Law and Economics, (New York: Praeger Publishers, 1978), p.88.

The Performance of Conservation Programs

Although conservation programs have been designed to offset the disincentives for soil conservation, the performance of these conservation program has been deficient. This performance is partially a result of conservation programs inadequately addressing the disincentives for conservation. Moreover, existing programs do not adequately address other fundamental institutional problems which inhibit the adoption of effective conservation methods by farmers.

The Soil Conservation Service has been able to greatly reduce the information costs to farmers, but a critical information barrier still exists, the relation between erosion and soil productivity. Although studies have estimated the impact of erosion on production in some areas, agronomists have not been able to develop a general theory for erosion and soil productivity. Some agronomists question if "T" values are appropriate measures for ensuring the preservation of soil productivity.[8] Until this relation is formally established, it is impossible for a farmer to be fully aware of the costs of erosion.

8. Donald McCormack and William Larsen, "A Value's Dilemma: Standards for Soil Quality Tomorrow," in Economics, Ethics Ecology; Roots of Productive Conservation, ed. Walter Jeske, (Ankeny, Iowa: Soil Conservation Society of America, 1981), pp. 392-406.

Contractual costs are low in conservation due to the establishment of local committees, however, two flaws remain. First, allocation of funding has been left to the discretion of local committees. Uncertainty of funding could be high, among some farmers, in a system of subjective allocation. A formula based allocation system at the county level would reduce this uncertainty. Secondly, the contractual costs of obtaining SCS technical assistance may be high for some farmers. SCS is a service organization for the local Soil and Water Conservation District (SWCD) members. To qualify for technical assistance, a farmer must sign up as a SWCD cooperator with SCS. Costs associated with becoming a SWCD cooperator may deter some farmers from seeking SCS technical assistance and adopting conservation practices.

Information and contractual costs have been effectively reduced for a majority of the farm population, but the financial question remains. Farmers must perceive benefits that equal or exceed the costs of conservation for it to be undertaken. The financial incentive programs have reduced the cost of conservation, but cost remains. Conservation investments must compete with other farm investment opportunities. Uncertainty over the payoff from a conservation investment, the long run character of its returns (if measurable), the low present value of those returns, and the high cost of installation result in conservation investments being unattractive relative to most other investment opportunities. Farmers are not realizing a high enough return for conservation. The financial incentives of conservation programs as presently designed are inadequate to fully offset the cost disincentives for conservation.

Furthermore, conservation programs have not addressed the reinforcements for erosive behavior or the ability of farmers to create costs for others through erosion. The reversal of the reinforcements for erosive behavior over time and a farmer's ability to shift costs provides an environment which is conducive to both one person traps and social traps.[9] A one person trap occurs when an individual continues an action which is advantageous to the individual in the short run (a positive reinforcement), but after a time delay--provides a negative reinforcement for the individual's action. In this context, erosive behavior is a one person trap, intensive land use provides a short run reinforcement to the producer, an increase in revenue. However, there is a reversal of reinforcements after a time delay. The long run reinforcer is negative, the loss of productive capacity resulting from the earlier intensive use. A social trap occurs when each individual continues to do something for his/her individual

9. John Platt, "Social Traps," American Psychologist, (August 1973): pp.641-51.

advantage that collectively is damaging to the group as a whole. The existence of uncompensated interdependencies between the agricultural producer and society provides an environment which is conducive to social traps. In such an environment, much of the cost of erosion is not borne by the producer but rather society pays much of the cost through environmental degradation, loss of the soil base, and potentially higher food prices. In most cases, the time delay for a producer to realize the cost of erosion incurred on a productive unit and the producer's ability to shift most of these associated costs to society, prevent any effect on behavior by the negative reinforcement.

Hardin suggests freedom brings ruin in a social trap. He states that social arrangements that produce responsibility, create coercion, are necessary to avoid the ruin of a social trap.[10] The problem in social traps is not freedom; however, rather it is the reinforcements for the ruinous behavior. The solution to social traps is to create responsibility by changing the reinforcements of the behavior which has the negative impact. Existing soil conservation programs have failed to address the reinforcements for using erosive production methods. Existing conservation programs have attempted to create social responsibility through non-coercive incentives. This

10. Garrett Hardin, "The Tragedy of the Commons," Science, 162(1968): pp.1243-48.

social responsibility labeled, the "conservation ethic", has been presented to the agricultural sector as an ideal to which every "good" producer strives. Conservation programs have been designed as bridges to this Shangri-la on the premise that voluntarism and non-coercive incentives are sufficient to realize a desired level of soil conservation. However, this approach has only been partially successful and erosion is apparently continuing at an intolerable rate. Soil conservation policy to be more fully successful must examine alternatives--formulated in the institutional context of agriculture and that address the reinforcements for erosive production practices.

CHAPTER IV

INSTITUTIONAL INNOVATION IN CONSERVATION

The United States Congress's General Accounting Office (GAO), in a 1977 study criticized U.S. conservation policy as not being as effective as it could be. [1] Congress concurred with the GAO report and, through the Resource Conservation Act (RCA), legislated the analysis of alternative conservation strategies. RCA is an acknowledgement of the need for institutional innovation in conservation, that is, the need to introduce new policies for improving our conservation performance. The erosion problem still exists and better ways are needed to solve it.

The Design of Conservation Policy

Bain, in his book on industrial organization, introduced the structure-conduct-performance paradigm (SCP). Bain's paradigm asserts that the structure of an economic entity and the environment in which it operates, determine the entity's conduct and therefore its

1. United States General Accounting Office, To Protect Tomorrow's Food Supply Soil Conservation Needs Priority Attention, (Washington, D.C.: United States Government Printing Office, 1977).

performance.[2] Schmid, has extended this basic paradigm to include public choice. Schmid suggests that situation variables, e.g., physical, technological, and psychological factors create interdependencies among individuals. Property rights order these interdependencies and determine the opportunity sets of individuals. Ultimately, these property rights determine performance.[3]

If the performance of soil conservation programs is to change, some adjustment of the institutional framework within which these programs operate must be expected. To affect change, the opportunity sets of individual land users, a critical factor in their environment must be altered, thereby altering land users' conservation behavior. The land users' opportunity sets define the costs and benefits of conservation. Property rights in these opportunity sets include financial-incentive conservation programs, conservation institutions, and erosion rights, whether given explicitly or implicitly. Institutional innovation by altering these property rights should result in a different performance by soil conservation programs.

As previously noted, USDA in the RCA 1980 Review

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2. Joe Bain, Industrial Organization, (New York: Wiley, 1959).

3. A. Allan Schmid, Property, Power and Public Choice; An Inquiry into Law and Economics, (New York: Praeger Publishers, 1978).

Draft suggested seven alternative strategies for altering the performance of conservation policy.[4] These are:

(1) "Redirecting present conservation programs" to adapt existing soil and water conservation programs to meet common national objectives. A redirection would be designed to minimize duplication and conflict in the existing programs.

(2) "Regional resource project strategy" to target programs to critical programs in a specific area, while allowing certain nationwide programs to address widespread problems.

(3) "State Leadership" to transfer the leadership for soil and water conservation to the states. Under this proposal, USDA would retain oversight responsibility for the conservation programs and states would submit proposed programs to USDA for approval.

(4) "Regulatory Emphasis" emphasizing mandatory compliance with standards for soil and water conservation. Standards are to be designed to meet national objectives.

(5) "Conservation Performance Bonus" rewarding

4. United States Department of Agriculture, Soil and Water Resources Conservation Act, 1980, Draft Review, (Washington, D.C.: U.S.Department of Agriculture, 1980).

land users who achieve an "acceptable" level of conservation by preferential treatment in USDA programs. For example, target and loan prices would be higher, or subsidized interest rates would be available on loans to those who achieved the acceptable level. The proposal is similar to Benbrook's Conservation Incentive Program, (CIP)[5] which would also provide preferential treatment in USDA assistance programs for conservation. The proposal increases the benefits of conservation for the farmer.

(6) "Natural Resource Contracts" would establish a contractual agreement between the USDA and the land user. A land user is to be paid for each ton of soil retained by conservation methods.[6] This proposal also increases the benefits of erosion control.

(7) "Cross-compliance Among USDA Programs" requires that a farmer achieve a specified level of conservation in order to participate in selected USDA assistance programs. Ex ante, cross-compliance raises the cost of not conserving the soil. Ex post, cross-compliance increases the benefits of conservation.

5. Charles Benbrook, "Integrating Soil Conservation and Commodity Programs: A Policy Proposal," Journal of Soil and Water Conservation, 34(4)(1979): pp. 160-67.

6. United States Department of Agriculture, Soil and Water Resources Conservation Act, 1980, Draft Review, (Washington, D.C.: U.S.Department of Agriculture, 1980).

The first three out of the seven forementioned strategies attempt to improve the performance of conservation programs by altering those institutions which have been established to promote soil conservation. None of these strategies explicitly address the individual land user's behavior as the basis for altering the performance of conservation policy. The remaining four strategies do attempt to directly influence behavior. These strategies propose to alter property rights in order to elicit conduct consistent with conservation performance goals. The fourth alternative proposes to remove the conservation decision from the land user by enacting a prohibition on erosion which exceeds a given level. The above latter three strategies establish incentives to elicit conservation. The incentives either increase the short run benefits of conservation or increase the short run costs of not conserving the soil, while leaving the ultimate conservation decision with the land user.

This study examines one of the proposed alternative strategies, cross-compliance. Cross-compliance appealed to the researcher for a number of reasons:

(1) Cross-compliance attempts to resolve the disparity existing between the short-run incentives facing a farmer and the long-run need for conservation;

(2) Cross-compliance maintains the voluntary nature of existing USDA conservation programs. The "rules of the game" are altered, that is the consequences of the choice to participate or not to participate are altered but the choice is the individual's;

(3) Cross-compliance is probably less costly than other incentive strategies. There is no increase in subsidies or payments for farmers under cross-compliance as with these other strategies, yet enforcement and administrative costs are probably comparable;

(4) Cross-compliance can reduce the conflict in federal programs between short-run-farmer assistance programs and long run conservation programs; and

(5) Cross-compliance is operated at the federal level. Erosion and its effects do not follow jurisdictional boundaries. A federal program minimizes those boundaries.

Past Studies of Soil Conservation Policy

Numerous studies have estimated the impacts of alternative soil conservation strategies. At least two of these studies have focused on the farm-level effects of conservation policies; however, a majority of these studies have examined the effects of implementing alternative strategies on a national or a regional level. Studies analyzing conservation policies at the national and regional level have been conducted mostly at the University of Illinois and Iowa State University. Both institutions utilize linear programming models which differ in terms of scope and objective functions. Iowa uses a cost minimization objective function for the agricultural sector of the United States' economy. The Illinois model is for the corn belt states and the model's objective function maximizes consumer surplus plus producer surplus minus the cost of production.

Wade, Nicol and Heady at Iowa State utilized a model covering all major regions, commodity markets, resources and transportation networks underlying the agricultural sector of U.S. economy.[7] They constrained this model with two soil loss restraint scenarios which restrained soil losses, as estimated by the Universal Soil Loss Equation, to a five ton per acre annual loss and to a three ton per acre annual loss. The cost of erosion control practices to meet these restraints was reflected by an increase in total farm income. Their study concluded that the per capita cost of reducing soil losses as

7. James Wade, Kenneth Nicol and Earl Heady, "Income Effects of Reducing Agricultural Polution," Southern Journal of Agricultural Economics, 8(1)(1967): pp. 65-71.

represented by changes in commodity prices was not great. Total farm income was estimated to increase four percent to attain the five ton limit and found to increase 6 percent to achieve the three ton limit. However, the study estimated a substantial shift of farm income between regions. For example, the model estimated that agricultural income would drop by as much as 37 percent in Michigan and increase by as much as 59 percent in the Carolinas under a five ton soil loss limit.

In another Iowa State study, Heady and Vocke considered the competition between production costs and soil conservation objectives in U.S. agriculture.[8] Their study utilized the Iowa State model which was previously described with the addition of a second goal in the objective function that of preventing or reducing soil losses. Their study considered five scenarios in which soil was valued at 0, $2.50, $5.00, $10.00, and $20.00 per ton with a full value placed on cost efficiency. An additional scenario valued soil at $20.00 per ton but placed no value on cost efficiency. The study found that with a 5 dollar per ton valuation (tax) soil loss was reduced 36 percent. A 20 dollar tax reduced soil loss by 64 percent. The returns to land decreased with the 5 dollar tax to 96 percent of returns to land with no tax. A

8. Earl Heady and Gary Vocke, "Trade-offs Between Erosion Control and Production Costs in U.S. Agriculture," Journal of Soil and Water Conservation, 33(5) (1978): pp. 227-30.

20 dollar tax increased the returns to land to 168 percent of the no tax returns due to a substantial increase in prices. The study also showed major shifts in comparative advantage among regions.

Osteen and Seitz at the University of Illinois estimated the spatial economic impacts of alternative soil conservation policies in Corn Belt states.[9] The study utilized a linear programming model of the Corn Belt economy. The objective function of the model was maximized subject to the land base and specific soil conservation policies. The study's alternative conservation policy, which is most pertinent to this study, placed a three ton per acre soil loss restriction on the entire corn belt. The three ton limit was estimated to result in a social cost of 64 million dollars with consumer surplus rising 258 million and producer surplus falling 322 million. The model estimated that soybean prices would rise as the crop generates higher soil erosion rates than other crops. The prices of other crops were found to fall as the crops were shifted to more fertile land which had highly erosive crops. Their study concluded that "the model predicts that economic incentives will encourage farmers to adopt conservation tillage methods and reduce soil loss."

9. Gary Osteen and Wesley Seitz, "Regional Economic Impacts of Policies to Control Erosion and Sedimentation in Illinois and Other Corn Belt States," American Journal of Agricultural Economics, 60(3) (1978): pp. 510-517.

Government action through financial assistance would not be needed to bring about the decrease in soil loss associated with the adoption of conservation tillage.

Seitz et al. summarized the results of a number of analyses examining alternative soil conservation policies utilizing the Illinois model.[10] Among the policies examined were a soil loss tax of $2.00 per ton, a soil loss restriction of three tons per acre and a three ton soil loss restriction with a 50 percent subsidy for the cost of terracing. It was noted that the $2.00 tax was the most economically efficient with a net social cost of $192 million for a soil loss reduction of 337 million tons. The tax alternative resulted in a net decrease in farm income; however, the impact on aggregate was positive for the other alternatives. The positive impact is due to an elastic demand curve with decreased supplies increasing total revenue.

Two recent studies analyzed the impacts of various soil conservation policies on farm income utilizing models of representative farms. The objective function of these linear programming models minimized production costs subject to alternative conservation constraints.

10. Wesley Seitz et al., "Economic Impacts of Soil Erosion Control," Land Economics, 55(1) (1979): pp. 28-42.

Boehlje, McGrann, and Boggess evaluated the impact of conservation using three soil-association groups in Iowa and representative farm models.[11] Padgitt analyzed the effect of various conservation policies on representative Minnesota grain and grain-livestock farms.[12]

Boehlje et al. examined the effects of a regulation limiting soil loss to various levels, a tax placed on erosion over a given level, and a terracing subsidy program. Their study found that the impact of conservation policies on income is dependent on soil characteristics and farm enterprise. For example, they estimated that farms on two soil groups could limit soil loss to two tons per acre without "major financial consequences." However, limiting soil loss to this level on the third soil group would result in significant consequences. They concluded that a uniform policy for soil conservation, i.e., one tailored to limit erosion to a mandated level, would result in "serious equity and income redistribution problems" due to the policy's differential effects.

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11. Michael Boehlje, James McGrann, and Bill Boggess, Nonpoint Pollution Regulation What it Might Mean to Farmers, Iowa State University, Cooperative Extension Service, EC-1398g, (Ames: 1979).

12. Merritt Padgitt, "An Analysis of On-farm Impacts for Soil Conservation and Non-point Source Pollution Abatement Practices and Policies on Representative Farms in Southeast Minnesota," (Ph.D. diss., Michigan State University, 1980).

Padgitt's study examined conservation policies which included subsidies, a soil loss tax, a regulatory limit and requirements for the adoption of a conservation plan. All of his policy options showed a reduction in net farm income with the largest decreases in income resulting with a regulatory limit. Padgitt's "minimum" conservation plan was designed to meet a minimum conservation requirement similar to that which could be required with cross-compliance. The minimum plan assumed no straight row planting on erosive soils, grassed waterway establishment and the use of contouring or strip cropping on row crops. The Padgitt data indicate the cost to the producer for using this practice varies from one to four dollars per acre.

In summary, research indicates that the imposition of national soil conservation policies will probably result in soil erosion reduction with a minimal net social cost. It is probable that overall farm commodity prices will rise, production will be reduced and farm income will rise. Furthermore, the imposition of uniform policies will impact individual farms differently depending on the characteristics of the individual farm. All of these studies are hypothetical, based on LP models. None of these studies have attempted to predict the potential impacts of a conservation policy utilizing empirical data.

Structure and Design of a Cross-Compliance Policy

A cross-compliance conservation policy must be designed with special regard to the economic decisions facing an agricultural producer. A program must offer sufficient benefits to a farmer who achieves a given level of conservation. Cross-compliance has two major components; the assistance programs which are to have a cross-compliance requirement and the measures of compliance utilized to indicate eligibility for those assistance programs.

For a cross-compliance to be effective, the assistance programs --which are cross-complied-- must provide a short run financial incentive sufficient to elicit participation in the conservation program. The positive impact of cross-complied assistance programs, i.e., funds paid plus the value of any risk reduction, must off-set the opportunity cost to the land user of achieving a given level of conservation. The greater the incentive which is provided for a given level of conservation, the more likely a farmer is to comply.

The assistance programs selected for cross-compliance determine who is affected by a cross-compliance policy. Different assistance programs are targeted to different clientele groups. The focus of this study is the agricultural producer; however, the scope of a cross-compliance policy could be expanded to include non-agricultural land users. For example, national forest cutting permits could be cross-complied to ensure conservation on the part of forestry concerns.

Cross-compliance is particularly relevant for those programs which provide negative incentives for conservation practices. Ciriacy-Wantrup analyzed the relations between price supports and conservation policy.[13] He found price support programs --enacted for a limited period-- encourage land users to shift to higher use rates in the present period, thereby depleting the soil of land being harvested. The capitalization of commodity programs into land values increases conservation costs by raising the opportunity cost of removing land from production for conservation.

The provisions of commodity programs also conflict with conservation. For example, the definition of "normal crops acres" in the 1977 Agricultural Act did not include grass areas used for conservation.[14] This provision penalized the conservation farmer and provided an incentive to move these areas back into production.

13. S. V. Ciriacy-Wantrup, Resource Conservation, Economics and Policies, (Berkeley: University of California Press, 1952), p. 51.

14. Linsey Grant, "Speculators in the Cornfield," Journal of Soil and Water Conservation, 34(2) (1979): pp. 50-3.

Conflict with conservation is not limited to commodity programs. Credit subsidy programs encourage production expansion and may cause marginal lands to be moved out of conservation into production. Disaster programs encourage the use of high risk lands. Lands susceptible to drought are high risk both in production and conservation. However, not all commodity program provisions have a negative impact on conservation. Diversion and set aside programs which require idle land to have vegetative cover lower erosion. Price stability, as provided by a grain reserve program, reduces price uncertainty and may encourage conservation.[15]

The scope of the programs which could be cross-complied is large. Agricultural Stabilization and Conservation Service (ASCS) commodity programs are one possibility. Loan programs administered by the Farmers Home Administration would affect both agricultural owners-operators and non-agricultural land owners. It would be possible to include quasi-public organizations such as the Commodity Credit Corporation, the Federal Crop Insurance Corporation, and various organizations under the Farm Credit Administration.

The time dimension of cross-compliance is vital.

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15. S. V. Ciriacy-Wantrup, Resource Conservation, Economics and Policies, (Berkeley: University of California Press, 1952), p. 51.

The incentives which federal assistance programs provide are volatile. When prices are high, there is little incentive to participate in commodity programs. Yet conservation is needed most in these high price periods.[16] For the long run stability that an effective conservation program needs, contractual agreements may have to be formulated for continuing compliance over a period of time. However, a contractual agreement which is ideal for conservation presents an unrealistic planning horizon to a farmer. Assistance benefits would be discounted at a high rate since both the economic and political environment create uncertainty as to their value. A five year contract is probably the maximum period which could be expected for a cross-compliance policy.

A final factor to consider in choosing compliance programs is the underlying intent of an assistance program. Many programs benefitting the farmer provide a large benefit to society as a whole. Major commodity programs have aimed at increasing and stabilizing farm incomes, but consumers have benefited through the insurance of adequate supplies and stable prices.[17] The needs of an assistance program may conflict with the needs of conservation. For

16. Lenny Losh, "Alternative Program Strategy No. 2, Cross Compliance," (Washington, D.C.: RCA Coordinating Committee, U.S. Department of Agriculture, 1979).

17. United States Department of Agriculture, Status of the Family Farm, Second Annual Report to Congress, Agricultural Economics Report No. 334, (Washington, D.C.: U.S. Department of Agriculture, 1979).

example, supply controls need to maintain flexibility of land use but conservation has to maintain stability in land use. The design of cross-compliance has to weigh these concerns.[18] The consumer, as well as farmer, benefit in the short run from programs which encourage production. If these programs are in conflict with long term conservation goals, then both parties shall bear part of the cost of conservation. Tweeten points out that "environmental protection for society and low cost for consumers conflict."[19]

In regard to measurements of eligibility for assistance programs, Seitz differentiates between policy and individual performance measures. "Performance indicators are technical ways to assess whether a policy is achieving its objectives. Compliance measures are methods of examining the actions of individuals who are subject to the policy."[20]

Of crucial importance for cross-compliance are those compliance measures used to measure a farmer's

18. Melvin Skold, "Cross Compliance," (Fort Collins, Colorado: Colorado State University, Department of Economics, 1979).

19. Luther Tweeten, Foundations of Farm Policy, (Lincoln, Nebrasksa: University of Nebraska Press, 1979), p. 57.

20. Wesley Seitz and Robert Spitze, "Soil Erosion Control Policies: Institutional Alternatives and Costs," Journal of Soil and Water Conservation, 33(3) (1978): pp. 118-25.

performance. Compliance measures are critical to a farmer in determining his participation in a conservation program. Therefore, a compliance measure must consider three important elements. First, compliance measures should be an accurate reflection of an individual's actions. For example, membership in a SWCD is not an adequate measure of an individual conservation effort. Second, since compliance measures create a goal for a farmer, these measures must clearly define a farmer goal. A clearly defined goal allows a farmer to estimate the cost of participation and weigh the trade-offs of compliance. Finally, compliance measures need to be implementable.

Two types of compliance measures are possible for soil conservation programs. An output measure would gauge the performance of soil conservation practices on a parcel of land by estimating the soil lost from the parcel over a given time period. Such an output measure, although perhaps ideal as a performance measure, would not be a good compliance measure. First, with output measure the cost of a farmer's participation is difficult to calculate. Second, implementation of an output measure would probably be costly due to the time and financial resources required for measurement.

Alternatively, an input measure would gauge conservation by observation of the production and soil conservation practices used by a farmer on a land parcel. Since production practices accurately reflect an individual's conservation effort, an input measure would provide a good measure of compliance. An input measure, also, presents a definable goal to potential program participants. Furthermore, input measures are implementable in regard to measurability. Aerial surveillance, as used in some commodity programs, or visual inspection could readily indicate compliance by a farmer. Given the two alternative methods of compliance, standards based on production and soil conservation practices would seem to be more feasible.

The level of conservation required for compliance defines the cost of conservation. It is assumed that participation in a cross-compliance program will occur only when the cost of conservation is less than the benefits in a cross-compliance program received by compliance. Individual conservation practices may be lumpy, but a conservation plan for a production unit is not. A plan incorporates various practices with varying costs associated with each practice. The level of conservation achieved can vary with the number of practices employed in a plan. A series of conservation grades from "minimum" conservation to "full" conservation could comply with various assistance program combinations. A variable conservation requirement allows marginal calculations on the part of participants. Compliance measures which equate complied program benefits with conservation costs should encourage maximum participation in the conservation program. Low benefit assistance programs or programs which do not conflict with conservation can be complied with a low level of conservation. This approach would maintain participation in these assistance programs and produce some conservation. Neither result would be obtained if full conservation were the only alternative. Skold suggested this approach, noting it could increase the conservation emphasis in both program objectives and program provisions.[21]

To summarize the above points an effective cross-compliance program would require a farmer to employ various levels of conservation to be eligible for various assistance programs. The level of conservation would be required to be maintained for a number of years. The level of conservation would be measured by practices used by the farmer. The average benefits received from assistance programs for a particular level of conservation should be equated with the average cost of that level of conservation. In selecting programs for cross-compliance consideration should be given to the social costs of

21. Melvin Skold, "Cross Compliance," (Fort Collins, Colorado: Colorado State University, Department of Economics, 1979).

discouraging participation in an assistance program. Given these general requirements the next chapters examine an empirical application of a cross-compliance policy.

Chapter V

THE CROSS-COMPLIANCE STUDY

Data Collection

Data for the cross-compliance survey were obtained from three sources: data retrieved from the Grain Reserve Survey, data collected from ASCS county office, and data collected from SCS county office. A list of data retrieved from the Grain-Reserve Farmer survey and questionnaires sent to the ASCS and SCS county offices are in the Appendix.

The Grain Reserve Survey was conducted as part of the North Central Regional Research Project NC-152 and coordinated by Mary Ryan at the Agricultural Economics Department of the University of Minnesota.[1] The survey evaluated corn and wheat farmers' attitudes toward and experience with the farmer-owned grain reserve program since

1. Mary Ryan, "An Analysis of the Farmer-owned Grain Reserve Program," (Minneapolis: University of Minnesota, Department of Agricultural Economics, March, 1980).

its inception in 1977.[2] A sample of corn farmers was drawn in seven states and wheat farmers in eight states. The survey was conducted between June and August 1979. A complete description of the data of the survey is in the Appendix.

A sample of 390 farmers drawn from the Grain Reserve Survey provided the initial data base for the cross-compliance study. This sample originally contained 458 farmers; however, 68 farmers were eliminated due to incomplete data files. The sampling was random but biased. Bias was introduced so that the proportion of farmers from a state reflected the number of farmers in that state as derived from the 1974 Census of Agriculture. The bias also compensated for differential return rates by states in the Grain Reserve Survey. Data from the survey provided a name, address,and other demographic information as well as farm data such as enterprise mix and acreage for each farmer .

This initial data base was supplemented by data obtained through two questionnaires. One questionnaire was sent to the county ASCS office of each farmer in the sample. The ASCS questionnaire asked which ASCS programs a

2. The farmer-owned grain reserve program was established by the Food and Agriculture Act of 1977. The program offers farmers long-term commodity loans and payments for storing grain in return for agreement to certain restrictions on grain sales. Although farmers retain ownership of the grain, they must hold it off the market until prices rise well above loan rates or until the loan matures.

farmer had participated in and the amount of payments received through each program for a three year period, 1977-1979. The other questionnaire was sent to the county SCS office of each farmer in the survey. The SCS questionnaire asked if a farmer was a SCS cooperator, if a SCS conservation farm plan had been filed and if the farm plan was being followed during the 1977-79 period. In addition, the SCS questionnaire requested the name of any conservation practices installed with SCS technical assistance and the year in which it was installed. The questionnaires were mailed out and received between May and July 1980.

The three sets of data were merged to form one data file for each farmer in the sample. The SCS conservation practices were entered according to SCS codes. ASCS programs were divided into four categories: price support programs, production adjustment programs, conservation programs and disaster programs. The SCS and ASCS code definitions sheets are in the Appendix.

Characteristics of Survey Respondents

Table 1 on page 77 summarizes the characteristics of farmers in the survey. Of the 390 farmers, 297 participated in ASCS programs and 212 were Soil Conservation District cooperators. One hundred and six farmers, one-half

Table I
Sample Characteristics

Number in sample	390
Number in ASCS programs	297
Number of SWCD cooperators	212
Number of farmers who follow a farm conservation plan	106
Mean age for sample	50.6
Percentage of sample from:	
Illinois	15.9%
Indiana	13.6%
Iowa	13.3%
Kansas	10.5%
Michigan	5.4%
Minnesota	12.8%
Nebraska	10.0%
North Dakota	7.4%
Ohio	11.0%
Number of farms growing corn	312
corn yield	105
Number of farms growing wheat	144
wheat yield	33

	Full Sample	Sample with farm plan	Sample without farm plan
Mean Farm Acreage	540	664	493
Land Tenure			
Percent rented land	35%	30%	37%
Percent own land	65%	70%	63%
Enterprise Mix (percent of income from)			
Grain	38%	37%	39%
Livestock	40%	47%	37%
Other	22%	16%	24%

of the cooperators, were following a SCS conservation farm plan in the 1977 to 1979 period. Farmers who followed a conservation farm plan operated considerably larger farms than those who did not follow a conservation farm plan (mean farm size was 664 acres and 493 acres, respectively). Overall, 210,600 acres were covered by the survey about one-third of which was under a conservation farm plan. The farm-operator owned 65 percent of this land and rented the remainder.

The distribution of respondents from states covered by the survey is also shown in table 1. As previously mentioned, the survey was biased in order to conform to 1974 Census data on the number of farms in each state. Biasing the survey to the number of farms in each state rather than total acreage in each state results in the survey being weighted to corn-belt states which have more farmers on smaller units. Therefore, the number of farmers growing wheat is substantially less than the number of farmers growing corn. Although the sample was expected to be biased to grain producers, livestock accounted for the largest share of farm income. Overall, grain sales constitute 38 percent of the total sales of the farms survey, livestock sales account for 40 percent and other products such as hay and soybeans constitute 22 percent of total sales.

Study Methodology

This study postulates a cross-compliance policy which would permit a farmer to participate in selected ASCS programs only if the farmer follows a conservation plan. A fuller analysis of a cross-compliance policy would examine compliance possibilities with assistance programs from other agencies; however, limitations on time, financial support and data required this study's focus on ASCS. Of the four ASCS program categories, only participation in price support and production adjustment programs were assumed to require compliance with a conservation plan. ASCS conservation programs were excluded since the programs are already incentive measures for conservation. Disaster programs were excluded due to insufficient data for evaluation. The gross payments received by a farmer from the price support programs and from the production adjustment programs were averaged on an annual basis over the 1977-79 period. This figure was divided by the normal crop acreage of the farmer to yield an average annual payment received per acre. Only ASCS payments were considered. The value of commodity programs in reducing risk and uncertainty was not evaluated. However, the benefits from the grain reserve program were incorporated. This benefit accrues from the availability of loans at less than market rates. To simplify valuation of these loans, the value of loans was calculated as three percent of the loan value over a one year period.

As noted in Chapter IV, participation in a cross-compliance program is contingent on the cost of conservation. To allow comparison with federal assistance programs, the cost of conservation was estimated as the cost per acre for an entire farm unit. Furthermore, a marginal approach was desired; therefore, two conservation levels were chosen. A "minimum" conservation plan as defined in Padgitt's study was chosen since the practice had an estimated conservation cost. The minimum conservation plan assumes no straight row planting on erosive soils, grassed waterway establishment and the use of contouring or strip cropping on row crops. This "minimum" conservation plan provided a floor for the conservation requirement. A "full" farm plan was chosen for the other level. A "full" farm plan is nebulous in definition. It is a plan which SCS would design for a farm to maintain an erosion rate less than the tolerance levels ("T" values) for soil on that unit. No empirical cost base for a "full" farm plan could be found. Cost for the "full" plan were assumed to be either 15 dollars per acre or 25 dollars per acre. These costs have no empirical basis; they were chosen as higher estimates of conservation costs. These costs are the average cost over normal crop acreage, not just those acres with conservation practices. The cross-compliance policy requires that a farmer adopt and follow "minimum" conservation plan for participation in production adjustment programs. Adopting and following a "full" conservation plan permits a farmer to participate in price support and production adjustment programs.

The study uses two alternative decision rules to determine a farmer's participation in cross-compliance, as follows:

Decision Rule One- A farmer will adopt a "minimum" conservation plan, if annual production adjustment benefits exceed five dollars per acre. A farmer will adopt a "full" conservation plan, if annual production adjustment and price support benefits exceed 15 dollars per acre.

Decision Rule Two - A farmer will adopt a "minimum" conservation plan, if annual production benefits exceed five dollars per acre. A farmer will adopt a "full" conservation plan, if annual production adjustment and price support benefits exceed 25 dollars per acres.

The alternative decision rules are based on the behavioral assumption that if the expected benefits from those ASCS programs requiring cross-compliance exceed the costs of complying with conservation then a farmer will meet the compliance requirement.

In a year with no set aside or diversion program, a producer will comply if $B \geq CA$, where B equals total ASCS benefits received for the farm, C is the per acre costs of conservation practices and A is normal crop acreage. However, during years when a set aside and/or a diversion is in effect an agricultural producer has an additional cost for participation in the ASCS assistance program, that is the opportunity cost of land diverted or set aside. Under a set aside program an agricultural producer qualifies for price supports if a specified portion of the producer's land is left idle. Under a diversion program an agricultural producer qualifies for an additional payment if an additional portion of a crop's acreage is left idle. Both of these programs required a producer to forgo income from land which is idled. The actual costs incurred by the producer is the net revenue of the land if not idle, that is total revenue minus the variable costs of using the land.

In 1978 and 1979 a 10 percent set-aside and a 10 percent diversion program were in effect for corn and wheat. In these years the actual cross-compliance decision rule facing a producer required expected revenue from the farm under a cross-compliance program to equal or exceed the expected farm revenue without participating in the compliance program. With a 10 percent set aside, a producer's decision rule is

$$B - .1A(NR) \geq CA$$

where B = total ASCS benefits,

C = per acre conservation cost,

A = normal crop acreage,

NR = net revenue per acre.

Program benefits are reduced by the opportunity cost of acreage taken out of production. Similarity with a 10 percent set aside and a 10 percent diversion program, a farmer's decision rule is $B-.2A(NR) \geq CA$.

Net benefit calculations as described above were not used in this study due to inadequate data. Not all of the surveys received specified if the farmer participated in the set-aside program and the productivity of idled acreage was not available. Average farm productivity is an inappropriate proxy for this figure since idled acreage is generally the least productive acreage on a farm. Therefore, a gross calculation comparing assistance program benefits with conservation costs was utilized.

Finally, as suggested earlier an effective cross-compliance policy would necessitate the establishment of long term agreements to insure the maintenance of conservation practices. With long term agreements an agricultural producer is required to estimate benefits over an extended period. Therefore, the producer's participation in a cross-compliance program will be contingent on the producer's expectations of future government supply control policies. This study examined two policy scenarios, Scenario One assumed that the chance for a set-aside in any year is 66 percent. This scenario used data for the 1977-79 period. Scenario Two assumed that no set aside would occur in the next five years. This scenario used data only from 1977 when no set aside was in effect.

The Impact of Cross-Compliance on Soil Conservation

Ideally, a measure of a conservation policy's impact on the soil erosion problem should evaluate the quantity and quality of soil retained due to the policy's institution. However, due to the costs of collecting the necessary data such a measure was not utilized for this study. Rather, the impact of cross-compliance policy is measured by the number of acres expected to be covered by a conservation plan and by the number of participants expected to adopt conservation plans.

If a farmer's participation in the conservation program is contingent, solely, on the study's assumed decision rules, some farmers who presently use a conservation plan but who received few benefits from government assistance programs, would be predicted to discontinue their participation in the conservation program. However, it is probable that most of these conservation plans which are currently being implemented are sufficient to meet the cross-compliance requirement. Although there may be some backlash to the property rights change with a cross-compliance policy, farmers who currently perceive it to be in their interest to conserve their soil base with the incentives presently available are expected to maintain their conservation plans. Therefore, these farmers are counted in the results as conservation farmers under a cross-compliance policy regardless of their predicted behaviors under the decision rules.

The impact of a cross-compliance policy was first examined under Scenario One. Under this scenario a farmer's expectations of federal assistance programs payments are based on the average annual gross per acre payment received between 1977 and 1979. No set aside was established for 1977, but in 1978 and 1979 a set aside program was in effect. Therefore, a farmer's expectations of a set aside in any one year are 66 percent.

Table 2, on page 86 is a summary of participants expected to have a conservation plan under Scenario One and Decision Rule One. Decision Rule One assumes that a farmer will adopt a full conservation plan if average annual per acre payments from price support and production adjustment programs are greater than or equal to fifteen dollars per acre and will adopt a minimum conservation plan if average annual per acre payments from production adjustment programs are less than fifteen dollars but greater than or equal to five dollars per acre.

Table II. Scenario One, Decision Rule One

	Participants adopting a "minimum" plan		Participants adopting a "full" plan		All participants	
Number of farmers cross-complying based on decision rule	64		22		86	86
Number of participants who previously had a plan	24		9		33	
New conservation farmers	40		13		53	
Number of farmers expected to continue a plan independent of the decision rule						73
Total number of farmers with conservation						159
Number of acres covered by conservation	total	mean	total	mean	total	mean
Participants with a farm plan	19696	854	5436	604	25132	761
Participants without a farm plan	20600	515	3757	289	24357	459
Total acreage	40296	629	9042	411	49338	573
Land tenure (percentage of land)	rented	owned	rented	owned		
Participants with a farm plan	24	76	38	62		
Participants without a farm plan	40	60	43	57		
Total acreage	34	66	39	61		
Enterprise mix (percent of total income)	livestock	grain	livestock	grain		
Participants with a farm plan	40	42	40	50		
Participants without a farm plan	32	54	29	49		
Corn - Number of farms growing	40		18			
- Average yields	113 bu/ac		125 bu/ac			
Wheat- Number of farms growing	40		7			
- Average yields	33 bu/ac		34 bu/ac			

A cross-compliance policy under these assumptions apparently would have significant impacts on conservation. One hundred fifty nine farmers, 41 percent of all farmers, are expected to be following a conservation plan, an increase of 52 percent from the 106 farmers who had a conservation plan. Sixty-four farmers, 16 percent of the sample, are expected to adopt a minimum conservation plan; 22 farmers, 6 percent of the sample, are expected to adopt a full conservation plan; and 73 farmers, 19 percent of the sample, would be expected to continued their current conservation plan. Forty five percent of the acreage in the sample, 94,834 acres, is expected to be subject to a conservation farm plan with the cross-compliance policy; an increase of 35 percent over the acreage subject to a farm plan without cross-compliance, 70,384 acres.

Table 3 on page 88 is a summary of participation in conservation programs under Scenario One and Decision Rule Two. Decision Rule Two assumes that a farmer will adopt a full conservation plan if average annual per acre payments from price support and production adjustment programs are greater than or equal to twenty-five dollars per acre and will adopt a minimum conservation plan if average annual per acre payments from production adjustment programs are less than twenty-five dollars but greater than or equal to five dollars per acre.

Table III. Scenario One, Decision Rule Two

	Participants adopting a "minimum" plan		Participants adopting a "full" plan		All participants	
Number of farmers cross-complying based on decision rule	69		14		83	83
Number of participants who previously had a plan	27		5		32	
New conservation farmers	42		9		51	
Number of farmers expected to continue a plan independent of the decision rule						74
Total Number of farmers with conservation						157
Number of acres covered by conservation	total	mean	total	mean	total	mean
Participants with a farm plan	23841	883	1285	257	25126	785
Participants without a farm plan	21798	519	2106	234	23904	468
Total acreage	45639	661	3391	242	49030	590
Land tenure (percentage of land)	rented	owned	rented	owned		
Participants with a farm plan	23	77	48	52		
Participants without a farm plan	40	60	30	70		
Total acreage	33	67	34	66		
Enterprise mix (percent of total income)	livestock	grain	livestock	grain		
Participants with a farm plan	52	43	46	52		
Participants without a farm plan	33	54	29	43		
Corn - Number of farms growing	43		12			
- Average yields	113 bu/ac		124 bu/ac			
Wheat- Number of farms growing	43		3			
- Average yields	33 bu/ac		32 bu/ac			

A cross-compliance policy under Decision Rule Two, apparently would also result in a significant increase in conservation although fewer farms would have, full conservation farm plans. The difference in the impact of cross-compliance between Decision Rule One and Decision Rule Two is the shift of some farmers from the adoption of a full conservation plan to a minimum conservation plan and the non-compliance of some farmers who received large payments from price support programs but minimal payments through production adjustment programs. Overall, the conservation Decision Rule Two yields results which are similar to the results under Decision Rule One. Forty-one percent of all farmers, 157 farmers, are expected to be following a conservation plan, an increase of 48 percent from the 106 farmers who had a conservation plan. Sixty-nine farmers, 18 percent of the sample, are expected to adopt a minimum conservation plan; 14 farmers, 4 percent of the sample, are expected to adopt a full conservation plan; and 74 farmers, 19 percent of the sample would be expected to continue their current conservation plan. Forty five percent of the acreage in the sample, 94,288 acres, is expected to be subject to a conservation farm plan with the cross-compliance policy; an increase of 35 percent over the acreage subject to a farm plan without cross-compliance, 70,384 acres.

Although little difference can be seen between the

Decision Rules under Scenario One, substantial changes are apparent between Scenario One and Scenario Two. Under Scenario Two, a farmer has no expectations of a set aside program being instituted in the next five years. Therefore, the model assumes that a farmer's expectation of payments from federal assistance programs are based on the annual per acre payment, received in 1977. Since no set aside or diversion program was available under this scenario, gross benefits equal net benefits.

Table 4 on page 91 is a summary of participants expected to have a conservation plan under Scenario Two and both Decision Rules. There was no difference in the results between the Rules. The impact on conservation under the no set aside scenario is minimal. Approximately 31 percent of all farmers, 120 farmers, are expected to be following a conservation plan, a 13 percent increase, from the 106 farmers currently using conservation plans. Twelve farmers, 3 percent of the sample, are expected to adopt a minimum conservation plan; seven farmers, 2 percent of the sample, are expected to adopt a full conservation plan; and 101 farmers, 26 percent of sample, would be expected to continue their current conservation plan. Thirty-five percent of the acreage in the sample, 73,530 acres, is expected to be subject to a conservation farm plan with a cross-compliance policy; approximately a 5 percent increase over the acreage subject to a farm plan without cross-compliance, 70,384

Table IV. Scenario One, Decision Rules One and Two

	Participants adopting a "minimum" plan		Participants adopting a "full" plan		All participants	
Number of farmers cross-complying based on decision rule	12		7		19	19
Number of participants who previously had a plan	4		1		5	
New conservation farmers	8		6		14	
Number of farmers expected to continue a plan independent of the decision rule						101
Total Number of farmers with conservation						120
Number of acres covered by conservation	total	mean	total	mean	total	mean
Participants with a farm plan	4920	1230	275	275	5195	1039
Participants without a farm plan	2024	253	1122	187	3146	629
Total acreage	6944	578	1397	199	8343	439
Land tenure (percentage of land)	rented	owned	rented	owned		
Participants with a farm plan	12	88	0	100		
Participants without a farm plan	26	74	40	60		
Total acreage	21	79	35	65		
Enterprise mix (percent of total income)	livestock	grain	livestock	grain		
Participants with a farm plan	47.5	45	50	50		
Participants without a farm plan	37.5	38	21	48		
Corn - Number of farms growing	8		7			
- Average yields	114		138			
Wheat- Number of farms growing	5		0			
- Average yields	37		0			

acres.

Given these results, a cross-compliance policy would elicit an inadequate increase in conservation if no set-aside program existed. This result is expected, for the lack of a set-aside generally means that carryover stocks are low and that prices are expected to be adequate for the next year. Such a supply climate would exclude most federal assistance payments except from support programs in minor crops and disaster programs.

Distributional Impacts

The distributional impact of a cross-compliance policy on farmers was analyzed with respect to farm size, enterprise mix, yields and land tenure.

Farm size. Under both scenarios, farms that adopt a "minimum" conservation plan are larger in size than the sample's mean size. However, farms adopting a "full" conservation plan are smaller in size than the sample's mean size. This result would seem to contradict studies of ASCS programs where it is concluded that commodity programs benefit larger farmers more than smaller farmers.[3] In

3. United States Department of Agriculture, Status of the Family Farm, Second Annual Report to Congress, Agricultural Economic Report No. 334, (Washington, D.C.: U.S. Department of Agriculture, 1979).

fact, the small farm bias for adoption of a "full" conservation plan is due to assistance payments being averaged over a farm's normal crop acreage. Although the absolute level of assistance payments received by larger farms may be higher than that received by smaller farms, these smaller farms may receive greater per acre payments than larger farms. Although a larger sample is necessary to reach a firm conclusion on the structural effect of a cross-compliance policy, a cross-compliance policy does not seem to have an explicit bias for large or small farms.

Enterprise mix. Under both Scenarios, grain sales constituted a larger percentage of total sales than did livestock sales. For farmers without conservation plans, grain sales exceeded livestock sales by 48 to 69 percent under Scenario One. Sales data under Scenario Two were more indefinite with grain sales exceeding livestock sales by 220 percent for full conservation farms but being essentially equal for minimum conservation farms. These results are to be expected. Since most ASCS programs are targeted at grain producers, the increase in the conservation program came primarily from grain producers. This grain farm bias of the proposed cross-compliance policy explains the indefinite results under Scenario Two when the largest grain programs are assumed to be dormant. As proposed, cross-complying ASCS programs allows conservation policy to focus on cropland erosion problems. However, range and pasture erosion problems would not be directly effected without an additional incentive to the livestock and/or dairy operator.

Yields. The targeting of ASCS programs for a cross-compliance policy results in greater enrollment by high yield grain farms. The variation in yields between farms affected by cross-compliance and the rest of the sample is significant for corn farms, but not for wheat farms. Corn yields are 10 to 20 percent greater on farms that would participate in the conservation program. This difference is due to ASCS programs being based on production; therefore, per acre ASCS program benefits are higher on farms with higher yields. This effect was not seen on wheat farms probably due to corn yields being more variable.

Land tenure. Land tenure differences present a problem in conservation policy. Land renters and landowners face different opportunity sets and respond to different incentives. It is difficult to create a single program to affect both groups. The land owner is concerned with the long term productivity of the asset and may be relatively detached from short run production decisions. The land user is concerned with short term productivity. An effective conservation plan must have the cooperation of both the land owner and land user. If either party is not committed to the plan, it is doomed to failure. Ciriacy-Wantrup cites four aspects of tenancy affecting conservation, instability, incidence of revenues and costs, fixed regressive rents and imperfections in the markets for assets.[4] The owner-user dichotomy is reflected in the present conservation performance of the sample. Farmers who follow a farm plan own 70 percent of their land and rent the remainder. Farmers who do not follow a plan own only 63 per cent of their land and rent the rest. Cross-compliance will not solve the owner-user conflict in conservation unless programs which directly assist both groups are linked to conservation in the program. By linking short-term production incentives with long-term conservation practices, cross-compliance can significantly increase the conservation behavior of those who use, but do not own their land.

The owner-user conflict may be resolved by the indirect results of cross-compliance. For example, if the owner has a crop-share lease with the land user, the owner may indirectly receive ASCS benefits. Cross-compliance would, then provide an incentive to both the land owner and land user. Alternatively, if some land owners refuse to participate in conservation programs, a rent differential may develop between land with and land without conservation practices. This may lead to a capitalization of the value

4. S. V. Ciriacy-Wantrup, Resource Conservation, Economics and Policies, (Berkeley: University of California Press, 1952), p. 51.

of conservation into land prices, providing a conservation incentive to the land owners.

In summary, increased participation in the conservation program with a cross-compliance requirement on ASCS programs will come primarily from farmer-owned, higher yielding grain farms. This implies that rented farms, lower yielding grain farms and livestock farms are not presented with a sufficient incentive to participate in conservation programs with a cross-compliance requirement on ASCS programs. However, as designed, cross-compliance would target those farms with erosion-prone crops such as corn and its high yield bias may result in the conservation of more productive soils.

Chapter VI

SUMMARY AND CONCLUSIONS

This study has examined the potential impact of a cross-compliance requirement between conservation programs and ASCS assistance programs. The study explicitly addressed the consequences of such a requirement on soil conservation and the differential effect of the requirement on various agricultural producers. However, a number of other factors concerning a cross-compliance policy should be addressed.

First, is a cross-compliance policy feasible in the context of administration and implementation? A cross-compliance policy would require closer interaction between SCS and ASCS. However, the institutions necessary for a cross-compliance policy are already in place. Enforcement of a cross-compliance program can be readily undertaken by ASCS. Since conservation is defined by a visible input measure, production practices; aerial photographs can be readily used to monitor compliance. Monitoring by aerial photography is currently used to establish compliance with existing requirements for the set-aside program. With a successful cross-compliance policy, the largest administrative cost would probably be for an increase in the professional staff of the Soil Conservation Service, necessitated by an increased demand for technical assistance.

Second, what would the effect of cross-compliance be on the supply of agricultural products and on participation in commodity programs? If most farms participate in the conservation program, production cost increase may shift the supply curve to the left. This will result in higher consumer prices, and higher farm incomes. However, in the long run higher prices mean smaller assistance payments and after a cross-compliance contract expires, the incentive to continue participation may be negative. If high commodity prices are expected, there is a positive incentive to increase production often by removing conservation practices. A cyclical problem could be foreseen under a cross-compliance policy, whereby low prices induce compliance resulting in high commodity prices as costs increase. However, as farmers' cross-compliance contracts expire, high commodity prices lead to an expansion of production eventually leading again to a glut in supplies and lower prices.

In a similar vein, if a cross-compliance policy results in higher commodity prices due to decreased production, a potential free rider problem exists. Farmers who don't participate can benefit from higher prices without being in the conservation program. The cost to these farmers is small if high prices preclude the possibility of ASCS assistance benefits. Therefore, higher prices create the incentive to increase production and not participate in the conservation. Ultimately, a free rider problem could destroy a cross-compliance policy.

In addition to the effect of price and supply on the farmers, cross-compliance could be counter to the public interest in the commodity programs. If there is the perception that a set-aside program is beneficial to the public by encouraging supply flexibility in the agricultural sector, a cross-compliance requirement on the program may destroy the program's benefit to the public. Commodity programs may have to be redesigned if a cross-compliance element is included. For example, cross-compliance may skew the distribution of program benefits to land owners, since renters may not be able to negotiate a lease of sufficient duration for conservation improvements to be economic. In such a case, an adjustment of the commodity program may be desirable, if it is felt that program benefits are not being distributed fairly or that the program's effectiveness in supply control has been compromised.

Further, if a cross-compliance requirement decreased participation in ASCS set-aside programs, it may actually result in an increase in erosion. Farmers who participate in the set aside and diversion programs have to place some cover on their idled acreage. The coverage can be as minimal as corn stalks. Some farmers who were previously in the set aside program will not participate under cross-compliance. These lands which were previously set aside will now come into production. The effect would be increased erosion, the magnitude of which is uncertain.

Additional study is needed to address the impact of cross-compliance on the supply of agricultural products and on the commodity support programs in general.

Finally, cross-compliance places the burden of conservation on the producer. Since the public as a whole benefits from soil conservation, should the public pay all or part of the cost? To question who should pay is to question where the property rights in erosion lay. Does the farmer have the right to erode? A middle ground would require both consumers and producers to pay the cost of erosion. This analysis has not considered cross-compliance in conjunction with other programs. If the cost sharing program were continued and cross-compliance instituted, the effect on conservation would be much greater than either program alone. Both of the parties which benefit from erosion control may have to bear the cost of conservation.

Before further studies are undertaken, data difficulties should be resolved. James Bonnen has stated that "The cost of poor decisions and subsequent lack of appropriate information is extremely high. The foundation of effective information management for agricultural decisions is careful design of data and information." [1] Bonnen's quote is very applicable to conservation policy. Decisions have to be made concerning conservation policy. Policy makers expect support from policy analysts, especially the economist. However, there are multiple data inadequacies in conservation, therefore, the probability of inaccurate policy prescription is high. This researcher sees three data needs:

First, insufficient physical data are available upon which to base an abstraction of the effect of erosion on productivity. Such a physical relationship is needed so that the benefits from erosion control policies can be evaluated.

Second, a generalized soil loss calculation would improve data availability. Currently, the cost of site specific erosion data is prohibitive. This study intended to use actual soil loss figures to calculate the effect of

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1. James Bonnen, "Assessment of the Current Agricultural Data Base: An Information System Approach," in A Survey of Agricultural Economics Literture, Volume 2, ed. Lee Martin, (Minneapolis: University of Minnesota Press, 1977).

cross-compliance on erosion. However, it takes two men two days to calculate the average soil loss for a farm.

Third, the data banks maintained by ASCS and SCS need to be centralized, the current system is inadequate for the needs of policy evaluation. Data are kept at county offices. No state or national data system exists except at extremely aggregated levels. Even the data collected at the county level is inadequate for full economic analyses.

The data collection requirements imposed by RCA will, hopefully, improve the data which are currently available.

Conclusions

Conservation of our soil resource base is a legislated goal; therefore the question facing an analyst of conservation policy is not should we have a soil conservation policy but rather which policy should be followed. Given an array of proposed policies, each policy should be evaluated on the basis of its cost effectiveness and its distributional impact. More specifically, the evaluative criteria for a soil conservation policy are the effect of that policy on the erosion problem, the cost of that policy and the distribution of that cost.

This study has examined the roots of the erosion problem and the responses of economic paradigms to that problem. It examined alternative strategies for conservation and their potential effectiveness. Finally, a cross-compliance policy was developed conceptually and examined empirically. The following conclusions are made:

1. Cross-compliance will provide a conservation incentive for some farmers who are not presently practicing conservation.

2. Cross-compliance will not provide effective conservation coverage for all farmers. The policy, however, will provide a substantial increase in the conservation incentive, while allowing a producer to choose to erode or not.

3. Cross-compliance's impact on conservation is dependent on future agricultural market conditions. If future conditions are similar to 1977-79 period, cross-compliance will be effective. If future conditions suggest no government programs, the value of cross-compliance is questionable.

4. Cross-compliance will provide consistency

among certain government programs by tying the programs' goals.

5. The taxpayer expense of cross-compliance is low. Conservation financial incentives are realized from existing sources. Additional costs arise from the expense of administration and enforcement.

6. Cross-compliance affects those who benefit most from conservation, small and large farmers. The effects are centered on high yield grain farms.

7. Cross-compliance may increase conservation behavior of those who use, but do not own their land.

8. Cross-compliance will result in new equity problems between the land owner and land user in our commodity programs.

9. Cross-compliance reduces the flexibility of production controls, by eliminating participants from our commodity programs. The cost of commodity program participation is higher than before cross-compliance.

APPENDIX

Manual for Users of Data Tape from the Grain-Reserve Farmer Survey NC-152, subproject 4

I. Introduction

The materials in this manual provide background for using the data tape from the grain-reserve farmer survey, subproject 4, of NC-152. Included are a synopsis of survey procedures and the questionnaire forms; a list of variables and their codes, referenced to the questionnaires and the data tape; a description of how the data are organized on the tape and the computer specifications; a description of hand (pre-keypunch) and computer editing rules, accompanied by SPSS* routines to implement computer rules and by tabular results of selected rules and calculations of descriptive statistics. Also included are tables of selected data not punched on the tape that may be added by analysts desiring to do so and tables listing some data corrections made on the data tape. A list of exhibits appears at the end. The exhibits will accompany the data tapes.

II. Survey Procedures and Questionnaires

The study surveyed corn and wheat farmers to evaluate their attitudes toward and experience with the Grain Reserve program. Samples of corn farmers were drawn in 7 states and of wheat farmers in 8 states. The wheat samples covered 2 hard spring wheat states, 2 hard winter wheat states, and 4 soft red winter wheat states.

There were three steps to the study: a mail survey, telephone interviews with farmers and collection of data from county ASCS offices. All questionnaires, interview forms and instructions to interviewers are included as exhibits II-1 to II-4. Exhibits II-5 and II-6 summarize surveying results.

Questionnaires were mailed in June 1979 to all respondents in both samples. Questions for wheat and corn farmers were identical except that detailed information about grain utilization and storage (questions 5-8a) and two questions about the grain reserve (questions 14 and 16) were asked only for the designated crop. After two to three weeks a second mailing was made to all respondents who had not returned the first questionnaire.

There were two parts to the telephone survey with farmers. In one part interviewers telephoned farmers who indicated on their mail questionnaires that they were in the grain reserve. These farmers were asked a set of questions about grain storage and their plans for selling grain-reserve wheat or corn (Wheat-I or Corn-I questionnaires). Questions Wheat-I and Corn-I were identical with one exception. Question 4-c (Variable 101) was asked only on corn interviews.

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*Statistical Package for the Social Sciences

In the other part, interviewers telephoned farmers who had not returned the mail questionnaires. If they were in the grain-reserve program, a subset of questions from the mail questionnaire and Wheat-I and Corn-I were asked. Not all questions were asked because of the length. The questions asked were on Wheat-III and Corn-III. The questions were identical except June appeared on Corn-III and May for Wheat-III in questions 5 and 7.

Only a few farmers who were not in the grain-reserve program were asked questions. Those questions are on Wheat-II and Corn-II. The information obtained is about farm and farmer characteristics to permit evaluation of possible bias in the mail returns.

Most telephone interviews with farmers were made during July and August 1979. Interviewing in Indiana and Nebraska extended into October.

The final step in the data collection process was to obtain information from county ASCS records about grain-reserve agreements of farmers in our sample. The questions appear on ASCS-I and the answers were recorded on ASCS-II. Data were not punched for bushels per bin for more than 9 bins per agreement. The unpunched data are given on exhibit III-3.

III. Data Organization

All data for each respondent are placed consecutively on the data tape. There are 437 variables per respondent, see exhibit III-1. Codes for blanks are entered on the tape for missing data (-1 for variables with two or more columns; 0 for variables with one column). There are many blank fields because many respondents were not asked all questions. For example, there is information only for 35 variables on telephone forms II, so at least 402 variables are blank for respondents interviewed on that form. And, for all respondents eight variable numbers were not used. No differentiation is made between a blank because the question was not asked and a blank because the question was asked but not answered. Which occurred can be inferred by the subsample of the respondent, V 6.

In a few cases questionnaires were sent in without respondent numbers. Data given are punched but V 1 is blank. Kansas ASCS data are complete only for wheat grain reserve agreements. Some data appear for other crops but they are not complete.

The variables on the tape are taken directly from the questionnaires, with one exception. A new variable for crop reporting districts within states, V 2, was generated from county numbers, V 4. County and district lists are exhibit III-2.

If a mail questionnaire and a form II or III were received from the same respondent, information for duplicate questions was taken from the telephone interview form, II or III. The data tape allows for 11 agreements per respondent and, as mentioned, for 9 bins per grain-reserve agreement. No respondent had more than 11 agreements. A few respondents had more than 9 bins. Bushels per bin for the additonal bins are listed on exhibit III-3 for use by analysts desiring that information. For these respondents, V 159 or V 185 or V 211 or . . . . V 419 is punched 9 although 10 or more bins were used because only one column was allowed on the tape.

The data tape is sorted first by crop, V 5, then state, V 3, subsample, V 6, and respondent number, V 1. For the subsample sort, codes 1, 2, 3, 7, and 8 were grouped together so that all grain reserve participants appear first for each state. This sorting procedure means that the first respondent on the tape is a grain reserve participant, from Illinois, in the corn sample, with the lowest respondent number for Illinois; and the last respondent was not in the grain reserve, was interviewed on form II by telephone, was from Ohio, and in the soft winter wheat sample. This sorting order will ease setting up subfiles for analysis of just corn, corn in one or two states, and the like.

IV. Editing

There were 5 steps in the editing process. First, all questionnaires were hand edited before keypunching. Exhibit IV-1 gives hand editing rules. There is some uncertainty regarding the correctness of rule 11 for the debt/asset question, so exhibit IV-2 is included listing edits. Tape users may wish to examine the list and change some or all of the edits.

Next, several data corrections were made on the data tape. Most were keypunch errors discovered in the process of merging punched data from the various questionnaire forms. One change corrected an error on questionnaire form Corn-I for V 103. Only two columns were allowed for keypunching so the missing digit was added by individual computer edit when the data tape was generated. (For example, a moisture content of 11.5% was punched originally as 11 but changed to 115 by a computer edit.) No exhibits are included with data corrections since they did not alter the original responses given on the questionnaire.

The third step was a series of edits by computer to correct inconsistency in responses, check for keypunch errors and generate missing data where possible. The editing rules appear as exhibit IV-3. The SPSS program to implement them is exhibit IV-4. Editing rules 27-30 were <u>not</u> implemented on the data tape because of cost. Computer routines to implement them are at the end of exhibit IV-4 for use by anyone desiring to apply them.

Exhibits IV-5 and IV-6 are tables generated by the editing routines. The tables in IV-5 were generated before any computer edits were made and those in IV-6 after all edits were computed. The tables are labeled to correspond to the rule numbers in exhibit IV-3.

The "before" tables permit examination of unedited data so that analysts may determine the types and magnitude of some computer edits.* The "after"

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*The data on the tapes sent to you are edited. A tape of unedited data is being kept for reference. W. Meyers will have it when M. Ryan leaves Minnesota.

tables permit examination of data not meeting certain editing rules so that questionnaires could be checked if keypunch errors seemed likely. No tables are printed for rules whose edits seemed straightforward.

As an example, "before" table 2-a shows that 25 of the 38 respondents did not meet the rule that the sum of acreage planted to wheat, corn, oats, barley and sorghum (V 8 + V 9 + V 10 + V 11 + V 12) should not exceed 110% of total cropland (V 7). For those 25 respondents, rule 2-a changed answers for V 7 to blank since there was some obvious misunderstanding of the question. For 13 others the discrepancy was less than 10% so V 7 data were not changed. It was assumed these were minor arithmetic errors.

A comparison of tables 4 on IV-5 and IV-6 shows that the editing reduced the number of respondents not meeting rule 4 from 235 to 150. "Before" tables 7-a and 7-b do not list all cases not meeting these rules. Only the first 360 were listed from a total of 660 for 7-a and 948 for 7-b. If needed, complete lists may be obtained by rerunning those rules on the unedited tape. A comparison of table 7-a on IV-5 with 7-c on IV-6 shows that editing rules reduced the number of respondents not meeting the criteria from 660 to 251.

There is no notation on exhibits IV-5 and IV-6 to show that some apparent errors were checked against questionnaires. The errors found and corrected are listed in exhibit IV-9.

Rule 31 examined ASCS data for grain reserve agreements made in October 1979 or later. This is a problem because collecting of ASCS data in Nebraska extended into December 1979. Since the reserve was opened in October 1979 for entry of some grains, Nebraska data were inconsistent with that for other states. Only the crop variables, V 152, V 178, ... V 412 were changed to blank by this edit. Thus anyone using other ASCS data (V 152-V 437) should screen by the crop variables or change all agreement data to blank if the crop = 0 to avoid problems.

In the fourth step descriptive statistics were computed from aggregated data (all states, all crops). Frequency distributions were generated for discrete variables and measures of central tendency and dispersion for continuous variables (SPSS programs Frequency and Condescript). The computations are presented as exhibits IV-7 and IV-8. These are tables to check the accuracy of the data, <u>not</u> analytical tables. Descriptive statistics were not calculated for all variables because of cost.

As for the errors discovered in the editing process, no notations are made on exhibits IV-7 and IV-8 but errors corrected are listed on exhibit IV-9.

There seems to be too many code 9's for V 35. Since this is not especially important information, they were not checked. Apparently the keypunchers punched 9 if no number was given but something was written in. Common "write-ins" are granaries, buildings, and silos.

On exhibit IV-7, several "9's" appear in frequency distributions for V 153, V 179, V 205, ... V 413. Those appear on the tape and they turned up in the tables because the tables were not screened first by V 152, V 178, V 204, ... V 412. This is an example of the situation mentioned above in the discussion of edit rule 31.

The editing process revealed many errors that were corrected but it was far from exhaustive. It would be appreciated by all tape users if all subsequent data errors discovered are reported to the subproject coordinator. In turn, he can advise all others of the corrections needed.

LIST OF EXHIBITS

DATA COLLECTED FROM FARMERS GRAIN RESERVE SURVEY

Respondent Number

Crop Reporting District

State

County Number

Crop

Cropland Acres 1978

1978 Acres Planted

Wheat

Corn

Oats

Barley

Grain Sorghum

1978 Yield

Wheat

Corn

Oats

Barley

Grain Sorghum

1978 Farm Sales Percentage from five grains (wheat, corn, oats, barley, grain sorghum,) other crops

livestock

Age

Tenancy: percentage of 1978 land owned

rented

Debt/Asset percentage

ASCS DATA SHEET	Respondent Number:	County:	State:
Name:	Address:		
Acreage Total:	Tillable Acreage:		
Has the farmer participated in ASCS programs?		yes	no
Has he participated, but not been certified?		yes	no

PROGRAM PARTICIPATION DATE FOR THE LAST THREE YEARS, 1977-1979

Name of Program	Year	Level of Participation ($)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

Comments:

Please return to: Steve Dinehart
Dept of Ag. Econ.
Rm. 18 Chittenden
Michigan State U.
E. Lansing, Mi

ASCS PROGRAM CODES

100 Price Support Programs

110 Commodity Loans and Purchases
111 Soybeans
112 Corn
113 Wheat
120 Storage Management
130 Farm Stored Facility Loan Program
140 Wool Incentive Payment Program
170 Livestock Feed Program
180 CCC Claims

200 Production Adjustment Programs

210 Wheat and Feed Grain Programs
220 Deficiency
221 Wheat Deficiency
222 Corn
223 Sorghum
224 Barley
230 Set-Aside
240 Voluntary Diversion
250 Prevented Wheat
260 Low Yield

300 Conservation Division Programs

310 Agricultural Conservation Program
330 Emergency Conservation Program
340 Forestry Conservation Program

440 Disaster Programs

440 Feed Grain Disaster
441 Corn Disaster
442 Wheat Disaster

SCS DATA SHEET, CROSS COMPLIANCE STUDY

Respondent Number: County: State:

Name: Address:

Please circle or fill in

Is this farmer an SCS cooperator?	yes	no	
If not do you know if he is following some conservations practice?	yes	no	
Does he have a farm conservation plan?	yes	no	
When was the plan originated (year)?	year-		
Do they follow the plan?	yes	no	don't know
When was he last in contact with your office ?	year-		

Could your list the practices he has installed with technical assistance from your office and the year in which it was installed?

Practice	Year
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

Comments on his erosion problem:

Please return to: Steve Dinehart
Dept. of A. Econ.
Rm. 18, Chittenden
Michigan State University
East Lansing, Mich. 48824

INDEX

CONSERVATION PRACTICE STANDARDS

(Alphabetical Listing)

Practice Name and Unit (Continued)	Code
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Minimum Tillage (Ac.)(10/78)	478
Mulching (Ac.)(10/78)	484
Obstruction Removal (Ac.)(11/77)	500
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Pasture and Hayland Planting (Ac.)(10/78)	512
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Pond Sealing or Lining-Bentonite (No.)(11/77)	521
Pond Sealing or Lining-Cationic Emulsion-Water Borne Sealant (No.)(11/77)	521
Pond Sealing or Lining-Flexible Membrane (No.)(11/77)	521
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