THE ECONOMICS OF SOIL CONSERVATION

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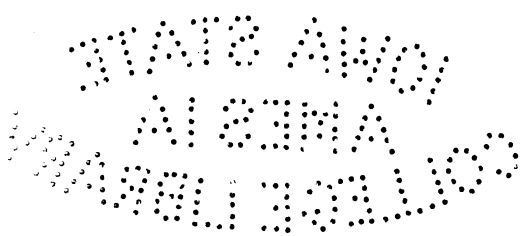

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To H. H. BENNETT

. . . for thirty years a pioneer in soil conservation

. . . who has made this country conscious of erosion and initiated action to prevent it

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INTRODUCTION

The problems of conservation planning range all the way from deciding whether to put a 5-acre field into alfalfa on a specific farm, to evaluating the criteria which may be used to determine how much of the national income should be expended to control erosion. The very scope of the field implies the use of both induction and deduction, particularly when national policies are being formulated and scarce resources have to be allocated to alternative means and areas.

Conservation is an objective of social planning, and should include within its basic purpose the concept of maximizing individual and social wealth over time; its primary, but not sole, concern is to direct the use of resources toward this end. For agriculture this corresponds to the objective of farm management except that conservation planning should be directed first to those areas where the misuse of resources is greatest, while farm management applies broadly to all farms whether any social problem exists or not. Conservation planning, however, also is concerned with intangible values and must consider these in their relationship to other individual and social ends.

Soil conservation is a physical or technological problem, as well as economic, and it is essential that the interrelationships between these two aspects be clearly seen. The physical specialist needs to understand the economic implications of physical changes just as the economist needs to understand the physical factors which underly the problem. Those who formulate policies should base decisions upon both physical and economic factors if social action is to become progressively more effective and economic in nature.

Social planning, which is directed towards non-economic or intangible ends, inevitably includes economic problems because choices between alternative means must be made and the economic repercussions of specific actions must be estimated. All social planning, therefore, must include within it the concept of maximizing social net returns, whatever the end may be. Much social planning of today can only include these economic problems as we develop improved techniques of social accounting.

This does not mean that economic values must be the criteria by which all planning is evaluated; there are many non-economic values or ends which at certain times and in certain localities may be more important; it does mean, however, that economic values must be given consideration in determining the most economic means of achieving the desired end. In all cases where social action is necessary, we must draw upon whatever empirical data there are, we must set research procedures in action to obtain more facts, and we must interpret the data and analyze the problems according to the best theoretical devices available, whether they be statistical, economic, or sociological in nature.

In this study an attempt is made to outline in a broad way the economic and social problems of soil conservation. For, as Pigou has so well expressed it:

> "We are thus put in a position to detect and expose sophistical dogmatism. It is better to know exactly what facts are required to make the answering of a question possible, even though these facts are unattainable, than to rest in a fog of vague and credulous opinion."[1]

The study as a whole may be divided into three major parts. The first section, comprising Chapters 1 to 3, develops the theoretical tools used throughout the study. Concepts and terms are defined in order to give them explicit meanings,

[1] A. C. Pigou, *The Economics of Welfare*, (Fourth Edition) Macmillan Co., London, 1932, p. 227.

and their interrelationships are developed. This involves a brief analysis of production economics as applied to agriculture and the development of the concept of the elasticity of production which has received too little attention in works on agricultural economics.

The second section includes Chapters 4 to 7, and deals with the factors affecting the use of the land by the individual. First we review the effect of virgin fertility upon the cost of production, land values, and prices, and the problems of adjustment that develop as this original productivity is used up. We then move to an analysis of the comparative advantage of exploitive and conserving crops and the effect of price changes upon land use by the individual. Finally, the factors that determine when conservation is economic to the individual are discussed in detail, and the resistances to individual economic adjustment are reviewed. Here we consider not only theoretical relationships but also institutional and sociological factors as they comprise part of the world in which the individual lives, "economizes," and plans his use of the land.

The third major section takes up almost half of the book and contains the remaining five chapters, all of which deal with various aspects of soil conservation as it is related to society. The causes of differences between individual and social net returns are analyzed briefly, and the necessity of social action is related to the basic causes of exploitation that is undesirable from a social point of view. Economic factors, such as differences between the prices available to the individual and to the government, and the failure of all costs to impinge upon the individual, are discussed together with such social and institutional factors as inertia and insecurity of tenure which are also important causes of deviations between individual and social interests.

This analysis is then followed by a brief description and discussion of the major means of social control over land use

and the problems of conservation planning. The need for more accurate methods of social accounting and the necessity of developing techniques of evaluating social gains and losses are stressed and related to specific problems of soil conservation. From the general we proceed to the specific. Chapter 11 deals with war and conservation and suggests in some detail the kind of governmental action that is needed if increased production for war needs is not to result in greatly increased erosion.

The final chapter discusses the basic problems of formulating public policy and action for conservation, and the important part that may be played by economic research in this key function of democratic planning.

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CHAPTER 1

DEFINITIONS OF TERMS

Weaknesses of Early Definitions

The early conservation movement, which was initiated by Theodore Roosevelt in 1908 when he called together a conference of state governors, apparently collapsed because of its vague and credulous opinions. In many ways it became a moral issue and could well be compared with the movement for prohibition. To many the term conservation became a synonym for the good life as expressed, for example, in the statement by Van Hise that "Conservation means 'the greatest good to the greatest number—and that for the longest time.'"[1] In an early work on the subject, Richard T. Ely suggested that conservation means three things: (1) maintenance as far as possible; (2) improvement where possible; and (3) justice in distribution. Regarding the latter point he states, "In general, it may be said that the conservationists wish to cut off, or at least reduce, the private receipt of property and income beyond what is a fair return to capital and labor and enterprise, reserving the surplus for public use."[2] These broad interpretations of the term conservation are so indefinite that they cannot be used for analytical purposes. In many cases, to use the term in this broad sense is confusing, and for these concepts the term social welfare seems more appropriate. The pattern of the distribution of wealth and property rights cer-

[1] Charles R. Van Hise, *The Conservation of Natural Resources in the United States*, The Macmillan Co., New York, 1910, p. 379.

[2] Richard T. Ely in *The Foundations of National Prosperity*, by Ely, Hess, Leith, and Carver, The Macmillan Co., New York, 1918, p. 6.

tainly affects the use made of resources, but to subsume the problems of justice and "fair" returns to labor and capital under the term conservation adds to the difficulty of defining social ends in such explicit terms that they become useful tools in developing policies of social action.

In an excellent statement of the problem of conservation, L. C. Gray suggests that the heart of the conservation problem "is the determination of the proper rate of discount on the future with respect to the utilization of our natural resources."[3] He also states that "Conservation as a single principle of action involves the equal importance of future wants and present wants," and then points out that this leads to absurdity because present use would "become infinitesimal."[4] Present and future wants are not valued equally either by individuals or society, and a concept of conservation based upon the assumption that these wants should be equal becomes an ethical ideal that it is impossible and absurd to attain. The basic problem of conservation, as Gray points out, is the determination of the proper rate of discount for the future; in this respect it is similar to the problem of investment and is essentially economic in nature. Other economists have made the term *conservation* synonymous with economic use so that it has no specific meaning of its own; on the other hand, many physical scientists use the word to denote the reduction of physical waste and reduction in the rate of physical disappearance.

We may well feel like agreeing with Erich W. Zimmerman that, "The word *conservation* seems impossible of final definition, for its meaning changes with time and place."[5] In spite of this statement Zimmerman presents an excellent summary and analysis of the economic problems of conservation and

[3] L. C. Gray, "*Economic Possibilities of Conservation*," *Quar. Jour. Econ.* Vol. XXVII, 1913, p. 499.

[4] *Ibid.*, p. 515.

[5] Erich W. Zimmerman, *World Resources and Industries*, Harper & Bros., New York, 1933, p. 788. *See* Chapter XXXIX "Economy and Conservation of Natural Resources."

distinguishes between *economy*, *conservancy*, and *conservation*. The latter term he defines as, "any act of reducing the rate of consumption or exhaustion for the avowed purpose of benefitting posterity."[6] The use of the word *conservancy* to denote a reduction of the rate of exhaustion achieved by the action of economic forces and not directed to the purpose of benefitting posterity seems to make the terminology more complex and classifies actions into two groups depending upon our judgment as to the end involved. When present as well as future economic benefits accrue, it is impossible to make this distinction in fact. Before making this distinction Professor Zimmerman states,

> "Conservation involves a reduction of the rate of disappearance or consumption and a corresponding increase in the unused surplus left at the end of a given period."[7]

This definition of conservation is similar to the economic term *investment* which also emphasizes the curtailment of present consumption for the future. Under these circumstances economic conservation is simply the maximization of social net returns over time. When the term *conservation* is used to apply to all kinds of resources, there appears to be no alternative to using this broad definition in its economic meaning, but the definition cannot then be used in a physical sense to apply to both fund and flow resources. In the case of labor, our most perishable resource, conservation must imply its full utilization rather than any decrease in the rate of use. Again it is doubtful if a "reduction in the rate of disappearance" of our soil resources can be called conservation in any meaningful sense because then any reduction of the rate of exhaustion would be soil conservation even though rapid exploitation were continuing. On the other hand, a system of agriculture which had entirely eliminated soil exhaustion

[6] *Ibid.*, p. 792.
[7] *Ibid.*, p. 790.

and established a system of fertility maintenance could not be called a conservation system according to this definition because no reduction in the rate of use would be taking place! It appears impossible to define conservation in such a manner that it will apply with equal validity to all resources, unless it is done in such broad terms as to become practically meaningless. For this reason the use of specific definitions related to clearly defined cases seems desirable.

Conservation of Fund and Flow Resources

Conservation is, therefore, a word of many meanings. It is currently applied to all kinds of natural resources and has been given both physical and economic connotations.

In order to avoid confusion it appears essential to limit the term *conservation* to a purely physical concept and use the adjectives *economic* or *uneconomic* to describe those aspects of conservation which can be measured in monetary terms. It is also helpful to define the term differently according to the type of resource being considered; three major resource classes should be distinguished because they are fundamentally different in character and raise different problems of conservation.

(1) Fund or exhaustible resources are limited in amount, and conservation may be defined as a reduction in the rate of consumption which will leave a larger quantity available for future use.

(2) Flow resources occur periodically over time, and conservation means using them in such a way that physical waste (non-use) is minimized.

(3) Biological resources of plant and animal life partake of the characteristics of both fund and flow resources upon which they are dependent. They differ from fund or flow resources in that their annual productivity may be decreased through exploitation, maintained at the present level, or increased by the actions of man. Under these circumstances

conservation may be defined as the maintenance of the present level of productivity.

Fund resources include the essentials of industrial production using inanimate power such as coal and oil, and depending upon iron and other metals for the harnessing of power and building of machinery. These resources may be absolutely limited in extent from a physical point of view, but they are only relatively limited from an economic point of view because changes in techniques of extraction, transportation, and the economic possibilities of substitution introduce dynamic factors. For fund resources, economizing means that rate of exploitation or use which will give the greatest social net returns over time; this depends upon costs of extraction, interest rates, and the relative prices of the products. Conservation of fund resources involves higher prices in the present and may best be attained by monopolistic control.[8] A major difficulty in determining the proper rate of use lies in the evaluation of the dynamic factors of technological changes and the possibilities of substitution as, for example, the use of alcohol (a flow resource) for gasoline. These factors vary for each resource as do the institutional conditions of ownership and control. The problems of conservation can, therefore, only be realistically approached by detailed studies including both physical and economic factors.

Flow resources occur periodically over time as, for example, sunshine, precipitation, wind, water flow, fertility from the action of solutions and organisms in the soil together with fibre or organic matter formed by the growth of roots, and the spacial element of land. When applied to these resources conservation means an increase in the rate of use of these factors.

[8] *See* the article by Harold Hotelling, "The Economics of Exhaustible Resources," *Jour. Pol. Econ.*, Vol. XXXIX, 1931, pp. 137–75.

The objective of economizing is, of course, identical for all resources in that it aims at maximizing social net returns over time. For flow resources, however, present use does not diminish future use of the resource, and the major problem is that of deciding whether present use is economic or not. This involves a consideration of the substitutability of a flow resource such as water power for fund resources such as coal and oil. Where this occurs conservation of flow resources coincides with the conservation of fund resources, and the economics of conservation, in its broadest sense, involves an analysis of these interdependencies and the economic feasibility of substitution.

The problems of mixed fund and flow resources are associated with biological production; a forest a thousand years old can be exploited as a fund resource or placed on a perpetual yield basis; fisheries can be exploited so that the annual yield declines rapidly; the catch can be regulated so that the annual flow is maintained; or, where the optimum biological balance has not been reached, the flow may be increased. The economic problem of maximizing social net returns over time includes the income and costs of present and future periods of time and this again necessitates a detailed study of the physical and economic factors affecting each particular resource. In this light, resources must be segregated into numerous classes according to the physical problems involved. For example, the conservation and the improvement of the flow of herring present entirely different problems from those associated with salmon. In this monograph no attempt is made to deal with the economics of fund and flow resource conservation as such. Of the large number of resources that are biological in character, only land is dealt with in detail. However, many of the principles resulting from this analysis are applicable to other resources in this general category.

Conservation of Land

One of the difficulties of dealing with agricultural land lies in the fact that it is partly a fund resource, partly a biological resource, and partly a flow resource. Agricultural production may exploit the stored up fertility of thousands of years, or it may utilize the fertility annually renewed through flow resources together with the current receipts of energy and moisture. Agricultural land differs from a mine in that its productivity may be increased or built up by man over time. *Conservation* of agricultural land appears to mean the maintenance of the fund resources and the present level of productivity of the soil, assuming a given state of the arts. Improved varieties of crops and techniques of production will mean increases in productivity as these changes occur. *Exploitation* means the using up of the fund resources of the soil, while *improvement* means increasing the physical productivity of the soil by amendments, drainage, irrigation, and other means.

Reclamation is usually used to denote the creation of agricultural land from waste lands, but any increase of productivity by means of applications of capital or labor to the soil is essentially the same and can be included under the more general term improvement. There is always the difficulty of classifying expenditures as land improvement (a capital outlay) or simply as an annual expense. The difference between applying fertilizer or lime and building terraces or installing drains is purely relative and depends upon the time over which each will yield benefits. Whether any particular expenditure be classed as an operating cost or land improvement will depend on whether the benefits will extend over a long or short period of time. Within obvious limits, the division that is made is in practice a matter of accounting and convenience; those expenditures classed as operating costs do not enter into

the capital value of the land, while land improvements do.

Soil types vary greatly in their natural productivity and response to treatments. Many of the podzolic soils have little virgin fertility and have to be improved by careful husbandry and the application of amendments. The chernozem soils, on the other hand, often have large stores of virgin fertility which may be exploited by man for decades. The problem of wise land use involves not only the question of exploitation but also of improvement, and the general statement that we must conserve our soils has little meaning when applied to all soil groups.

In many cases the need exists not only to conserve our soils but also to improve them. The physical problem of conservation differs with each soil type. The physical factors associated with the development of the soil profile include parent material, precipitation, temperature and topography; these determine the plant and animal life that has developed in the past. The soil type, with its characteristic profile and chemical and structural conditions, reflects all of these factors. Some soils are mature and have reached a biological balance, while others are immature and represent young soils not fully developed. The same basic physical factors together with the soil type also limit the crops that may be grown and the cultural practices that can be used in the present.

The limits set by physical factors are not rigid or static and permit many alternative uses at any one time. The biological range of wheat, for example, is extremely wide and only a small fraction of the area that could be devoted to that crop is actually planted to it. The range for tobacco, cotton, and corn is much more limited, but the limits are always relative and not absolute. For corn there is an optimum area in the United States usually designated as the corn belt and as we move from this area yields decline as physical conditions become less suitable; but corn is grown

in Alberta, Canada, and also in the southern states. The development of plant breeding has greatly extended the biological range of many of our domesticated species; drouth- and rust-resisting wheat have expanded the area of wheat in the west; early maturing varieties of corn have extended the corn range northward. These physical factors may be called the "permissive" factors affecting land use because they limit the alternative uses available to man.

Impinging upon these permissive factors are economic and social factors which determine the actual combination of crops which will be grown in any given area. Prices reflect, among other things, the market demand in relation to the area and relative productivity of the land available for and suited to the production of particular crops. Transportation facilities, nearness to markets or centers of population, and the perishability of the product all affect the prices received by the producer. The outcome is largely determined by the profitability of the various alternatives in accordance with the general principle of comparative advantage. These economic factors may be called the "causative" factors because they determine the specific alternatives selected from those "permitted" by the physical conditions. It is because these causative factors of land use are so complex that any analysis of the economics of soil conservation must consider many of the problems of agricultural production as a whole.

Economic Relationships

Exploitation, *conservation*, and *improvement* can all be either economic or uneconomic from both individual and social standpoints. These concepts have the following relationships: When exploitation is economic in any homogeneous area, both conservation and improvement of the same area must be uneconomic; when conservation is economic, exploitation and improvement are uneconomic; and when improvement

is economic, then conservation and exploitation are uneconomic. In economic analysis these physical concepts are closely paralleled by the concepts of *disinvestment*, *maintenance*, and *investment*, with reference to land as a capital asset.

The economic relationships may be expressed in a simple form in terms of marginal theory under the usual assumptions of a flexible competitive economy. Land improvement involves capital investment, and it is economic for the individual to improve his land up to the point where the marginal returns from investment equal the marginal costs. Up to this point the value of the improvement will be greater than the cost. Land exploitation or disinvestment will be economic to the individual as long as the marginal returns from disinvestment are greater than the value of the resource used up. Conservation (capital maintenance) is essentially an equilibrium concept and is economic for the individual when further investment or disinvestment is uneconomic. At this point marginal returns from investment equal marginal costs, and marginal returns from disinvestment equal the value of the resource used up.

The problem of whether certain expenditures for labor and improvements are current operating costs or represent capital investments has to be decided upon the basis of the time period involved, as was mentioned above. How these are classified is a matter of convenience and makes little difference to the general theory, because all factors of production are applied (in the theoretical model) up to the point where the marginal returns equal marginal costs and net returns to the entrepreneur are accordingly maximized.

Simplifications of this nature are useful in revealing broad general relationships in a simplified world created by the assumptions of a competitive enterprise economy. These assumptions abstract from numerous important features of the real world, and in reality, we must consider divergencies

between individual and social net returns, differences in the substitutability of capital for land, the effect of this upon investment and disinvestment, and the problems associated with the institutional structure.

Net Income, Net Returns, and Rent of Land

Net income from land may be defined as the returns to land as a factor of production after all costs of production (including the returns to labor and capital) have been deducted from the gross farm income, including the value of shelter and of home-consumed products from the farm.

Net returns to land as used here is the net land income plus or minus any change in the capital value of the land resulting from exploitation or improvement.

Any decrease or increase in the capital value of the land due to exploitation or improvement is not included in net income; under exploitation, net income would be greater than net returns by the amount of the depreciation of the capital value of the land. This distinction is important because many farmers make no allowance for the depreciation of land values resulting from exploitation.[9] In the case of a system of farming that improves and builds up the productivity of the land, the increase in land value due to this improvement must be added to the net income in calculating the net returns if sound accounting principles are followed. Under a conservation system net income and net returns become identical because no change in productivity or land values takes place.

Economic rent can only be made the basis of land valuation through capitalization when the rent is considered as the annual net return to land under a system of conservation. Under an exploitive system net returns cannot be main-

[9] There are many causes for this attitude, and they are discussed in detail in later sections.

tained over time because the productivity of the land is declining; to capitalize net returns under these circumstances is to capitalize a declining income flow, and this would lead to overvaluation. As shown later, this has been an important factor in introducing fixed costs that make the adjustment from an exploitive to a conservation system difficult. Rent, therefore, may be defined as the net return to land (including the sunk capital applied to it and not separable from it) under a conservation system.[10] Under these conditions net income, net returns, and rent of land become identical. Under static conditions rent and land values would continue unchanged over time; dynamic changes affecting the marginal productivity of any of the factors of production would be reflected in changes in rent and land values. Rent, therefore, represents the expected permanent returns to land under given conditions.

In these definitions the landowner is looked upon as the residual recipient,[11] and management returns are included in costs under the returns to labor. Similarly, interest and depreciation on movable capital goods are included as costs.

To be economic to the individual, exploitation or disinvestment must yield an annual net return for the current year

[10] This definition avoids the controversies regarding the determinants of rent. The marginal productivity theory has some advantages in that it permits a uniform approach to all factors of production, while the classical approach has the advantage of emphasizing differences in qualities of land. In either case the returns must be limited to those occurring under a conservation system. Any realistic analysis of contractual rents must consider four specific determinants: (1) the physical productivity of the land; (2) the supply and demand conditions both of the factors applied to land and the products derived from it; (3) the relative bargaining position of tenants and landlords; and (4) the institutional factors of property rights, custom, and inertia. Any formal definition cannot fully represent reality, and the one used here oversimplifies some problems in order to show other relationships more clearly.

[11] The concept of the landowner as the residual recipient is wholly arbitrary and is adopted as a useful analytical concept in the general theoretical framework developed for this specific study. In other analyses the concept of a residual recipient may be dispensed with, or the residual recipient may be the entrepreneur, or any other factor of production, depending upon the problem being being investigated. *See* chapter 3, footnote 2, and the discussion of population and intensity.

greater than would conservation. If, for example, a rent (net return per acre under conservation) of $5 could be obtained, the capitalized value of the land at 5 per cent interest would be $100. Exploitation, however, might yield a net income of $7 this year, and whether this would represent a higher net return would depend upon the rent that could be earned the next year under a conservation system. If, for example, the rent were reduced to $4.90 an acre, the value of the land would now be $98, and the capital loss would be $2, leaving a net return of $5. In this case the net returns are identical. If the future rents had been reduced to less than $4.90, however, exploitation would have been uneconomic, while if the future rents had not been reduced to $4.90, exploitation would have yielded a higher net return. The same method may be applied to the concept of land improvement or investment to determine whether it is economic or not.

The differences between rents under conservation and net returns from exploitation vary greatly between soils and between different states of exploitation of the same soil; the changes in capital value also vary with changes in the interest rate; changes in the price structure and in techniques of production also affect net income and net returns. These factors and relationships are discussed more fully in later chapters and are only mentioned here to indicate some of the difficulties that arise in attempting to decide whether exploitation, conservation, or improvement is economic for the individual. When the divergence between individual and social interests is considered, the difficulties are further increased by the necessity of introducing concepts of social accounting.

Fertility Depletion and Soil Deterioration

Erosion has been divided into two major categories: normal or geological erosion resulting from the activities of nature, and accelerated erosion resulting from the activities of man.

As used here the term erosion, unless specially qualified, will denote accelerated erosion. This includes wind erosion, and water erosion (sheet, rill and gully); it is a general term implying a movement of the soil. It may be extremely rapid or very slow and represents a destruction of the fund resources of the soil. Fertility depletion refers to the removal of plant nutrients from the soil, and occurs concurrently with erosion; a reduction in the productivity of land may be the result of either of these factors or both together.

Professor Schickele[12] has made a distinction between *fertility depletion* and *soil deterioration* which is of great importance in the study of conservation problems. He states, "Erosion is the most conspicuous form of soil deterioration and, from an economic viewpoint, also the most dangerous because of its irreversible character."[13] The term depletion is used to refer to the removal of plant nutrients and organic matter through crop removals and leaching when these can be replaced by the use of fertilizer, manure, and lime. This distinction is basically physical in nature but may be made economic by expressing it in other terms that may be more useful in determining social-policy. Disinvestment (or exploitation that results in soil deterioration) represents erosion and fertility losses which permanently lower rent; this occurs when the cost of restoring the physical productivity of the soil after a period of exploitation would be greater than the sum of the annual costs, including interest, which would be incurred in maintaining it. Deterioration implies a loss in the value of the soil as productive capital resulting from impairment of its physical properties, and means permanently lower rent to the owner or higher prices to the consumer. Exploitation that results only in fertility depletion, on the other hand, represents

[12] Rainer Schickele, *Economics of Agricultural Land Use Adjustments. 1. Methodology in Soil Conservation and Agricultural Adjustment Research*, Res. Bul. 209, Ia. Agr. Exp. Sta., March, 1937.

[13] *Ibid.*, p. 363.

the use of resources that can be replaced later at a cost equal to or less than the costs of maintaining them. No permanent reduction of physical productivity and rent takes place.

In the case of fertility depletion, the entrepreneur should maintain the productivity of the soil at the point where the costs of marginal inputs equal the value of the marginal product. If he fails to do this because of ignorance or other factors, he and society lose, but the loss is not irreparable. The level of fertility may fluctuate as prices of products and costs vary. In general the entrepreneur tends to be price responsive and increases the intensity of his applications of fertilizer and other input factors when prices rise or costs fall. In this case society need have little concern unless some national crisis demands a larger output of agricultural products, and failure to use resources fully becomes a social menace. In the case of deterioration, exploitation would only be economic for the individual up to the point where the marginal returns from disinvestment equalled the value of the resource destroyed. Failure of the individual to maintain the soil resources at the point where conservation becomes economic means that a permanent social loss takes place, and society is justified in initiating action to prevent it.

This distinction is economic and not physical in nature. From a physical point of view there might be considerable overlapping, and we would find that in some cases physical erosion might be classified as fertility depletion from an economic point of view; this would happen when the cost of restoring the productivity of the soil after a period of exploitation would be no greater than the sum of the annual costs of conservation including interest for the same period. Similarly there may be cases where depletion of soil fertility, with no physical erosion, may cause such changes in the soil that after a period of exploitation the costs of returning to the previous productivity level would be greater than the annual costs,

including interest, of maintaining this level. In this case fertility depletion is essentially the same as erosion from an economic point of view because the rent has been permanently lowered. Thus, from a purely economic point of view soil deterioration represents *any* permanent reduction in rent, while fertility depletion (or utilization) represents the case where no permanent reduction of rent results. This distinction is fundamentally one of the relationship between the costs of restoring the productivity to its previous level and the sum of the annual costs, including interest, of maintaining that level.

While no empirical facts are available to prove that this distinction we have made is sound, it is based on the assumption that in many cases erosion permanently reduces net productivity, while in the case of fertility depletion the cost of restoring productivity will not usually exceed the cost of maintaining it. In both cases exceptions will occur, and these are closely related to the types of soil involved. Where the subsoil is not suited to agricultural uses and does not respond to management, deterioration will be synonymous with erosion because no matter how great the expenditure of capital the resource cannot be replaced. This concept of deterioration is also dynamic, and losses may range all the way from zero to large sums for damage that is expensive to remedy. These losses on any given area will vary as techniques affecting the cost of rehabilitation vary. Whether exploitation resulting in deterioration of the soil will be economic to the individual will depend upon the price relationships and physical factors involved. These will be discussed in detail later.

The importance of this distinction to public policy can be illustrated by the events that took place during and after the world war of 1914–18. In response to high prices and government appeals large acreages of grazing lands were

plowed and placed in crops under systems that caused rapid deterioration of the soil. Where this occurred the original productivity of the soil was destroyed, and serious wind and water erosion developed, so that the land rapidly became submarginal under the farm size pattern and soil management practices that had developed. Where this occurred the population was forced to vacate the land or became dependent upon relief. Where increases in erosive crops only resulted in fertility depletion, no serious maladjustments occurred, and the physical productivity of the soil was rapidly restored. If the present war demands a large increase in the quantities of erosive crops such as corn and soybeans this increase should take place, as far as possible, on lands not subject to deterioration.

These problems are further discussed from the individual and social points of view in Chapter 6 which deals with fertility maintenance, and in Chapter 7 which deals with soil deterioration. Historically we have developed an exploitive agriculture based upon an abundance of soil resources. While much of our early exploitation represented waste (or uneconomic use of resources) much of it was economic because labor and capital were scarce relative to land. One of the major present difficulties, as we shall see, is to adjust the land use patterns developed in a period when exploitation was economic to the new patterns required by a change in the relative scarcities of labor and capital to land.

Some General Relationships

The interrelationships of all these terms may be clarified by examining them with reference to the differences between land and capital, and fixed and variable costs. From an economic standpoint agricultural land is a capital good and differs analytically from other capital goods primarily in its

peculiarities as to reproducibility or substitutability.[14] Land itself is, as we have seen, a composite of fixed and flow resources; at one extreme is the whole complex soil structure (with both the A and B horizons associated with its productivity) which, once destroyed, may never be replaced; at the other extreme is its nitrogen content which may be replaced by legumes or applications of fertilizer. One represents the concept of fixed capital, the other the concept of variable costs. Just as we must use judgment in classifying fixed and variable costs in industry (as, for instance, in deciding whether the cost of an instrument with a certain length of life is a fixed or variable cost) so must we use judgment in classifying the fixed and variable properties of land. There are no absolute criteria of classification, and the division must be made on the basis of its usefulness to the problem under consideration.

For the purpose of an analysis of the economic and social problems of soil conservation, exploitation should refer to a reduction of the fixed capital (i.e. a permanent impairment of productivity and hence of capital value) and be synonymous with soil deterioration. Soil depletion, however, can be looked upon as analogous to the failure to maintain stocks of currently used factors which are usually looked upon as variable costs. Both exploitation and soil depletion represent disinvestment, but depletion is only a short-time phenomenon, while deterioration represents disinvestment which can never be offset by reinvestment or only by a reinvestment of a larger amount of capital. Conservation should refer specifically to maintenance of the fixed capital but would permit temporary changes in fertility due, for example, to variations in the quantity of fertilizer or other factors classed

[14] The spacial element of land is sometimes looked upon as being an absolute difference between land and capital; but in urban areas, where space is most important, space scarcity is overcome by skyscrapers and transportation so that this difference is also only relative.

as variable costs. Land improvement refers to applications of labor and capital of a more permanent nature and would correspond to investment. Whether exploitation, conservation, or improvement is economic to the individual depends upon the cost price structure and varies as these factors vary; furthermore, the fact that any particular course might be economic for the individual does not necessarily mean that it would be economic for society as a whole because society must consider costs, benefits, and prices which may differ from those affecting the individual; both aspects must be considered. Before discussing the relationship of the individual and society to conservation, however, we must analyze the relationships between the various factors of production and show how these affect land use.

CHAPTER 2

EFFICIENCY, CAPACITY, ELASTICITY, AND INTENSITY

Relationship of Land to the Firm

Much of the confusion at present existing in the use of the tools of analysis can be traced to the failure of agricultural economists to distinguish between land as a form of capital and the firm as an economic organization. Concepts which apply peculiarly to the firm have been applied to land, and economic and physical concepts have been confused. The following statements from a well-known textbook are indicative of this conceptual and terminological confusion:

"Within a given area of very similar land value, an office building, a hotel, a department store, a theatre, a filling station, and even a parking lot may exist side by side . . . The office building sells space . . . and to get the maximum of space economically a towering structure is necessary. The department store sells merchandise and space is subordinate to that function; the result is a building of moderate height. In this case the *capacity of the land* (italics mine) is much less than for the skyscraper; it is still less for the filling station and is practically non-existent for the parking lot.

"The productivity of land is two-dimensional and consists of capacity and efficiency. . . Some land can absorb only a few inputs of labor and capital but each unit returns a large output; the reverse is true for other types of land use. The skyscraper calls for high capacity and moderate efficiency, . . . whereas the filling station can operate at a low capacity but has extremely high returns for every dollar of input. . . .

"The same differences in capacity and efficiency of land may be found in agriculture."[1]

[1] Richard T. Ely and George S. Wehrwein, *Land Economics*, The Macmillan Co., New York, 1940, pp. 129 and 130.

The erroneous character of this analysis is easily laid bare. If the land is in a "given area of very similar land values" it would seem that the land is for all practical purposes identical, and any differences in the uses of different parcels are due entirely to the differences between firms and have nothing directly to do with the land as such. By a parallel reasoning process one might speak of iron, using a pound as a measuring unit, and compare a sewing machine, a farm tractor, and a cast iron roller, proceeding to the absurd conclusion that the iron in the sewing machine has a high capacity but low efficiency, in the tractor it has a lower capacity but greater efficiency, while in the roller it has almost no capacity but high efficiency. It is plainly inadmissable that the iron is not identical in all cases, and that the differences result from the combination with it of labor and other factors directed towards achieving entirely different purposes.

Furthermore, physical efficiency and economic efficiency are not rigidly related. For example, one engine might deliver more horsepower per gallon of fuel than another and therefore might be physically more efficient in turning fuel into horsepower; but if the price of the engine in question were extremely high it might be much less efficient in yielding horsepower per dollar.

EFFICIENCY

The most useful sense of the term *efficiency* may have reference to the comparative *net returns* to the factors of production; for example, the most efficient entrepreneur tends to obtain the highest rate of profits, the most efficient land to obtain the highest rent per unit, and the most efficient labor to obtain the highest rate of wages.[2] Such differences in ability to

[2] Efficiency is a result of heterogeneity of different units of the factor being considered; where the factor is homogeneous no difference in efficiency can occur. Moreover, physical efficiency is one thing and economic efficiency

(*Footnote continued on page 22*)

earn returns are due to many factors; in the case of land they result from differences in physical productivity, location, relative scarcity, and the efficiency of any secondary production taking place in the farming system.[3] The physical efficiencies of various pieces of land can be compared only when identical physical units of input are applied to them and the same products are raised under identical managerial efficiency. Thus, differences in physical productivity may be much less important than location, management, character of product, and many other factors, singly or in combination, in determining net returns or rent. Under perfect competition the *marginal* economic efficiency of all factors of production becomes identical because the price of each factor will be such that under equilibrium conditions an added dollar of input of any one factor cannot yield more than an added dollar of input of any other factor.[4] However, a realistic analysis of land effi-

[3] (*Continued*)
another, and the independence of each concept can be well illustrated in the case of land. For example, an area of land might be homogeneous in physical productivity, but different rents and values on different parts of it tend to result from inequalities in the closeness of markets or good roads. Similarly, land in cities might contain soils varying greatly in their physical efficiency in producing corn, but they may, nevertheless, earn the same rent and have the same value for building purposes. In the first case the physical efficiency is identical but the economic efficiency differs, while in the second the economic efficiency is the same but the physical efficiency for growing corn differs.

[3] Secondary production refers to any agricultural production not directly derived from land. Primary production refers to the growing of crops. A farmer producing products from the soil for sale is engaged largely in primary production, while a farmer growing crops and feeding them to livestock is engaged in both primary and secondary production; a farmer using land as space and purchasing feed is largely engaged in secondary production. A cash grain farm represents primary production, a mixed farm producing both crops and livestock products represents a combination of both, while an intensive poultry farm where the land is largely used as exercise ground represents secondary production. This difference is also fundamental to an understanding of the relationship between intensity of land use and the intensity of agriculture.

[4] This is the concept of efficiency as defined by George M. Peterson in his book *Diminishing Returns and Planned Economy*, Ronald Press, New York, 1937, p. 63. Professor Peterson discards the concept of capacity as being useless, as formulated in the past. The weakness of past definitions, however, seems to be largely overcome by the use of the concept of elasticity, which is discussed at length in later sections of this chapter. While I agree with Professor Peterson's concept of the law of diminishing returns applying to the ideal combination of

(*Footnote continued on page 23*)

ciency can hardly emphasize the highly special case of perfect competition, which obscures many of the principal conditions affecting land values and returns in the actual world.

CAPACITY

Capacity refers simply to the ability of one factor of production to absorb inputs of other factors under a given organization of the firm at the highest profit combination. As in the case of efficiency, the capacities of two pieces of land can only be compared when identical applications of variable factors (including management) are applied and the same products are raised. A statement that two pieces of land vary in capacity, while assuming at the same time that the other factors of production are organized differently, cannot be conclusive, for the difference in capacity may result from differences in the firms, while the two pieces of land may be identical. In an economic sense, therefore, capacity represents the value, at the highest profit combination, of all other factors applied in a firm (or other similar unit of economic management) to a given factor selected as a basis of measurement. Thus we might say that the capacity of farm A is $10 an acre, while for farm B it is only $7 an acre; but we cannot say categorically that the capacity of land A is greater than that of land B unless identical units of input, of output, and of management are involved. In diagrammatic presentations capacity is represented by the length of the net or gross productivity rectangle at the point of the highest profit combination.[5]

[4] (*Continued*)
flexible factors in the long run, I also feel that, because agricultural land is relatively fixed (at least in operating units over short periods), farm size is relatively inflexible and that in order to simplify the problems and deal with them more realistically, the assumption of land as a fixed factor is justified. One of the most important difficulties arises from the fact that entrepreneurial ability may also be relatively fixed, and any realistic analysis must also consider the importance of this as it affects adjustments in the combination of factors.

[5] J. D. Black and A. G. Black, *Production Organization*, Henry Holt, New York 1929, p. 155.

It is important to realize that in most of the analyses that have been made of this problem, it is usually the capacity of the firm that is represented and that land is used solely as a unit of measurement. The term is similar to the "normal" concepts of the neoclassic theoretical tradition, and theoretically the "capacity" of a firm fluctuates with every change in the relative prices of products and factors; in this sense it is a concept almost as abstract as that of the intensive and extensive margins.

Elasticity of Production

The fatal weakness in the existing body of analysis of land productivity (or returns)[6] and the problems of the intensive and extensive margins of production seems to lie in the fact that agricultural economists have not made use of concepts which dealt with the slope of the total, marginal, and average returns curves in spite of the fact that the slopes of these curves are one of the important factors affecting changes in efficiency, capacity, and margins. *Elasticity of production*, in its simplest terms, reflects the ability of the farm business or plant to maintain its average returns as more and more units of variable factors are added. In essence the concept is similar to elasticity as applied to demand and cost curves.[7] If when the units of variable input are doubled the output also doubles, the elasticity of output is said to be unity. The

[6] The terms average and marginal *returns* seem preferable to average and marginal productivity when applied to economic phenomena, as this avoids confusing economic and physical concepts. Productivity may best be used to designate physical output, and returns to mean economic output.

[7] The concept of elasticity as applied to cost and supply is not new. It has been developed by Marshall and other economists but never utilized or applied in agricultural economics. Professor R. G. D. Allen has developed the concept in his treatise, *Mathematical Analysis for Economists;* Macmillan and Co., Ltd., London, 1938, pp. 260–64. The major difference in treatment is that the marginal and average productivity curves have been used here instead of the cost curves used by the above writer. Professor Stigler has further developed a similar concept using the term "adaptability," in his article "Production and Distribution in the Short Run," *Jour. Pol. Econ.*, Vol. XLVII, No. 3, June, 1939.

elasticity may be measured by the slope of the tangent to the curve of total returns when plotted on double logarithmic paper; up to the point of diminishing average returns the value would be greater than 1, and beyond that point it would be less than 1. A simple formula for average production elasticity between two points would be

$$\frac{\text{The \% change in total returns}^{8}}{\text{The \% change in units of input}}$$

In comparing two farm enterprises we might find that in case A the total product for one unit of input is \$10 and for two units of input it is \$15; the elasticity of production at this point would then be $\frac{50\%}{100\%}$ or 0.5. In case B, if one unit produced \$20 and two units of input produced \$35 then the elasticity would be $\frac{75\%}{100\%}$ or 0.75. When we compared farms A and B at 2 units of input, we would find the returns of A relative to B equal to $\frac{15}{35}$ or 3 to 7, whereas for one unit of

[8] Only as the limit of this ratio is reached do we obtain the measure of elasticity of a given point on the curve of total production. If Y = the total product and X = the units of input, the formula becomes the proportional increase in Y divided by the proportional increase in X or

$$\frac{\frac{\Delta Y}{Y}}{\frac{\Delta X}{X}}$$; multiplying numerator by denominator,

we get $\frac{\Delta Y}{\Delta X} \cdot \frac{X}{Y}$ and elasticity = limit of $\frac{\Delta Y}{\Delta X} \cdot \frac{X}{Y}$ as ΔX approaches zero, or elasticity = $\frac{X dY}{Y dX}$

input it has been $\frac{10}{20}$ or 1 to 2; the cause of this change in the relationship between the returns of A and B is the fact that the elasticities were different.[9]

These elementary relationships are stated here in order that the limitations of the use of the terms may be clearly seen. The relative returns of two firms vary at different inputs if their elasticities vary; the elasticities of output of two farm enterprises can be compared when the average and marginal returns at the same units of input are known. Relative returns are represented by the ratio of the ordinates of the average return curves for two farms at the same scale of input; the relative returns of the same farm at differing levels of input would be the ratio of the ordinates of the average returns curves at these points. Elasticity is related to the slope of both the marginal and average return curves. The exact relationship is that elasticity equals marginal returns divided by the average returns.[10]

As in the case of efficiency and capacity the elasticity of production can be applied in a physical sense to the productivity of land, and land having a high elasticity of output

[9] The fact that the figures 0.5 and 0.75 represent only average (or arc) elasticity between the units 1 and 2 must be kept in mind. Actually the elasticity would usually vary at every point on the curve. It can be the same for all inputs only when its function plotted on a logarithmic graph is a straight line, which is an impossibility if the principle of diminishing returns is applicable.

[10] Elasticity $= \frac{dY}{dX} \cdot \frac{X}{Y}$ or $\frac{dY}{dX} \div \frac{Y}{X}$, therefore, since marginal returns $=$ the limit of $\frac{Y_2 - Y_1}{X_2 - X_1}$ or $\frac{\Delta Y}{\Delta X}$ which becomes $\frac{dY}{dX}$ as ΔX approaches 0, and since average returns $= \frac{Y}{X}$, then elasticity $= \frac{\text{marginal returns}}{\text{average returns}}$

and all values up to the point of diminishing average returns will be above 1 and below it will be less than 1, while at the point of intersection of the marginal and average return curves the value will be 1.

would, over the range of high elasticity, be able to absorb many units of fertilizer or labor with comparatively little change in average productivity. Land with low elasticity would be subject to rapidly diminishing average productivity which would decline rapidly as additional units of input were added. In this case the elasticity of production of two pieces of land can be compared only when the same crop is grown and identical physical inputs and management are applied. In the economic sense elasticity of production refers to the dollar output of the total farm organization in relationship to any combination of variable factors with a constant fixed factor (or fixed set of factors) measured in terms of dollars.

Elasticity of Production and Fixed and Variable Factors

The basic factor affecting the elasticity of production for any given farm is the flexibility of the ratio of fixed to variable costs. In general an inflexible and high ratio of fixed to variable costs means low elasticity of production and vice versa. In the case of a cash grain farm where there is almost no processing of the produce of the land through feeding to livestock or other means (i.e., very little secondary production), almost all the factors of production may be fixed. Climate, the size of the farm, taxes, and family labor are relatively rigid, and the only significant variables are the quality and quantity of seed, of fertilizer, hired labor, and machinery. Assuming output to be at the highest profit combination, when an increase in price occurs further applications of the variable factors may be made; but the extra output for each additional input will decline rapidly, so that there is very little flexibility of the ratio of fixed to variable costs. In the case of a specialized dairy farm, where the land is largely in permanent pasture and concentrate feeds are purchased, the variable factors are much more numerous. Higher producing

cows may be purchased, larger and better rations of concentrates may be fed, more roughage in the form of hay may be purchased, the size of the milking herd might be increased, and the ratio of variable to fixed costs is thereby increased. Thus, in response to a rise in price a large increase in milk production might take place with only a small increase in unit costs, and the return curves of the dairy farm would be much more elastic than those of the cash grain farm. A fruit ranch would generally have a highly inelastic production curve while an Iowa beef-feeding farm would have a highly elastic curve.

In considering the inflexibility of certain factors the question of short- and long-run periods must be considered. In agriculture we find that many factors such as population density and farm size are relatively fixed over long periods, and concepts which theoretically apply only to short-run phenomena may apply over fairly long periods of time. These fixed factors, however, usually affect primary production much more than secondary production, and high elasticity of total production may be associated with an inelastic primary production when there is much greater elasticity of secondary production.

Intensity

The concept of intensity can have many different meanings when applied to agriculture, and in many cases these differences have not been clearly distinguished by those using this term. Most of the obscurity and misunderstanding in past treatments seem to result from a failure to observe clear-cut definitions of intensity and efficiency and a failure to distinguish clearly between the physical and economic meanings.

Just as we have distinguished between primary and secondary production so may a distinction be drawn between primary intensity and secondary intensity.

1. *Primary intensity* (or intensity of primary production) refers to the direct application of labor and capital to the land in the production and harvesting of plant material. Intertilled crops represent a high degree of primary intensity, while permanent pasture represents a low degree of such intensity. An increase in grass crops represents a move towards conservation while an increase in primary intensity by the use of more intertilled crops may mean an increase in exploitation.

2. *Secondary intensity* (or intensity of secondary production) refers to the application of labor and capital to all processing of agricultural raw materials undertaken on the farm land. Livestock enterprises and all other agricultural production where the inputs are not directly applied to the land determine the level of secondary intensity. Dairying, beef-feeding, and poultry farms represent intensive secondary production.

3. *Intensity* without any prefix refers to the sum of primary and secondary intensity; that is, the total amounts of labor and capital per acre applied in the farm business. This is in harmony with the generally accepted use of the term and tells us nothing about the intensity of primary production or the land use pattern.

Physical and Economic Meanings of Intensity and Elasticity of Production

In its economic meaning intensity must always refer to the value of inputs, not to physical inputs. Physical intensity can only be measured, for comparative purposes, when identical physical units of input are used. It may well be questioned whether the economic meaning of primary intensity is of great value in the discussion of physical land use problems because inputs of dollars may represent entirely different things. A similar problem exists when dollars are replaced by physical units—labor hours or machine hours—and we are left with

only broad measures of land use, in terms of rotations and crops grown, as a realistic approach to the meaning of the intensity of "land use" or cultivation.[11]

The general statement that an increase in "intensity" leads to conservation has often been made. Whether this is true or not depends upon whether the increase in intensity was primary or secondary. Even if we assume an increase in primary intensity, it does not necessarily mean a movement towards conservation because this will depend upon the type of changes in land use introduced by the increase in intensity. If, for example, pasture land is plowed up for grain crops we have an increase in primary intensity and very probably increased exploitation of the soil. On the other hand, the building of terraces, contour farming, and increased applications of manure also represent an increase in primary intensity, and these would be associated with conservation.

Similarly, for elasticity, the same distinctions may be made. Primary elasticity of production, in a physical sense, is a measure of the ability of the land to absorb additional units of fertilizer, labor, etc., and produce proportionate increases in yields. Secondary elasticity in this physical sense indicates the ability of secondary production to absorb more physical units and result in proportionate increases in physical output. In all cases the economic concept of elasticity refers to the ability of the enterprise to absorb additional inputs of dollars and produce additional money returns.

In the case of capacity the physical meaning refers to the

[11] The *land use capability classes* developed by the Soil Conservation Service are said to reveal the upper limits of the intensity of land use. For example, E. A. Norton states "classes of land according to use capability indicate the maximum intensity of agricultural use that can be practiced safely." This is a misuse of the term intensity and, as previously pointed out, "actually, land use capability classes establish land use and practice patterns or limits of tillage operations but do not represent levels of intensity." *See* E. A. Norton, "Land Classification as an Aid in Soil Conservation Operations," and the "Discussions" by G. A. Pond and by A. C. Bunce in *The Classification of Land*, Bul. 421, Mo. Agr. Exp. Sta., Dec., 1940, pp. 293–304, 305–8, and 309–13.

quantity of physical units of labor and capital goods applied to a unit of land at the highest profit combination for a given firm, while the economic meaning refers to the total value of all inputs at this point.

In the case of agriculture the use of these terms in a physical sense is extremely limited because of the lack of homogeneity in both the factors applied and the goods produced. The economic applications are developed in the next chapter.

CHAPTER 3

THE RELATIONSHIP OF RENT TO THE ELASTICITY OF PRODUCTION AND INTENSITY OF LAND USE

Average and Marginal Returns and Rent

The general relationships existing between rent, intensity, efficiency, and elasticity of production may be illustrated by examining the average and marginal return curves for four "ideal" types of farming. Figure 1 presents the hypothetical curves of farms A, B, C, and D.

The units of input ON measure the dollar value of all the factors of production applied to the land; the physical factors involved may be quite different for each farm, and the combination may vary on the same farm as the inputs are changed. The average and marginal returns curves are derived from the gross farm incomes per acre which are assumed to result from the application of different amounts of the input factors.

Farm A has high initial returns[1] and high elasticity; B has high initial returns but low elasticity. Farm C has low initial returns but high elasticity, and D has low initial returns and low elasticity. Land is assumed to be the fixed factor, and the returns are expressed on an acre basis. If we assume all managers achieve the maximum profit combination so that inputs of variable factors are continued until the marginal curve intersects the unit cost line BD, then the marginal efficiency of variable factors is equal in all four cases. The

[1] Initial returns refers to the returns up to the point of diminishing returns. *See* Chapter 2, footnote 6, regarding the use of the terms "returns" and "productivity."

comparative returns of each business are indicated by the relationship of the ordinates of the average returns curve at the number of units taken as a basis of comparison. The area OACN represents the gross income per acre. The area BACD represents rent or the net returns to land after all other

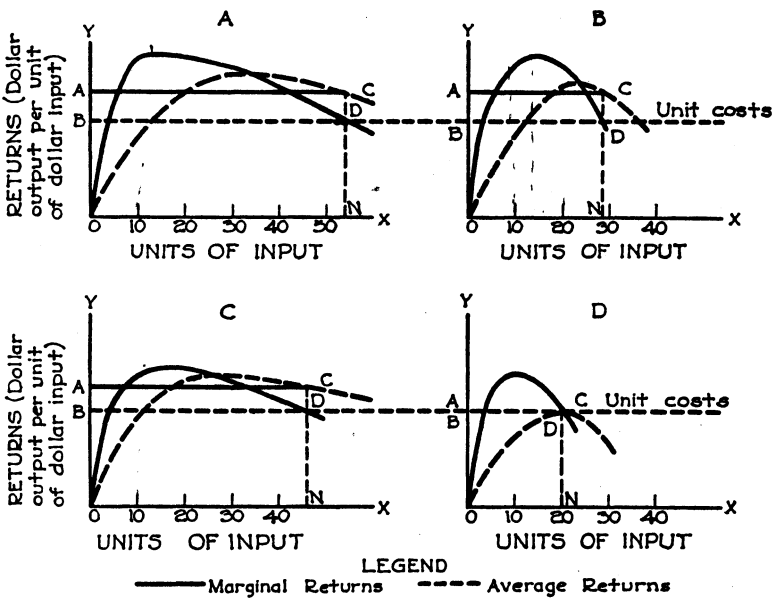

Fig. 1. Marginal and average return curves for four types of farms.

expenses of production, including wages, have been paid; this reflects the relative efficiency of the land as a factor of production. In the case of farm D the points A and B coincide, as do C and D, so that there is no rent.

Under the given cost and price conditions the capacity of each farm is indicated by the length of the line BD, and this will be determined by the height of the marginal return curve and its slope.

To make the picture more concrete, type A might be a

dairy farm where large amounts of capital in the form of machinery and stock are invested and where further investments in well-bred stock, feed purchases, and labor would continue to give proportionately large returns. Under these conditions the marginal returns decline only slowly so that the elasticity of production is high, and many units of dollar inputs may be added before the marginal returns curve intersects the unit cost line where marginal costs and marginal returns are equal.

Type B might represent a truck farm where initial additions of fertilizer and labor bring large returns but continued additions are followed by more rapidly diminishing returns; and even though the land in this case might be worked much more intensively than the pasture land of the dairy farm, it could still be a less intensive type of agriculture from an economic standpoint. In this case the marginal returns curve rises rapidly and declines rapidly so that the marginal curve intersects the unit cost line after comparatively few units of input have been added.

Farm C might represent a typical general mixed farm where the marginal returns up to the point of diminishing returns are smaller than in cases A and B, but because of the flexibility of the farm business, the marginal returns from the many alternative enterprises decline only slowly so the farm business as a whole has a high elasticity of production and can absorb many units of input.

Farm D could represent the conditions existing on a marginal western grain farm; the first applications of inputs do not bring very high marginal returns, and these decline very rapidly once the point of diminishing returns has been reached. No alternative enterprises are available so that the elasticity of production is very low, and few units of input can be applied. In the example given, the average returns curve touches the cost line where the marginal curve intersects it

so that no rent is possible; if the average returns curve had remained below the unit cost line the farm would be submarginal, and the returns would not cover all the costs. Our assumptions are that costs include returns to management and labor, interest charges, and all other expenses of production. On a submarginal farm all these costs cannot be paid; either the level of living of the family must be depressed, or interest, taxes, seed, and fertilizer bills left unpaid.

Primary and Secondary Production

While we are here mainly concerned with economic relationships, the fact that these economic differences are due to physical relationships within the farm must not be overlooked. Changes in the physical production plans of the farm to achieve conservation may offer many alternatives, and the most economic plan can be selected only when it is possible to estimate the economic effects of each of these physical alternatives.

Intensity is represented by the rectangle BDNO which is a composite reflecting the intensity of both primary and secondary production. To separate this into component parts is not a simple task and can be done only when a complete farm management analysis is made which would show the relationships of costs and returns for both primary and secondary production. If this were done we would have two sets of return curves. In many cases the curves representing the marginal and average returns of primary production might be extremely inelastic, while the curves representing secondary production might be highly elastic; the elasticity of the curves of total production represents the sum of these two influences.

This distinction is of fundamental importance to any analysis of the economics of soil conservation because any loss in income due to a reduction in the intensity of primary production in order to control erosion (as is the case when crop land

is retired to permanent pasture) may be offset by an increase in the intensity of the secondary production (as is the case when more livestock is fed and additional feed purchased).

The Function of Rent and Its Relationship to Elasticity

When we turn from the purely static analysis to a consideration of a dynamic society, the function of rent[2] appears to be that of reflecting changes in the cost price structure and thus assisting to direct agriculture into its most productive lines of endeavor. If population increases and the demand for the products of agriculture increases, there will tend to be an increase in prices, and the marginal and average return curves will tend to rise.

Instead of considering two sets of average and marginal return curves to analyze the effect of an increase in prices, let us assume that the unit cost line BD (Fig. 1) moves down toward the X axis;[3] the increase in intensity and rent which would take place for each type of farming would be related to the elasticity of production of that particular enterprise.

[2] It is assumed here that rent is the surplus accruing to the landowner and is determined by competitive bidding, not by custom or institutional factors as is often the case. Where the farm is operated by an owner the desire to maximize income would have the same effect as if he paid rent. Because the landowner is assumed to be the sole residual recipient, the importance of rent as a directing agent is exaggerated.

[3] Since we are expressing output-per-unit-of-input in terms of dollars, any increase in prices will result in a higher output per unit of input, and the cost line should always remain constant because it represents the unit of measurement. This means that two sets of marginal and average returns curves should be drawn on each graph, but for simplicity in presentation the unit cost line (and with it the x axis) is lowered. This procedure implies that the height of the returns curves at the new price level are exact multiples of the heights of the returns curves at the old price structure. For this to be true the supply of all the variable factors of production would have to be perfectly elastic for each firm. Realistically, such flexibility is unlikely to occur. Whether such an assumption is legitimate for heuristic purposes will depend upon the extent to which the increases in prices, by causing shifts in production, create a change in the demand for and prices of specific factors of production. The simplified method used here assumes that an increase in prices will not cause any significant change to take place in cost factors, i.e., the analysis follows the "particular equilibrium" method of the neoclassic approach.

Where the elasticity is high the relative increase in the intensity and rent of the enterprise will be great; where the elasticity is low only a small proportional change in intensity and rent will result.

The increase in intensity and rent in response to a general increase in the prices of agricultural products, however, is related to the elasticity of production existing under the farming system established before the price change; two farms yielding the same rent under the old prices may differ in elasticity of production, and the rents under the changed intensities may no longer be equal. This disturbs the earlier balance between rents and the extensive margins of competing enterprises, and the farm business which receives a *relatively* lower rent under the new prices may have to be changed to one which will yield a higher rent.

Thus an increase in prices, by raising the rent, may make a marginal farm submarginal for its past use and force the operator to adopt a more intensive type of agriculture with the result that the production function, and hence the elasticity, may also be changed. In general, the elasticity of production will be increased on those farms where the type of farming is changed to include more secondary production, while elasticity will decline on those farms which simply intensify their present use of labor and capital without changing their production organization. Where two types of farming as, for example, grain and dairying, exist side by side on similar soil types and have equal rents, the relationship will be such that any change resulting in a greater increase in the rent[4] of the dairy farm over the grain farm will force the grain farm into dairying. This expands both the intensive and extensive margins of the dairy industry while increasing

[4] Changes in rent in response to changes in prices will depend not only upon the elasticity of production, but also upon the shape of the net returns rectangle which reflects capacity (the abscissa) and marginal net returns (the ordinate). These relationships are discussed in Chapter 5.

the intensive margin and curtailing the extensive margin of grain farming. At the same time other shifts in production may cause a replacement of other farms or idle land by grain farms, and a new balance tends to be eventually achieved amongst all competing enterprises.

This relationship is illustrated in Figure 2. A dairy and a grain farm with identical soil resources are assumed to exist

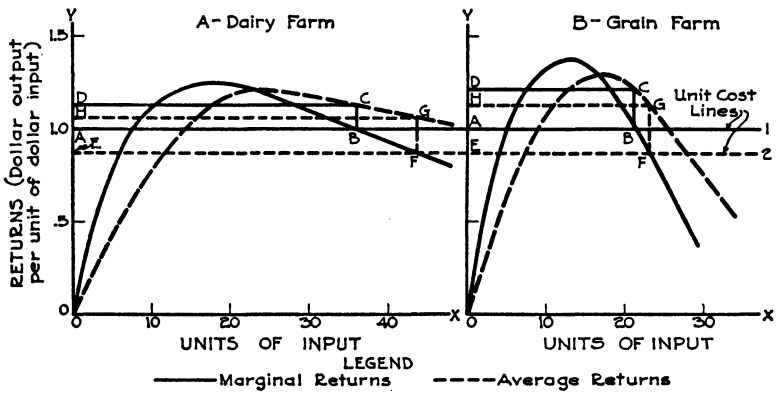

Fig. 2. Rents at two cost levels for farms differing in the elasticity of production.

side by side; both earn the same rent per acre, but the dairy farm has greater elasticity of production due to differences in the farm organization. At cost line 1 the rent is ABCD and equal to $4.20[5] in both cases (.12 × 35 for A and .20 × 21 for B). When the cost line is moved to position 2, the rent (EFGH) on farm A becomes .20 × 45 or $9, and on farm B it becomes .25 × 23 or $5.75. Because of the relatively low returns of the grain farm, it will be forced to change to another alternative in order to equalize net returns, or rent, on the two areas of soil having the same physical productive capacities.

[5] These figures are calculated from hypothetical curves for the purpose of illustrations only.

When we consider the relationship of a decline in the costs of factors of production to rent and the elasticity of production, no simplified generalizations can be made because the substitution of the relatively cheaper factor of production will change the organization of the physical factors and, therefore, the elasticity. If we assume a reduction in the rate of interest (which applies to all agriculture) there will tend to be a general increase in the application of capital to all enterprises; this may or may not replace labor, and any resulting increase in production will be related to the amount of substitution that occurs. If we assume that no substitution occurs, then production will be increased and price changes related to the elasticity of consumption will occur; finally a new equilibrium position tends to develop with rent, elasticity of production, and intensity all affected.

If we assume a new invention which reduces the costs of production of a particular crop, as the binder and combine have reduced the costs of wheat production, the extensive margin of the particular crop will tend to expand and production will increase; prices will tend to fall in relationship to the elasticity of demand, and the new equilibrium will affect the crop being considered and also the crops competing with it for land. In the case of wheat, inventions led to an increase in rent in the new level areas of production; areas which had been submarginal for wheat now returned rent because low yields were offset by an increase in the area that could be operated. The economic intensity of wheat farming was greatly reduced because the labor required per acre dropped to a fraction of its former amount. At the same time the reduction of the price of wheat forced older wheat-producing areas into other alternatives, and rent, elasticity of production, and intensity were all affected. Because of these interdependencies the relationship of rent, elasticity of production, and intensity to changes in costs is indeterminate

unless the rate of substitution of cost factors and the elasticity of demand are known. The general relationships to changes in both cost factors and product prices can, therefore, be expressed only in broad terms.

The general relationship is that any changes in prices or costs which cause changes in the relative rents of land will disturb the previous balance existing between the margins of competing enterprises. The elasticity of production is an important factor affecting the changes in intensity and rent that may result from price changes and, therefore, is an important factor affecting the margins of competing enterprises. Because the elasticity of production is related to the physical organization of the farm, any change in the production organization may cause a change in the production function and the elasticity of production. Where intensity and rents increase with no changes in production organization, the elasticity of production will always decline, while changes in production organization which increase the importance of secondary production will tend to increase this elasticity.

Theoretically, rents, intensity, elasticity of production, and the margins of competing enterprises should fluctuate according to both increases and decreases in prices or costs. Actually the necessary flexibility of the factors of production is seldom found, and realistically we have to deal with a world of pervasive rigidities.

The Effect of Institutional Rigidities

When the assumptions underlying the foregoing theoretical approach are contrasted with the institutional conditions under which agriculture actually operates, we find important differences. In general, the factors of production are not mobile or easily divisible even over relatively long periods of time. Available family farm labor is relatively stable and often has no alternative uses; farm sizes do not change rapidly;

capital once invested in buildings and machinery is not easily withdrawn; population shifts between different types of farming areas take place with difficulty; contractual rent is usually relatively inflexible and determined by customary shares rather than by competitive bidding; and the individual entrepreneur cannot easily adapt himself to new types of production. One immediate result of these conditions is that, during periods of rising prices, increased applications of labor and capital take place rather rapidly while adjustments between the extensive margins of production of alternative enterprises occur less rapidly. If there is a lag in the increase of rent, the entrepreneur finds himself with a larger income than before. Likewise, when prices drop or costs increase, while rent reductions are delayed, the farmer finds that his income is greatly reduced. At the same time production will tend to remain high because of the difficulty of disinvesting capital invested in the farm business and the inability to reduce farm labor. In other words it is extremely difficult for agriculture to reduce its intensity by curtailing labor and capital applications in any one type of enterprise and still more difficult to shift backwards to a less intensive type of agriculture. This is invariably true of short periods of time and very often even where quite long periods of time are allowed for readjustments.

A further rigidity is introduced when rent becomes capitalized into land values. As rents increase due to rising prices or declining costs, the price of land may reflect both the actual increase in current income and further anticipated income increases in the future. This usually will be the case if the increase in income extends over a long period of time, as in the United States during the expansion period of the past century. The capital invested in land becomes a fixed charge against the enterprise when the land is mortgaged, and during a period of falling prices, this fixed cost can be reduced only by a slow and painful process of deflation.

Population and Intensity of Land Use

It is sometimes assumed that a dense rural population and small farms necessarily represent intensive farming. This, however, is not an accurate generalization if it neglects the relative level of living of the groups involved. Only if farm families are perfectly mobile, so that the level of living of all persons engaged in farming tends towards the same general level, and only when applications of capital per unit of labor are equal, will the density of population indicate intensity of agriculture. With the immobility and variations in the applications of capital that exist today, and the great differences in levels of living, population density cannot be accepted as a reliable criterion of intensity. A dense rural farm population with a low level of living may mean that labor is relatively less productive than it is in other areas because the supply relative to other factors of production is abundant and cheap. This resulting low productivity may be due to the fact that mobility involves expense, adaptation to new methods of farming and social disruption. It may also be due to the fact that climate, soil type, customary methods of farming, lack of markets for alternative products, and lack of capital prevent the development of different types of agriculture having a greater elasticity and capacity than the old. Under any circumstances contractual rent is closely related to the cheapness of labor, and any fall in prices may force down the level of living of the farmers to an extremely low point or cause a fall in rent and a collapse of land values. Which of these possible results occurs will depend upon institutional factors, relative bargaining power, and the possibility of lowering the level of living of certain groups below that previously accepted.

Capital, unlike labor, is extremely mobile before it is sunk in capital goods. Buildings, fences, drains, and other permanent improvements can be applied to the farm industry in

any corner of the country. The only condition is that the expected returns will be large enough to cover risk, maintenance, and interest charges. These permanent improvements become part of the land, and their value, up to their replacement costs, is determined by the same factors that determine the value of the land. From an individual business point of view, the distinction between land and fixed capital largely disappears.

Historically landowners have been looked upon as the residual recipients to which all natural scarcity values flowed. In reality, however, the residual recipient will be determined by institutional factors, relative bargaining power, and mobility. Because of the short-term rigidity of interest rates and rental agreements, the residual recipient is generally the farm family, which absorbs the fluctuations in returns by receiving a fluctuating income. In the case of share rent contracts, the owner shares the fluctuations with the operator. While the theoretical relationships do not adequately reflect reality they do reveal the causes of pressures and indicate the direction of desirable adjustments. The following chapter applies the theoretical concepts to the problems of adjustment that have arisen because, in many areas, the presence of virgin fertility led to an exploitive system of farming that could not be maintained as the fertility was reduced and erosion developed.

CHAPTER 4

EXPLOITATION OF VIRGIN FERTILITY AND THE INTENSIVE AND EXTENSIVE MARGINS

Virgin Fertility and Costs of Production

The exploitation of large areas of land with accumulated stores of moisture and fertility means that the costs of production on such areas are lower than they would be if fertility were maintained. This affects the intensive and extensive margins not only of the areas possessing the virgin fertility but also of areas not possessing this initial gift. The effect depends upon whether exploiting the virgin fertility, thereby reducing costs and increasing supply, results in lower prices, or whether the lower costs simply result in higher net returns to the owners of land having virgin fertility with little effect upon prices because the supply did not increase more rapidly than population and demand. In either case any development towards an appropriate organization of factors under exploitive conditions means that maladjustments inevitably arise as the virgin fertility is used up and costs increase. Historically we know that the development of the vast areas of chernozem soils in the western prairies lowered the prices of grains and, coupled with reduced transportation costs, affected the agriculture on the podzolic soils not only in the east of the United States but also in Europe. During this period land values and rents were low, and the assumption that reduced costs due to virgin fertility were largely passed on to consumers appears justified. This might be referred to as the initial exploitation which took place as the westward migra-

tion across the continent occurred.[1] During the first world war, however, a second exploitive period set in, resulting from abnormally high prices for crops due to curtailed production in Europe. In this case the lower costs resulting from the exploitation of virgin fertility did not prevent a rapid rise in prices, and the net income to land increased so that rents and land values also rose rapidly. This second exploitive movement was associated with an increase in cash expenses through the introduction of tractors, and a reduction in the numbers of horses and mules; not only were the western plains plowed up for wheat, but the acreage in permanent pasture and meadow on individual farms was also reduced to make larger acreages of grains possible.

Exploitation and Land Values

Exploitation tends to result in lower prices and higher current net income to enterprises utilizing land, but the relative change in each will depend upon a number of factors. If virgin fertility gives rise to lower costs of production during the period of exploitation, it means that although prices do fall the net income accruing to the land will be higher than it would be when fertility has to be maintained; where prices do not fall it simply means that this differential will be greater. The immediate results of this high net income on soil types having exploitable stores of virgin fertility is a land valuation which is too high for the enterprise when it is placed on a fertility maintenance basis. Areas which would be submarginal when fertility had to be maintained are marginal or supramarginal while the native fertility lasts. A further important result is that the capacity of the farm enterprise may be increased and net income further raised and with it land

[1] *See* Ralph H. Hess, "Conservation and Economic Evolution" in *The Foundations of National Prosperity. op. lit.* pp. 99–112.

values. As a final result the intensive and extensive margins[2] of competing enterprises are established at positions which cannot be maintained when the decline in productivity makes higher costs inevitable.

A further complicating factor arises when the problem of real estate taxes is considered. These taxes, which are usually based upon the valuation of the farm, are collected in part to pay for improvements and services demanded and made possible by the high net income resulting from the virgin fertility. As this income declines the improvements and services remain, and where bonds are outstanding and services continued, they must be paid for from the declining returns which result as the original fertility is exploited. In some areas tax delinquency may result in higher tax rates on the better land, and the problem is then greatly intensified.

Price Ratios of Competing Products

A further effect of the exploitation of virgin fertility is the establishment of price ratios between competing farm products which of necessity reflect the supply determined by the intensive and extensive margins established under the exploitive system. A simple example may serve to illustrate the general line of argument. If wheat production were more profitable

[2]At the intensive margin of an enterprise the marginal returns from inputs of variable factors applied to land just equal the marginal costs.

At the extensive margin of an enterprise the marginal returns to a unit of land applied to the other factors of production when these are kept constant will just equal the marginal cost. The marginal cost of the land will be its net returns per unit from the nearest competing enterprise or its opportunity costs. Thus at the extensive margin the net returns per acre from enterprises competing for land are equal whether on the farm, between regions, or at the margin of utilization where net returns become zero.

Changes in prices and costs would cause both of these margins to fluctuate providing that all the factors were perfectly divisable and mobile. For an excellent discussion of the limitations of these concepts, *see* "The Concept of Marginal Land," by G. M. Peterson and J. K. Galbraith, *Jour. of Farm Econ.*, Vol. XIV, No. 2, pp. 295–310, April, 1932.

than raising beef cattle on western lands, while exploitation of the original fertility keeps cost down to a minimum, these areas would be taken over by the more intensive system. More capital and labor would be applied in the area, and rents and land values would rise. Wheat production is increased, and the area available for cattle production is curtailed. As a result the price of wheat relative to the price of cattle is different from what it would have been if the area of wheat cultivation had not been expanded, and this holds true regardless of changes in demand factors. The curtailment of the supply of cattle will tend to raise prices, rents, and land values in the grazing areas. If the increased output from the areas having virgin fertility lowers the price of wheat, then the areas of wheat production where fertility maintenance and improvement is an important cost will also be affected but in the opposite direction. This has been true of many of the podzolic soils of the east; farms which were marginal under the old price structure became submarginal, and readjustments in land use became inevitable. Fertility maintenance and improvement for the production of crops was no longer profitable in the older areas, and farms were ruthlessly exploited and abandoned.

The effect of exploitation upon the margins of production would not be important if the process were easily reversible, but in many cases this is not so. When the initial fertility of the land is reduced to the point where conservation becomes economic, several alternatives are possible. These alternatives will depend upon the comparative advantage of the exploitive over the conservation system, the relationship of primary and secondary production, the question of whether the various factors are divisible and flexible, and the rigidity of the institutional factors developed under the exploitive system.

Adjustments When No Change in Type of Farming Is Required

In order to analyze this problem of the effect of original fertility in lowering the costs of production and affecting the intensive and extensive margins, the intensity of land use, the relative prices of products competing for land, and the effect on conservation, three specific examples may be considered separately.

The simplest case is where original fertility has meant only a lowering of costs of production, and no change in the type of farming is necessary in order to achieve conservation. In this case the resistences to the adoption of conservation would not be serious, and costs of production would be increased in order to maintain yields and maximize net returns.[3] However, either rents and land values must decline or the level of living or labor income of the farmer must be lowered. Under actual farming conditions the comparative bargaining position of the landlord and tenant will tend to determine the share of the extra costs which each will bear. If the costs of maintaining the soil resources are not met and the exploitive system is continued, then net returns will decline beyond the point where conservation becomes economic, and the losses will be greater than if costs had been increased and income maintained. In this case the intelligence of the farm operator and his security of tenure, which should permit him to reap the benefits of increases in costs such as liming and fertilizing, would seem to be the main factors governing his decision whether or not to practice conservation.

A variation of this case occurs when, because of high rents and land values resulting from exploitation, a corresponding increase in intensity of use of labor and capital per acre takes

[3] Prices and technique are assumed constant in order to simplify the picture, although the same relationship holds when these vary.

place. In this case (assuming family farm labor) the size of the farm will be smaller under the exploitive system than it would be if conservation had been followed from the beginning, and more capital per acre in buildings and machines may be applied. This increases total output and total costs per acre and, as the original soil resources are depleted, not only would rent and land values have to decline, if the level of living is to be maintained, but capital might have to be disinvested and farm size increased (or hired labor decreased). Under these circumstances the labor income of the operator would probably be curtailed and possibly remain depressed. Whether conservation will be adopted depends largely upon the type of costs involved: if capital expenditures for terraces, moving fences, liming, and fertilizing are required, the lack of income and inability to disinvest or earn interest on capital already invested might become almost insuperable obstacles to the adoption of conservation farming even though such added investments are necessary to prevent further declines in income.

Large numbers of our general or mixed type of farms would fit into this first group. The problem of conservation is largely one of educating the farmers so that they realize that continued exploitation will lead to lower incomes and that conservation farming is economic after a certain period of exploitation has passed. At the same time suitable conservation measures must be demonstrated, and specialists should be available to help the farmer plan his farm and make a farm budget. At the same time, tenure on farms should be made more secure, real estate values, debts and taxes adjusted as far as possible to the new income levels, and small "reconditioning" loans (at reasonable interest rates and amortized over a suitable period) made available for initial capital outlays needed to establish conservation practices.

Adjustments When Two Areas Compete

The second example of the effect of lower costs resulting from the exploitation of virgin fertility is the case in which exploitation in one area induces conservation in another. A typical example is the change from grain farming with low elasticity of production to mixed or dairy farming with high elasticity that takes place in one area as a result of the development of exploitive grain farming in another. This is quite typical of the historical development of this country. Grass and timber land was first farmed exploitively to produce grain but later returned to a more conservational system as the exploitive grain area moved westward. This adjustment is still continuing, as the rapid increase in dairying in many states indicates; it will probably continue in the future because, as the fertility of the exploitive grain area is reduced, the comparative advantage of the exploitive grain farm over the more conservational mixed or dairy farm is reduced. Where this change in the comparative advantage of alternative systems has occurred, the problem of soil conservation is not usually acute, and the adoption of conservation practices together with some internal rearrangement of land use may be all that is required in the older grain-producing areas.

The basic problem is often one of land values. As the production of dairy products increases and prices tend to fall, the older established dairy areas face increased competition reflected in lower returns to the farm family or lower rents and land values. Where rents and land values are rigid the farmer may face a lower level of living and be driven to seek security by establishing areas of monopoly control in order to modify the force of competition. To the extent that this reduces the price of milk outside the control areas, it will tend to discourage the movement to a more permanent agriculture as well as maintain consumers prices above the competitive level.

Adjustments When the Extensive Margin of Arable Farming Is Affected

The third and most difficult problem is that which occurs when the existence of virgin soil resources causes an area to shift from a non-exploitive permanent system to a more intensive system with higher capacity and an exploitive use of soil resources. A typical example of this is the breaking up of pasture areas and development of grain farming. In this case the reserves of moisture, fertility, and organic matter in the soil make an exploitive system of grain farming yield a much higher net income during the early stages of exploitation of the land than is possible under a permanent grazing system. As a result the type of farming moves towards the system with the higher comparative advantage, and a more intensive system of farming develops. As a result more labor is applied (i.e., family farms become smaller) and more capital is invested in buildings and machinery. Rents and land values increase and tend to force all land possible into the more intensive use. Then, as the soil assets are depleted, yields fall, drouth hazards are increased, and as the organic matter is depleted, soil blowing and drifting occur. In order to maintain the soil resources, costs might increase so greatly that grain farming would yield smaller net returns than a grazing system, and wheat farming would become submarginal.

It is under these circumstances that it is most difficult to deal with the problem of conservation. Virgin fertility in this case leads to an exploitive system of farming with higher capacity, and land values which reflect this condition cannot be maintained. While this process is going on (and to some extent it has developed in some areas in almost all states), population density increases, and farm size decreases. Marketing resources that are suited to the exploitive system develop, villages, social institutions and their concomitant taxes are built up, and an institutionalized system founded upon a

false basis develops. The problem of the conservationist in these areas is to estimate whether it is cheaper to move part of the population and return the area to a less intensive type of agriculture with a lower capacity, or to retain the present population and try to develop a new type of agriculture which will maintain the soil and yield a labor income acceptable to the farm family if rent and land values decline.[4] The final decision depends upon the people, the physical conditions of climate and soil, the possibility of modifying the institutionalized economic factors of rent, taxes, and land values, the possibility of developing secondary production, and the nature and adequacy of public assistance.

In all cases the relationship of primary to secondary production is of fundamental importance, because any changes in land use necessary to achieve conservation will have repercussions upon secondary production. Adjustments in farm size, rents, land values, etc., which may be implied by changes in primary production might be offset by changes in the intensity of secondary production. If, for example, wheat or cotton farms could develop secondary production by purchasing feeds and producing dairy or poultry products, then the changes in farm size and land values might be much less drastic. The essential point that needs to be stressed is that conservation planning is not purely concerned with land use and primary production but must also deal with secondary production if it is to be practical and realistic.

Effect of Declining Costs or Rising Prices

Apart from the exploitation of virgin soils affecting the margins of production as outlined above, a long period of rising farm prices or declining costs followed by a decline in

[4] For an analysis of this problem, *see* the article by Sherman E. Johnson, "Definition of Efficient Farming," *Land Policy Review*, Vol. II, No. 5, Sept.–Oct., 1939, p. 18.

farm prices or increase in costs would raise similar problems of adjustment. A further complicating factor has been the historic development of land settlement. The 160-acre homestead available in all areas regardless of soil and climatic conditions need only be mentioned. The transitions from grazing to grain and then to mixed farming have characterized the western development. Older, once prosperous, rural areas have seen abandonment and decay due to the lowering of competing costs as new virgin soils were brought under the plow. Today our agriculture is suffering from the inability of the farming system to adjust the intensive and extensive margins of production of competing enterprises, particularly the extensive margins of arable land, to the new margins which have become necessary to correct the errors of the past, including the faulty cost structure which has resulted from neglecting to account for the exploitation of virgin fertility. It is suffering because the system has failed to place farming on a permanent basis of maintaining soil fertility in those areas where exploitation is no longer economic nor socially desirable, and because the system has failed to relate the ratios between the rent of various lands and the prices of their products so that they represent the true relative scarcities of productive resources in relation to demand.

It is impossible to separate the effects of exploitation of virgin fertility from the effects of prices and costs in determining the intensive and extensive margins. Maladjustments in land use patterns (as indicated by low levels of living, high relief loads, and high tax delinquency) and soil erosion may result from the fact that virgin fertility was available or from large fluctuations in prices. *If, under the present institutional arrangements of farm size, taxes, population density, and rents, a level of living acceptable to the people cannot be maintained when conservation is introduced, it is a waste of public funds to attempt to induce conservation without remedying the basic maladjustments.* In order to make

any decision as to what the income from any particular organization is likely to be, it is essential that we be able to anticipate relatively stable prices and price relationships. Theoretically, the intensive and extensive margins should fluctuate with changes in prices, but the rigidities of the farm organization and institutional factors prevent this from occurring, so that maladjustments may continue for long periods of time with exploitation and uncontrolled erosion being concomitants. Under these circumstances conservation is but one phase of the problem of agriculture as a whole and is linked up with industrial prosperity, international trade, and the whole complex economy of the nation.

CHAPTER 5

PRICE CHANGES AND CONSERVATION

Conditions Affecting the Value of Land as a Factor of Production

One of the most important functions of a flexible price system is that of assigning values to the factors of production according to their scarcities in relation to the demands for their respective products. In the early stages of development in the United States, land was abundant and cheap, but labor and capital were scarce and dear; as population and industrialization developed, land became relatively less abundant, and land values rose steadily while capital accumulation increased rapidly and interest rates declined.

Changes in the prices of productive factors are associated with changes in the combinations in which they are used, and these, in turn, are related to the substitutability of one factor for another. Thus, in a developing economy one would expect land exploitation to be followed by conservation and finally by improvement and reclamation. This has happened in many older civilizations, but the relationship between the growth of the economy and land use is likely to be direct only if the trade area is a closed one, which has not been true of the United States. Because so much of our agricultural production has been for export markets, a much more rapid exploitation of soil resources and rapid increase in land values has occurred. An earlier movement to conservation would have taken place if the export demand had remained constant

and other competing sources of supply had not opened up. This, however, did not happen, and as our high tariff policy bore fruits of retaliation, our export markets were curtailed, while competing sources of supply were forcing prices down. As a result our land resources since 1920 have become much more abundant in relation to demand and hence less valuable and less able to bear the more costly conservation measures. The implication is that a less intensive agriculture is desirable if this condition continues in the future.

Theoretically, adjustments of the intensive and extensive margins should take place as relative scarcities and prices change, but as was indicated in the last chapter, this adjustment is extremely slow to take place and faces a host of institutional resistances. When the dynamic changes in the technology of farming are also introduced, the difficulty of obtaining proper adjustments in the combination of factors is seen.

Some Factors Determining the Comparative Advantage of Exploitive and Conserving Crops

This lack of adjustment of the factors of production, however, does not necessarily mean that exploitation and erosion will be increased because, as we have seen, increases or decreases in intensity do not always imply decreases or increases in exploitation. Low prices and curtailed exports of wheat, cotton, and lard may result finally in less exploitation rather than more, because the comparative advantage of these crops may be reduced. The reason that we have exported vast quantities of erosion-inducing crops such as cotton, corn, wheat and tobacco has been the great comparative advantage we possessed in having vast areas of rich land with exceptionally low enterprise costs of production associated with an exploitive system. As fertility declined the costs of production would inevitably have risen, and conservation, with reduced

exports of erosive crops at higher prices, would have been the logical outcome. However, increased production from newer areas and reduced export demand have led to lower prices and a serious agricultural crisis which may lead either to greater or less exploitation of our soil resources. Which takes place will depend upon the institutional factors previously mentioned, the type of farming already being followed, and changes in the relative prices of exploitive crops such as corn and cotton to the prices of nonexploitive crops such as pasture and hay. These factors, together with the physical factors affecting yields, determine the comparative advantage of competing land uses.

Most of the soil conserving crops are marketed in the form of livestock, and the prices of these livestock products reflect the sale value of pasture and hay crops. Any movement of prices that increases the ratio of the price of grain or cotton to the price of dairy products, sheep, or beef cattle would increase the comparative advantage of the more erosive crops and encourage exploitation. As a result of the first world war, the price received by farmers for grains in 1920 was 132 per cent higher than in the period August, 1909 to July, 1914; cotton, and cottonseed prices were higher by 48 per cent, dairy products 98 per cent and meat animals 107 per cent (the latter figure is for 1919). During the six-year period from 1915 to 1920 the price ratios favored increased production of grain and cotton at the expense of hay and pasture. The price of tame hay increased only about 65 per cent during this period. During the postwar decade from 1921 to 1930 the price of dairy products did not decline as rapidly as grains, and the price ratio for these commodities favored dairy production. Cotton and cottonseed prices, however, retained their advantage from 1923 to 1925, while prices of meat animals fell drastically in 1921 but gradually increased to 1929 so that their competitive position was considerably better

than it was during the base period.[1] The effect of changes in price ratios for various products upon land use is very complex; physical and institutional factors, changes in costs, and the flexibility of the farming enterprises all play important parts; in one region such changes may have drastic effects upon land use while in others there may be only a negligible response.

Effect of Changes in Relative Prices on Land Use

To a large extent the effect of changes in comparative prices on land use will depend upon the internal organization of the farm and the presence or absence of alternative opportunities. Our exploitive crops can be grown in monoculture areas, or they can be grown in mixed farming areas where they would supply smaller parts of the total farm income. The generalization can be made that the more diversified the farm enterprise the less drastic will be the effect of changes in relative prices on income and the greater will be the possibilities of adjustment through competition. In monoculture areas the possibilities of adaptation are much less than in diversified regions because such areas have usually developed as a result of the very great comparative advantage of one crop over the nearest alternative. This is true of the specialized corn, cotton, and wheat belts.

Under these circumstances a change in land use patterns as a result of relative price changes can be expected only when two conditions are fulfilled: (1) The reductions in prices of the exploitive crops relative to alternative conserving crops must be so large that the conservation systems will yield higher net returns; (2) the new ratio of prices must continue for a period of time long enough to change the expectations of farmers, so that they no longer anticipate a return to the

[1] Figures taken from U.S.D.A., *Agricultural Statistics, 1940*, tables 420 and 693, pp. 316 and 573.

old level and make their plans according to the new ratios. Smaller fluctuation will have little effect on land use and will be reflected in variable farm incomes, rents, and land values. Even large fluctuations over short periods of time may only affect the operators incomes and rents, with no changes in land use patterns taking place. These conditions are usually associated with very little secondary production and great inelasticity of supply; changing the land use pattern may involve drastic changes in the whole farm enterprise and the development of new skills and abilities by the operator.

In areas of diversified agriculture, changes in relative prices may affect land use patterns considerably. High grain prices relative to dairy products, for example, may increase the acreage of these crops at the expense of hay and pasture, and vice versa. Because of this diversification and its associated flexibility, changes in relative prices have less effect upon farm income and land values but lead to rapid adjustments in land use patterns.

Since the government is concerned with both conservation and prices of farm products, these interrelationships should be studied and probable reactions anticipated, in order to avoid spending funds to achieve conservation while at the same time spending funds to increase the prices of erosive crops relative to those of alternative conserving crops. The present war may or may not result in a great increase in the ratio of prices of erosive crops to conserving crops. The increased demand for food both for shipments abroad and for our industrial workers will largely affect beef, hog, poultry, and dairy products. This may cause a change in price ratios favoring soil conserving crops, and efforts of the government might well emphasize assistance in making adjustments in this direction with less emphasis upon maintaining prices of exploitive crops in those areas where alternatives are available. In the event of a rapid rise in the prices of soybeans, corn, cotton,

and wheat, there will be strong pressure to expand the acreage of these crops even where it may encourage serious erosion. Under these circumstances it may be advisable to consider programs which will effectively control such price increases or prevent them from introducing land use patterns that can be shown to be disadvantageous to society when the costs of a slow and painful adjustment to contracting extensive margins are considered.

Effect of Changes in the General Price Level on Land Use

In addition to changes in the relative prices of farm products we must also consider the effect of changes in the general price level, assuming that relative prices remain constant. Usually these changes occur together, but a simpler analysis is possible when they are treated separately. The effect of changes in the general level of agricultural prices is modified by the degree of commercialization of agriculture. Where a large part of the farm produce is consumed on the farm, price fluctuations may have little effect on either the level of living of the family or on land use, while in the case of highly commercialized farms, price changes will be much more important. Similarly custom or institutional factors[2] may modify the effect of price changes. In spite of these limitations which must be constantly kept in mind, a simple analysis of relationships is valuable in indicating tendencies and pressures which arise and have to be anticipated in any attempt to make conservation planning fit into a dynamic agriculture.

[2] For example, where an increase in prices occurs, the prevalence of crop share tenancy may be an important factor in curtailing increased production through an increase in intensity, because the tenant will only increase inputs up to the point where they equal half of the marginal output. *See* Rainer Schickele, "Effect of Tenure Systems on Agricultural Efficiency," *Jour. Farm Econ.*, Vol. XXIII, No. 1, Feb., 1941, pp. 185–207. Under these circumstances government subsidies for lime, fertilizer, and seed, or leases which give the tenant the total returns above an agreed average yield, might be useful in increasing national production and retarding an expansion of erosive crop acreage.

It is sometimes assumed that an increase in the prices of farm products would have the effect of inducing conservation in all cases. As was indicated previously this assumption is not justified and whether conservation or exploitation is encouraged depends upon a number of factors. In general terms we may state that an increase in prices encourages conservation when it leads to an increase in primary and secondary intensity without any change in the crops grown, but where cropping plans are affected, either exploitation or conservation may result, depending upon the type of land use changes introduced. An increase in the price of cotton would encourage the use of fertilizers, terraces, and other means of increasing production on those areas already producing cotton, and this would result in greater conservation of the resources. As the increase in cotton prices raises the value of cotton land, the value of the soil capital destroyed by exploitation increases and conservation is encouraged. At the same time land in non-erosive crops might be placed in cotton, and exploitation increased.

Effect of Rising Prices on the Extensive Margins in Relation to Gross Income and the Elasticity of Production

A change in the extensive margin of production may take place although the *relative prices* of all farm products remain the same (under the assumption that an equal percentage increase in the prices of all farm products takes place). The change in the extensive margins of competing crops would depend upon the ratios of gross farm income under various alternative crop combinations and the elasticity of production of the specific products. If wheat production, for example, produced a net return of $3 an acre with a gross income of $10, and beef cattle on pasture also yielded a net return of $3 an acre but had lower costs and a gross income of only $7 an

acre, the same percentage increase in wheat and cattle prices which did not affect costs would increase the net returns from wheat more than from pasture, and the area in wheat would expand. If prices doubled, wheat farming would now yield a net return of $13 an acre, while beef cattle would yield only $10 an acre assuming that no increase in production or changes in costs took place. Actually, increases in production would take place, and the final relationship of net returns would depend upon the elasticities of production and demand of the two products. In general, the greater the elasticity of production the larger will be the increase in applications of variable factors as was indicated in Figure 2.

In considering the elasticity of supply we can not assume that the gross returns curve, and the associated marginal and average return curves, follow any universal form or any simple mathematical formula. The curves are the result of the combination of physical quantities of inputs of variable factors, and only as we know the physical relationships can we establish productivity curves. Point elasticity indicates changes in the relationship of output to input at a given level of input but gives no information regarding the shape of the curve beyond that point. At any given point the elasticity may be high, but as inputs are increased the point elasticity might be maintained or decline very rapidly. Because of this limitation, it is preferable to use the concept of arc elasticity as referring to the slope of the curves over the relevant range of increase in units of input.

In the example used above, the point elasticity of production of the wheat farm is 0.7, while for the cattle farm it is about 0.6.[3] This only indicates that at the given quantity of

[3] If we assume that the cost line parallel to the X axis is drawn at a level of one dollar, inputs will be added until the marginal returns equal one dollar, and marginal returns will always equal one dollar at the highest profit combina-

(*Footnote continued on page 63*)

input, wheat production has a higher point elasticity; as prices increase and more units of input are added, the point elasticity might decline rapidly in the case of wheat farming and remain relatively constant in the case of cattle farming. The only way we can know which would have the higher elasticity for a given increase in inputs of variable factors is by knowing the physical production relationships involved.

If the prices of products increase with no changes in costs, the elasticities of production at the old level of input remain the same. If prices double, both average and marginal returns are doubled, and the ratio of marginal to average returns remains the same. As more inputs are added, however, the elasticities at the new highest profit combination may be different because the shape of the productivity curves may change as production moves from the previous optimum.

Where an increase in prices leads to higher net returns under an exploitive system, there will be a shift from conservation to exploitation such as occurred during the period from 1915 to 1920 when grain acreage was expanded and the hay and pasture acreage decreased. This expansion of exploitive farming, however, was not entirely due to the increase in prices but also was the result of propaganda, tractors, weather conditions, and the fact that no one estimated the social costs of readjustments which had to be made as soon as the profitability of exploitation declined.

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[3] (*Continued*)

tion. Since we have shown that $E = \frac{MR}{AR}$, E becomes the reciprocal of average returns. In the example given the average returns for the wheat farm are $\frac{10}{7}$ and hence the elasticity is $\frac{7}{10}$ or 0.7; the average returns for the cattle farm are $\frac{7}{4}$ and elasticity is $\frac{4}{7}$ or approximately 0.6.

Effects Summarized and Related to Government Action in an Emergency

These relationships may be summarized in the generalization that, where resources are relatively scarce and used at a high intensity, an increase in prices will largely result in an increase in conservation and reclamation; while in areas of abundant resources utilized at a low intensity, an increase in prices will encourage more rapid exploitation. From a historical point of view the United States appears to have passed through a long period of exploitive agriculture culminating in the expansion period of 1914 to 1920 when the acreage of seventeen principle crops increased about 24 million acres. For the next twelve years this acreage fluctuated between 331 and 345 million acres but declined sharply from 1932 to 1934 when it reached a low point of 276 million acres. From 1935 the acreage increased, and for 1939 and 1940 it was approximately the same as in 1909 or about 300 million acres.[4]

If the present war emergency leads to an increase in the prices of agricultural products it need not result in a further increase in exploitation but rather to an increase in primary and secondary intensity and greater conservation. Government agencies could do much to encourage this by stimulating greater use of fertilizers and conservation measures to increase output rather than encouraging disinvestment through reckless expansion of erosive crops at the extensive margins. If shortages in Europe demand an increased output of erosion-inducing crops there are several methods of achieving this without increasing exploitation: (1) The area of such crops may be expanded on land which is not susceptible to erosion. (2) The yields may be raised by increasing the intensity of primary production; since labor may be limited this would

[4] U.S.D.A., *Agricultural Statistics*, 1941, table 672, p. 538.

mean increased use of fertilizer, machinery, and soil and water conserving practices. (3) An increase in the acreage of such crops on land susceptible to erosion should be discouraged, and when it does take place the effects should be minimized by the use of the most suitable erosion control practices. The problems of adjusting agricultural production to war needs and conservation are discussed in greater detail in Chapter 11.

Adjustments to Falling Prices

When we turn to an analysis of the effects of falling prices for farm products we often find that adjustments, corresponding to the reverse of what occurs when prices rise, do not take place. Where rising prices have led to an expansion of wheat and arable farming and a reduction in pasture it may be difficult for the reverse movement to take place because of the difficulty of disinvesting capital in farm machinery and equipment. If the more intensive land use has meant that large pasture areas have been broken up into smaller arable farms, a return to pasture means consolidation of land areas and a smaller population. This, in turn, implies a new tax base and the curtailment of such services as those provided by roads, schools, and villages. Such changes occur mainly through bankruptcy and finally migration; before this takes place the farm operator will of necessity exploit the land to the limit in the hope of a return to previous price levels. When this condition is associated with declining yields resulting from the loss of virgin fertility or the reduction of soil moisture, the conditions are made more hopeless.

Where high prices have led to more intensive farming and high land values, falling prices lead to a reduction in the use of fertilizers, hired labor, and other operating expenses. Where an operator has purchased a farm on a mortgage he finds that his payments remain high and his income is lower. This

may lead to an effort to disinvest by using up the fertility of the soil without regard to the future because of the uncertainty of whether he can retain ownership or not. At the same time falling prices and land values retard investments in conservation measures and reclamation projects.

Effect of the Time Period

The effect of price changes upon land use and conservation are also related to the length of time the trend persists. Price changes which persist long enough to affect land values are of major importance in creating problems of adjustment and conservation. Short-time fluctuations, however, are also related to the problem of conservation because of the uncertainty they create. To offset uncertainty considerable diversity and flexibility of production are desirable. Diversification may encourage conservation while price flexibility may discourage it by making it more difficult to establish and maintain the necessary crop rotations. Investment and farm reorganization to control erosion can be evaluated only in terms of their profitability in relation to some anticipated price level. Where there is a great deal of uncertainty regarding prices, the risks of investment are greatly increased, and long-time planning is handicapped. This can be offset by making conservation plans as well as debt payments as flexible as possible. Governmental action aimed at reducing price fluctuations may also be helpful in encouraging conservation investments.

Fluctuations in Costs; Interest Rates

When we consider fluctuations in costs as well as fluctuations in prices of farm products, we find general relationships almost identical to those just considered. Lower costs lead to conservation in some cases, while in others they may result in exploitation. Lower costs of fertilizer, lime, terracing, etc., encourage conservation; lower costs for tractors and the de-

velopment of improved machinery, on the other hand, may lead to greater exploitation by expanding the area of erosive crops at the expense of hay and pasture. As in the case of changes in the price of goods produced, the effect of changes in costs will depend upon the changes in the profitability of competing enterprises, and this will be determined by the new combination of the factors of production and the gross farm income.

Increased costs are likely to be associated with an increase in the prices of all products purchased by farmers, and the ratio of prices received to prices paid may be changed adversely. When this ratio declines it means that the farmer receives a lower real income, and where the level of living is low, pressure to maintain it by disinvesting is created. In many cases this may lead directly to exploitation of the soil, particularly where the capital loss is not borne by the operator. This pressure to exploit the land results from an attempt to maintain a given level of living in the face of a declining real income and would probably vary inversely with the accepted level of living and should, therefore, show wide regional differences. How important this pressure may be and what its relationships are to the availability of loans is not known, but it is probably closely related to conditions of tenure, the possibility of adjusting the size of the farming unit, and the availability of other sources of income. More research into these and related problems is needed.

Because of its relation to the value of the soil resources, one of the most important "prices" affecting conservation is the rate of interest. This problem is discussed at length in the next two chapters and need be mentioned here only by way of introduction. As interest rates are lowered land values increase, and the value of the soil capital destroyed by exploitation is increased; this encourages both conservation and improvement. At the same time the cost of applications of

capital to the farm enterprise are reduced, and larger expenditures may be made to attain the optimum combination of factors. This increase in the intensity of capital applications will encourage conservation in those areas where it increases the use of lime, fertilizer, livestock, terraces, etc., and it will encourage increased exploitation in those areas where it permits an expansion of the extensive margin of erosive crops by reducing the annual costs of tractors and other machinery. In this case the effect of changes in interest rates is identical with changes in other costs.

CHAPTER 6

THE INDIVIDUAL AND FERTILITY MAINTENANCE

Factors Which Determine When Fertility Maintenance Is Economic

There is a rather widespread belief that all exploitation of our soil resources has been bad and that the basic objective of all conservation work must be the introduction of land use which will stabilize our remaining soil assets permanently at their present level. This point of view fails to recognize that exploitation of land resources in the past and at present, where stores of virgin fertility yet remain, may be beneficial to both the individual farm operator and society as a whole. For this to be true, however, all costs of exploitation affecting both the individual and society must be considered. The difficulty lies in determining when conservation is economic to the individual and under what circumstances individual adjustment may be expected when conservation becomes economically and socially desirable.

In considering the bearing of exploitation, conservation, and improvement upon the returns to private enterprise, the distinction made between fertility depletion and soil deterioration is useful for analytical purposes. As was pointed out in Chapter 1, depletion, maintenance, or improvement of fertility may be looked upon as being related to the application of variable costs to the permanent capital assets, and no change in rent or capital value need result. Under these circumstances net returns, net income, and rent become synonymous, and it becomes economic to maintain the level of

fertility at the point where the marginal product just pays for the marginal inputs of labor and capital under the conditions prevailing at the time.[1] This point will be affected by the demand for farm products both at home and abroad and the relative scarcity of land in relation to the other factors of production. This level of fertility will fluctuate in response to changes in the cost price structure. Lower prices for phosphates and lime and higher prices for crops mean that fertility will be increased and yields improved; when the prices of products fall, cash outlays for fertilizer will be reduced as happened in the cotton belt during the period of low prices from 1931 to 1935. In the case of our chernozem soils, however, another factor has to be taken into consideration, and that is the presence of a surplus fertility that has accumulated over the centuries and has no cost of production. This we will call virgin fertility, and the immediate problem is to analyze the factors which determine the point in time where exploitation of virgin fertility should cease and fertility maintenance begin.

Virgin Fertility and Fertility Maintenance

The presence of virgin fertility means that, *for a period of time*, the costs of production are lower than they would be if fertility had to be maintained; this results in higher net returns during the period when exploitation is economic.[2] This has

[1] For a more complete discussion of this point, *see* the two articles by S. von Ciriacy-Wantrup, "Soil Conservation in European Farm Management," *Jour. Farm Econ.*, Vol. XX, No. 1, Feb., 1938, p. 87; and "Economic Aspects of Land Conservation." *Jour. Farm Econ.*, Vol. XX, No. 2, May, 1938, p. 462. The complete relationship of the present input-output ratio and time can be illustrated by a three dimensional graph giving the marginal productivity curve plotted on the X and Y axes with time extending on the Z axis at right angles to X and Y.

[2] Under a given demand situation and where no new land is being brought into cultivation, prices will be determined by the relation of total supply to total demand, and the total supply should be adjusted so that marginal costs equal the values of the marginal products. When land with virgin fertility is competing in a world where fertility has to be maintained on a large part of the land, the marginal supply will largely be determined by those areas where fertility

(*Footnote continued on page 71*)

important repercussions upon land values, types of farming, and the intensive and extensive margins of production. If we look upon virgin fertility as a store of plant nutrients (a fund resource) the utilization of which lowers the current expenses of production and increases the net income (and net returns), we can visualize the net return curves for a system exploiting the virgin fertility and for one conserving this fertility as shown in Figure 3. The shaded area on the left of the intersection of the two lines CE[3] and AB represents the individual gain from exploitation and the area to the right the loss due to continued exploitation. Theoretically, conservation should automatically be adopted at the point D if rent, land values, capital investment, and labor were perfectly mobile, and the farm operator had perfect knowledge regarding the combination of factors and returns for both the exploitive and conserving system. The slope of the returns curve under exploitation will depend upon the topography of the land, precipitation, soil type, and type of farming because these factors will determine the rate at which the fertility is removed. The distance between it and rent (the net returns under conservation) will depend upon the costs involved in maintaining the soil on a permanent basis. These again will depend upon the same factors enumerated above and the comparative advantage between the exploitive and conservation systems. One of the most important problems will be the question whether the

[2] (*Continued*)
maintenance is an important cost; virgin fertility will, therefore, be equivalent to lower cost structures in the areas where it is present and this will mean higher net returns at any level of intensity. When new virgin lands are first brought into production there is, of course, a large effect on price; this, theoretically, should result in a reduction in intensity and a reduced output from the old areas with higher costs, so that a new equilibrium is established. Both intensive and extensive margins will be affected, and the final result will be related to the elasticities of both supply and demand.

[3] The curve CE should, of course, be discontinuous because of the nature of the annual period of production. Smooth curves are used purely as a simplification and to follow formal procedures. It is important to note that the line CE represents both net income and net returns because the concept of fertility depletion implies that no change in rent or capital values occurs.

same general type of farming can be maintained under both the exploitive and conserving systems. If fertility maintenance should require an entirely different type of farming involving adjustments in farm size (or family labor mobility), the problem of adjustment is much more difficult.

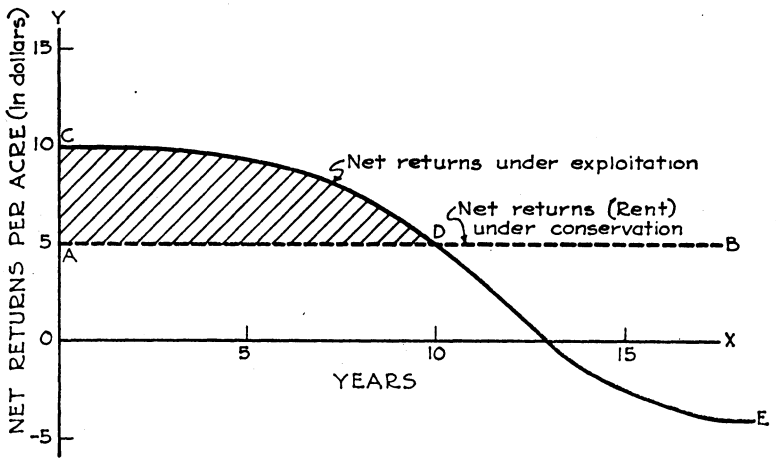


Fig. 3. Net returns curves under exploitation and conservation in the case of fertility depletion.

Price Changes and Fertility Maintenance

Changes in prices of farm products and changes in prices of production factors will cause changes in the shape of the curve CE and the level of AB with the result that the point D will vary in time according to such changes. Under certain cost and price relationships the line AB may be below the X axis and have a negative value. In this case the land might be profitable for cultivation during a period of exploitation of its virgin fertility, or subsoil water supply, but become submarginal for this use as soon as the stores of fertility or moisture are depleted. The costs of producing a sufficient volume of

output with the same pattern of farm size, population, land values, and tax rates would reduce net returns to a negative value.

The determination of the point at which the maintenance of fertility becomes economic is difficult partly for the reason that prices for various competing products vary and the physical data are aften unobtainable. The question of whether we are producing for a foreign demand as well as for the home market also has to be considered. If our production is limited to the domestic market, our natural resources are relatively more abundant; prices, rents, and land values would be lower than those which would result if we were also supplying an export market. Much land at present under cultivation in response to world demand would become submarginal, if our export outlets were cut off, and fertility maintenance involving increased costs would be less economic.

An implication of the above approach, that fertility maintenance involves higher costs or lower net returns than can be obtained from exploitation, may be questioned by many who believe that maintenance would actually increase net income rather than curtail it. The fact that fertility maintenance or improvement would increase net returns in a great many areas is due to a lack of technological knowledge on the part of many farm operators and to certain institutional and economic factors which prevent the change from exploitation to conservation from taking place at the level which would result in the maintenance of the highest possible returns under given conditions. The introduction of better farm management and budgeting analysis would tend to remedy this uneconomic continuation of exploitation if the exploitive nature of the present system should be recognized and its effects upon net returns revealed. If a farmer fails to maintain fertility at the optimum level he will receive a smaller income, and the

adoption of methods to maintain or improve the fertility will then result in an increased income.

Resistances to Adjustments Necessary to Maintain Fertility

Why have farm managers not maintained fertility at the point at which it is evidently economically sound? Apart from such social factors as ignorance, tenancy, and custom, there appear to be certain resistances which are ascribable to the fact that fertility depletion may appear to the farm operator to be the most remunerative practice in the early stages of land utilization on those soil types which have large stores of virgin fertility. There is ample historical evidence of this consideration in the 19th century development of the American Midwest. As was shown earlier, exploitation implies lower costs and tends to be reflected in higher net returns than would result under conservational procedures, and these returns may become capitalized into excessively high land values. This overvaluation of land tends to force the farm enterprise into types of farming with a greater capacity than would be the case if the existence of exploitable virgin fertility had not led to the relatively high capital value of land; consequently, a proportionality of factors of production is established during the period of exploitation different from that which is most profitable when fertility has to be maintained. The fact that farm labor has been historically largely family labor has tended to result in smaller farm units rather than more hired labor; and in order to adjust to the new cost situation resulting from the need to maintain the soil, farm size may accordingly need to be increased. Furthermore, prices of competing products were unquestionably strongly influenced by the supplies resulting from the exploitive system, so that readjustments in these price relationships tended to follow the changes in land use and types of agriculture.

Factors Affecting the Overvaluation of Land

Theoretically, the value of the land the first year should be its expected rent (permanent net returns) capitalized at the current rate of interest plus the present value of the area CDA (Figure 3).[4] If the permanent net returns were $5 per acre and the initial returns under exploitation $10, and assuming CD a straight line trend over ten years, then the value per acre at a 5 per cent interest rate would be $100($5 per year capitalized at 5 per cent) plus $23.51 (initial value of CDA)[5] or a total of $123.51 per acre. This value would then decline annually until it reached $100 in ten years' time. Actually land valuations have tended to take the annual yields, or short-time averages of annual yields, and capitalize these without due regard to the fact that part of the net income was not of a permanent nature and should not, therefore, be capitalized at the current rate of interest. This is one of the reasons why poorer land in many areas is relatively overvalued in terms of its productivity when compared to better land. If in the example chosen the land had been capitalized upon its net income the first year, its value would have been $200 instead of $123.51. Where this incorrect valuation has been made the basis of taxes and mortgages, the effects of this error in introducing untenable fixed charges against the enterprise can easily be perceived.

The extent to which overvaluation may have occurred would depend upon the slope of the net return curve (CE)

[4] It is important to note that this example refers to fertility depletion only. and no destruction of permanent productivity occurs.

[5] The value of the area CDA at the beginning of the period can be calculated from the formula

$$V_0 = A_0 + \frac{A_1}{1+r} + \frac{A_2}{(1+r)^2} \cdots + \frac{A_{n-1}}{(1+r)^{n-1}}$$

For further discussion of this problem, *see* D. B. Ibach, "The Role of Soil Depletion in Land Valuation," *Jour. Farm Econ.*, Vol. XXII, No. 2, May, 1940, and the note by J. J. Livers and G. H. Craig on this article, *Jour. Farm Econ.*, Vol. XXII, No. 4, Nov., 1940, p. 773.

under the exploitive system and the height of CD above AD. These in turn would depend upon the physical characteristics of the soil. A very rich, deep soil might have a relatively slow decline in net productivity, so that the point D might not be reached for decades, and the tendency would be for values to be established at the higher levels for a protracted period. Where the soil is shallow the curve would tend to be steeper and point D might be reached in five to ten years. The types of crops grown during the period of exploitation would also play an important part in determining both the speed at which the virgin fertility would be used up and the comparative advantage of the exploitive system.

The point of particular importance, however, is that once point D has been reached it becomes economic to increase costs and maintain fertility upon a permanent basis (unless the line AB is below the X axis and the land is submarginal for maintaining an acceptable level of living under the present farming system), because after this point failure to maintain the resources will result in lower and eventually negative net incomes. While it may be economic to maintain the soil resources at point D, there are many factors which may prevent this from taking place, and these factors are related to the type of change involved. If the change is merely a matter of applying lime and fertilizer it may be adopted readily; if it involves a change in crop rotations and the adoption of a livestock system of farming to replace or supplement a cash grain system, the change may take place more slowly, and institutional resistances may be more obstructive. Where arable farming is not economic when maintenance costs are necessary, the area may have to be abandoned or turned to other uses.

Fertility Maintenance and Social Welfare

From the point of view of preventing the destruction of vital natural resources, there seems to be little need for society

to control land use and see that the maximum net returns are obtained because, in the case of fertility depletion, no permanent damage to the resources results, and the land can be brought back to a higher level of productivity. Should widespread underproduction exist due to mass ignorance and inertia, society might be justified in initiating action to stimulate more economically feasible production, but in our present dynamic society the use of education, the revision of customary concepts, and some mitigation of institutional resistances might be all that is necessary from the point of view of maintaining the optimum level of soil fertility. On the other hand, if past overvaluation has led to too high fixed charges in taxes and interest, more direct social action might be desirable in order to avoid the wholesale dispossession of farmers due to the inevitable depreciation of the land assets. In the case of fertility depletion the need for economic planning therefore grows out of institutional factors and rigidities, and there is no theoretical basis for a conflict of interests between social and individual points of view. Changes in demand, the quantity of capital, and the interest rate would be reflected in prices and in cost combinations. Under pure or nearly pure competition, the point at which fertility maintenance would be economic would fluctuate according to the changes in these elements. Because the process of depletion is reversible (when no *permanent* lowering of net productivity takes place), new equilibria can be established at various levels. The reasons these automatic adjustments do not take place are largely institutional and social in nature and reflect such factors as custom, immobility of population, inflexibility of farm size in given areas, tenure patterns, and inflexibility of fixed charges; these rigidities result in inflexibility of adjustments at the intensive and extensive margins of production.

In a dynamic economy, fertility depletion and improvement may perform a useful function in providing a method of cushioning shocks due to price fluctuations. During a

period of low prices, costs may be cut by curtailing inputs and drawing upon fertility which may later be replenished during a period of higher prices. Similarly, where income is needed for immediate expenses for the education of children, or for buildings, or livestock investments, it may be economic to deplete the fertility of the soil and rebuild it when there is less urgent need for current income. This essentially represents a disinvestment of one form of capital and investment in another. Whether such a procedure is economic depends, among other things, upon the availability of loans, interest rates, the amount of the temporary income gained from reducing costs, and the cost of restoring the fertility later. The procedure may not only be economic for the individual but also for society as a whole when the new investment yields larger returns than the old. During the World War of 1914–18 the phosphorous content of the soils in Germany was greatly depleted, which made necessary abnormally high applications of fertilizer for a decade afterwards. Under such circumstances neither "conservation" nor fertility maintenance is economic either for the individual or for Society.

CHAPTER 7

THE INDIVIDUAL AND CONSERVATION WHEN EXPLOITATION INDUCES EROSION OR SOIL DETERIORATION

Factors Which Determine When Conservation Is Economic

In the preceding chapter we have discussed the case in which only fertility depletion occurred and no permanent reduction in rent or net returns resulted from exploitation; we now turn to the more complex problems that arise when exploitation leads to a permanent reduction in the productivity of the land and to decreasing rents and land values.

When exploitation not only removes the virgin fertility (fertility depletion) but results in an actual destruction of the productivity of the soil (soil deterioration) and permanently reduced rents, the difficulties of the problem of determing the point in time at which conservation becomes economic for the individual are enhanced, partly because of the importance of the interest rate and costs of achieving erosion control. In the early stages of exploitation, before erosion starts to destroy the permanent productivity of the soil, the two cases are substantially alike. As erosion develops, however, the rental potentialities are permanently impaired either by a reduction in total productivity or by a permanent increase in the unit costs of producing the same output as before.

If we assume that costs and prices remain stable over time and that an exploitive system leading to soil deterioration is established on any given area of land, the net income will

decline annually as the productivity of the soil is impaired and may finally become zero or have a negative value. Under these circumstances the costs of production (which include returns to family labor) cannot be met. In this case the farm operator faces two alternatives each year; he can either continue to exploit the land or adopt a conservation system that will permanently maintain the physical productivity of the soil and, therefore, stabilize rent over time. Which he will do will depend upon the net returns that can be earned from the alternatives available. He may stabilize production the first year the virgin land is taken up, and the net returns then would be rent because they would continue indefinitely into the future; and on the other hand, he might adopt an exploitive system and not adopt the conservation alternative for ten, twenty, or thirty years. Each year the level of productivity that could be maintained would decline and, therewith, the possible rents and associated land values would also decline annually. Since net returns represent net income less the annual reduction of the capital value of the land (or plus any increment in the case of improvement), the net returns under exploitation would decline annually, and the rate of this decline would be determined by the rate at which the land value was reduced. This in turn would be determined by the rate of physical destruction of the productivity of the soil and the interest rate. For the land being considered we can visualize one curve (CHD in Figure 4) representing the net incomes over time that would be associated with an exploitive system and, calculated from this, a net returns curve ($CHI_{(2)}$ in Figure 4) representing net income minus the loss in capital value calculated at interest rate $I_{(2)}$.

Because rents (net returns under conservation) can be maintained only at lower levels each year as the physical productivity of the land is destroyed, we find that, instead of one rent curve (such as AB in Figure 3) for the conservation

system, the height of the rent curve parallel to the X axis will be lowered as time passes, and we will have a whole series of parallel lines (UU to ZZ in Figure 4) representing rents or net returns under conservation systems inaugurated at successive points of time. The loci of the points where each of

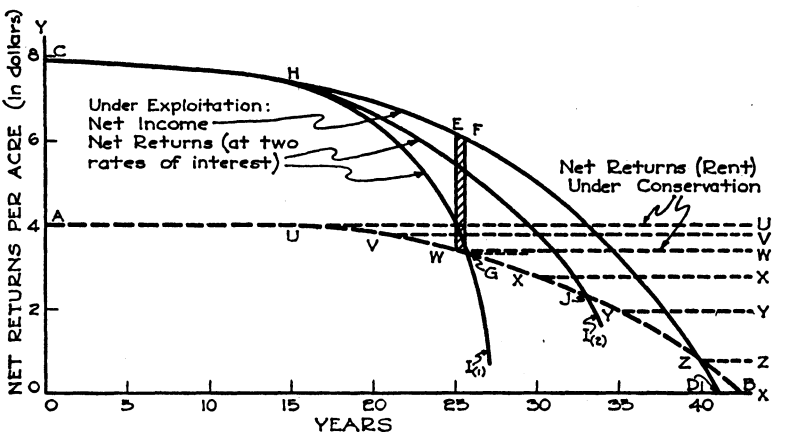


Fig. 4. Net income and net return curves under exploitation and various levels of conservation in the case of soil deterioration (depletion plus capital destruction).

these different levels of rent start in time will be a downward sloping curve, AB in Figure 4. The curve AB may or may not intersect CD (the net income curve under exploitation) depending upon the physical conditions of the erosion taking place, its effect upon productivity, and the increasing costs of controlling erosion as it progresses. Thus, instead of one rent curve AU which will rise and fall under dynamic conditions as new equilibria are established, there is a series of such curves at all levels below AU, and the whole series of curves will rise and fall in response to changes in the price and cost structure. This assumes, of course, that such adjustments are

made within the framework of the conservation system and do not result in further exploitation.

The basic fact of importance under the conditions assumed here is that as time passes rents (or net returns under conservation) are permanently reduced, and the process is not reversible.

Corresponding to this series of curves reflecting permanently reduced rents, and starting at the point U where rent commences to decline as a result of soil deterioration, will be a constantly increasing difference between net income (CD) and net returns (CI) under exploitation. The shape of the net returns curve under exploitation (net income per acre less the loss in the capital value of the land) is, therefore, determined by the curves CD and AB, and the interest rate. The generalization can be made that as interest rates decline, the capital loss increases, and the downward slope of the net returns curve becomes steeper. At a zero interest rate the capital loss becomes infinite, and the net return curve would be a vertical line from H to U. For all interest rates above 0 there will be a series of net return curves starting from H and sloping downwards at a decreasing rate as the interest rate increases. In Figure 4 two such net return curves ($CHI_{(1)}$ and $CHI_{(2)}$) are shown to represent interest rates of 2½ per cent and 5 per cent, respectively.

Two questions immediately arise. First, at what level does it become economic for the individual to conserve his soil under these circumstances? And second, is this necessarily the most economic level from the point of view of society as a whole?

In the case of the individual the point at which conservation becomes economic will depend, among other things, upon the interest rate and will be the point on AB where the annual return (at a given rate of interest) on the financial gain from exploitation equals the annual loss in rent resulting from

exploitation. This could also be expressed by saying that it becomes economic to conserve the soil when the capital loss in land value due to the permanent reduction of the productivity of the land equals the gain in annual income resulting from exploitation. In simpler terms conservation is economic where the *net returns* from exploitation equals *rent* at any given rate of interest. On Figure 4 this point is represented by the intersection of the net return curve CHI (at any given rate of interest) and the curve AB, because at this point the net returns from exploitation equal the net returns under conservation (rent). To continue exploitation beyond this point would mean that the net returns from exploitation would be less than the rent that would be obtained if conservation were adopted. Net income from exploitation would be considerably higher than the rent at this point, and the basic importance of deducting the capital loss is revealed. If the operator is not aware of this capital loss, or if he can transfer it to some other person or group, then he will continue to exploit the land.

Figure 4 indicates that for the first fifteen years (A to U), no permanently bad effects result from exploitation of the virgin fertility, and the exploitive system during this period is very much more profitable than the conservation system. During the next five years (U to V) continued exploitation results in some slight impairment of the soil so that when placed under a permanent system the net returns are lowered approximately 20 cents an acre in perpetuity. From V to W the rate of impairment and costs of control increase so that, at twenty-five years, rent under the conservation system is permanently 60 cents an acre lower than it would have been if conservation had been adopted ten years earlier, at U. As the years pass, however, cumulative erosion and increasing costs of control continue to lower the level of rent more and more rapidly, as is indicated by the increasing distances

between W and X, X and Y, and Y and Z for five-year periods. Each year the annual gain from exploitation (height of the column between AB and CD) decreases, while the loss in rent due to postponing conservation increases.

The Effect of Different Interest Rates

The importance of the interest rate may be shown by examining the two net return curves $CHI_{(1)}$ (assuming interest at 2½ per cent) and $CHI_{(2)}$ (assuming interest at 5 per cent). $CHI_{(1)}$ intersects AB at G (twenty-six years) and $CHI_{(2)}$ intersects AB at J (thirty-three years) and indicates in the example shown, that a difference in interest rates of 2½ per cent means a difference of seven years in the point in time at which conservation becomes economic to the individual. The arithmetic relationships may be illustrated by the following calculations: During the twenty-fifth year, W to G on the curve AB, the gain in net income from exploitation over the net returns (rent) under conservation is the height of the column FG or approximately $2.80 per acre; the permanent loss in rent due to this exploitation is represented by the difference between WW and the new horizontal line from G where $CHI_{(1)}$ intersects AB, and is about $0.07 per acre. At the interest rate assumed (2½ per cent), the annual return from $2.80 invested would be $0.07 and equal to the loss in annual rent. Similarly the loss in land values would be $0.07 capitalized at 2½ per cent or $2.80, and this deducted from the net income per acre makes net returns from exploitation equal to the rent, and it is a matter of indifference whether the soil is exploited or conserved during the twenty-fifth year; it would, however, be economic to conserve it after that time because the loss in rent will be greater and the gain from exploitation will be smaller. Similarly, at a 5 per cent interest rate the net returns curve from exploitation will intersect AB at J, and during the thirty-third year the gain in cash income

from exploitation over conservation will be \$1.80, while rent will be reduced by \$0.09; this loss in rent capitalized at 5 per cent equals \$1.80; the net returns from conservation and exploitation are identical, and conservation becomes economic in the thirty-fourth year.

If the lower interest rate also affects the costs of erosion control by reducing the annual costs of capital investments that are necessary, it will reduce the declines in rent resulting from exploitation so that the curve AUB will slope downward less rapidly from U to B.

The above arithmetical example illustrates the case when the interest rate has no effect upon costs, and this is true in so far as the decline in rent cannot be offset by capital expenditures but results from permanently lowered yields or increased costs. To the extent that capital investments in terraces, etc., can be used to control erosion, a lower interest rate reduces the annual costs and has the effect of moving the rent curves VV, WW, XX, and ZZ upwards by an amount equal to this reduction. If only the same amount of capital investment occurs over the whole range, the rent curves will all move upwards in identical amounts. This will have the effect of raising the curve UB without changing its slope, and the point U will be farther to the right. Corresponding to this change, the point of origin H of the net return curve $HI_{(1)}$ will move an equal distance to the right and slope down more rapidly and intersect the new rent curve to the left of G. This is necessarily so because the decline in rent due to one year's exploitation remains the same on both curves, while the distance between the net income curve and the rent curve is reduced.[1] The same results occur when any reduction in the

[1] Since $FG = \frac{WG}{i} \times 100$ and WG is the same on both rent curves, the raising of AUB will reduce FG, and a new equilibrium point will be established where $F_1G_1 = \frac{W_1G_1}{i} \times 100$ at an interest rate i.

costs of achieving conservation take place whether due to new inventions, lower wages, or lower interest rates.

The interest rate therefore influences two factors both of which have the effect of making a low interest rate favor conservation. As the interest rate falls, the capital loss representing the decline of the rents is increased, and the comparative advantage of the exploitive system over the conservation system is reduced because the annual payments on capital expenditures for conservation are made smaller.

Factors Affecting the Value of Land

When soil deterioration occurs, land values tend to decline over time and should correspond to the capitalized rents (UU to DB) plus the initial value of the area representing the gains from exploitation (this will be part of the area formed by the two curves CD and AB). At any given interest rate the initial value of the land will be a maximum when calculations are made on the assumption that conservation will be established at the point where it becomes economic to conserve the soil. While we may be justified in applying a straight-line trend to the net income curve from exploitation before any deterioration of the soil occurs (up to U in Figure 4), we cannot make that assumption after deterioration has commenced because, as has been pointed out, the character and relationships of the curves AB and CD depend upon the physical characteristics of the soil, the farming systems concerned, and the costs of establishing the conservation system.

In the example illustrated in Figure 4, the initial value of the land, at an interest rate ($I_{(1)}$) of 2½ per cent, must be based upon the assumption that capital maintenance would take place after twenty-five years. The value, in this case, would be the rent (WW) capitalized at 2½ per cent, plus the present value of the area CEWA. To make the estimate

we must know the shape and position of the curves AB and CD and no dynamic changes (e.g., in interest rates, prices, or techniques) may take place over the twenty-five-year period. Such conditions are never met in reality, and land values in the past have reflected net income, rather than net returns, with an increment added to take care of expected rises in value due to a growing population.

Social Welfare and Changes in the Interest Rate Over Time

An interesting problem of social policy arises when we consider the effect of changes in the interest rate over time. During the early expansion period of this nation, interest rates were high, and land values were low. Exploitation under these circumstances was economic to the individual. However, we know that capital accumulation can occur with great rapidity and that interest rates fall as capital becomes more abundant. This raises the question whether society should anticipate a declining interest rate and encourage conservation which may not be economic at the present rate of interest but would be economic at an anticipated future rate. The answer appears to depend upon whether the individual in anticipating increases in land values includes this factor in his estimate of the future, and to what extent capital can be substituted for land.

Interest rates are only one among many factors affecting the value of land; increases in population, the development of transportation systems, world trade, and the growth of cities are all important. Insofar as officials representing society can make more accurate forecasts of the future than do individuals, the government is justified in using appropriate means to guide and assist the individual in making a more rational estimate of the future. Capital may be substituted for land

in varying degrees: Drainage and irrigation represent sunk capital which is inseparable from land as such, while manure and fertilizer represent soil amendments which may replace exploited fertility. If we assume perfect substitutability, no case can be made for any social action which encourages investment in land at the expense of investment in other industries, because this would simply result in a lower social net product over time. If, on the contrary, we assume that substitution is possible only at increasing costs (this is implied in the declines in net returns from UU to ZZ in Figure 4) and further assume that the individual makes no allowance for a decline in interest rates, then social action to encourage capital maintenance or conservation when it is otherwise not economic for the individual would increase the social net returns over time. In the example assumed in Figure 4, conservation is not economic at twenty-five years at an interest rate of 5 per cent but is economic at 2½ per cent. If we knew that the interest rate would decline from 5 per cent at twenty-five years to 2½ per cent at thirty years, then the value of the capital loss at twenty-five years is not $0.07, capitalized at 5 per cent ($1.40), but should be $0.07 capitalized at 2½ per cent ($2.80), and discounted to its present value. In general, therefore, when a decline in interest rates is anticipated it is economic to conserve the land at that point when the anticipated future capital loss, discounted to its present value, is greater than the increment to current income gained from exploitation. This approach may, of course, be broadened to include all anticipated changes and simply represents a more correct accounting procedure which should be followed by an individual if the information were available to him. However, if the decline in interest rates is anticipated, the demand for long-time securities with a fixed interest rate would be so great that their prices would rise, and their yields decline, until a new equilibrium position had been established.

The Interest Rate and the Substitutability of Capital for Land

A decline in interest rates, however, also affects the slope of the curve AB showing the decline in potential rents over time, because the lower the interest rate the greater the possibilities of substitution of capital for land. To take a simple example let us assume that the physical productivity of a piece of land is reduced by exploitation over a period of ten years, but can be restored to its initial productivity by a capital outlay of $25 an acre without any change in the type of farming or labor requirements. At an interest rate of 5 per cent the decline in net returns at the end of ten years would be 5 per cent of $25, or $1.25. If, however, the interest rate declined to 2½ per cent during the ten-year period, then the decline in net returns at the end of ten years would be 2½ per cent of $25, or $0.625. This means that the locus of the rent curve would be 62½ cents higher at 2½ per cent interest than at 5 per cent interest.

The impossibility of using a zero interest rate for society is well illustrated at this point because, at a zero interest rate, the curve AB becomes a straight line. No decline in net productivity would result from exploitation, capital would have perfect substitutability for land, and exploitation would be economic to the point where CD intersects the new AB. At the same time, land earning any return would be infinitely valuable, but since no decline in net productivity results, no decline in land values would take place. Under these circumstances Figure 4 becomes identical with Figure 3, and erosion or soil deterioration is no different from fertility depletion.

As interest rates decline, the elasticity of substitution of capital for land increases, and to the extent that this occurs the importance of soil erosion or soil deterioration to society

declines. Even at low interest rates, however, the elasticity of substitution of capital for soil structure and its associated productivity may remain very low. This problem is related to the uniqueness of the productive powers of a given soil type; if they are unique and cannot be replaced at any cost, then the elasticity of substitution of capital for land is zero. Where a fertile topsoil has a subsoil that is responsive to management, so that terracing, liming and fertilizing, together with several years of green manuring will permanently restore the productivity, the elasticity of substitution might be very high at low interest rates and low at high interest rates.

The Comparative Advantage of Exploitive Crops

Apart from the interest rate, the point at which conservation becomes economic will be determined by the distance between the curves CD and AB and the rate at which curve AB slopes downwards.[2] The distance between the net returns curves for both the exploitive and the conservation system will depend upon the comparative advantage of the exploitive system compared with the best alternative conservation system. This will vary greatly between types of farming regions and the degree of change which may be necessary to achieve conservation. In general, in areas where the exploitive system has a great comparative advantage over the conservation system, exploitation will continue much longer, and greater losses in permanent net productivity will take place, than where the comparative advantage is small. This is particularly true in the case of an exploitive corn-hog system compared with a conservation system where more roughage and less grain are produced, in the case of cotton compared with most other alternatives, and in the case of wheat compared with extensive grazing and long rotations. Where a general

[2] *See* the discussion by Schickele of the breaking point of natural fertility, *Economics of Agricultural Land Use Adjustments*, *op. cit.*, p. 365.

mixed type of farming prevails, the conservation system may mean very little difference in the combination of factors and conservation may become economic before the virgin fertility is exploited and before permanent damage results.

From this theoretical analysis, any factors which increase or maintain the prices of such crops as cotton, corn, and wheat relative to the prices of other products, increase or maintain the comparative advantage of these exploitive systems and make the exploitive system (where it is being used) more economic than it would be if the relative prices for these products fell. Moreover, any factors which reduce the costs involved in adopting conservation tend to shift the comparative advantage to the conservation system.

Factors Affecting the Rate of the Decline in Rent

The major factors affecting the rate at which permanent productivity under exploitation is reduced can be divided into two groups. The first deals with the physical factors determining the kind and rate of erosion, and the second deals with the related factors affecting the costs of control. The first group deals with such factors as the seasonal distribution and intensity of precipitation, topography, soil type, and the land use pattern. These are the major factors which determine the rapidity of sheet erosion and degree of gullying. Because they vary between areas, farms, and even fields, the rate of destruction of the productivity of the soil varies. In the case of the factors affecting the costs of control, the physical conditions mentioned above, the amount of damage done, the changes in the farming system necessary to achieve conservation, and interest rates are important. In general, the costs of achieving control increase as erosion continues because more terraces and dams are needed and greater changes in land use have to be introduced. In attempting to determine whether conservation is economic on any indi-

vidual farm, the annual capital loss due to continued erosion, the capital costs of achieving control, and the probable effect of the changes upon net farm income have to be considered.[8]

Factors Determining the Effect of Exploitation Upon Prices

In the case in which the capital good being considered is unique in that it has no substitutes and cannot be replaced (in the case of soil this implies a cost of restoring productivity equal to infinity), the simplified assumptions regarding a constant cost-price structure cannot be maintained. A reduction in the quantity of the capital good will affect the prices of the products, and the present capital value must reflect the discounted anticipated values of the future. The change in future prices will be determined by the elasticity of the demand for the products (this reflects the possibility of substitution by consumers) and the amount of the reduction of the capital good in relation to its total quantity. If only a small part of the capital good were being destroyed and the demand were highly elastic, the effect upon prices and capital values would be slight. If a large part were being destroyed and the demand inelastic, a large increase in price and capital values would have to be anticipated. Under these circumstances exploitation or disinvestment would be economic up to the point where the marginal increase in income from exploitation equalled the value of the increment of resources used up (when the present value of the resource reflects the increase in prices due to the curtailment of total output).

This example is of little value for practical purposes because it is difficult to imagine such a unique capital good, but it serves to illustrate the relationship of substitutability of the capital good to the elasticity of the product demand and to

[8] For a method of making these estimates, *see A Method of Estimating the Economic Effects of Planned Conservation on an Individual Farm*, by Arthur C. Bunce and George Collier, U.S.D.A. Bul., Misc. Ser., No. 463, Jan., 1942.

future prices. Since the degree of substitutability varies for various soil types, each will have a different set of curves showing the net income under exploitation and net returns under conservation. At the same time, the elasticity of the demand for the particular products will affect future prices as the supply is reduced. To make a perfect adjustment the individual would have to know not only the future interest rate but also the probable effect of exploitation upon future prices, and then discount the anticipated future land values to the present. Because of the dynamic nature of our economic universe, in which demand and techniques change rapidly, the level at which conservation becomes economic is also dynamic and variable.

Land Improvement or Reclamation

When we turn from the problem of exploitation and conservation to that of improvement or reclamation, we find that identical problems and relationships exist except that instead of disinvestment we consider investment. Instead of a series of declining net returns curves, we would have a series of increasing net returns curves, and as long as the increase in net returns from the investment of labor and capital in land is greater than the returns from alternative opportunities, the investment is economic. Low interest rates encourage improvement, and anticipated declines in prices due to increasing output will discourage improvement. The problem of improvement is particularly important in the case of podzolic soils and, just as we find great differences in the effect of exploitation on soils with a high virgin fertility, so do we find differences in the responsiveness of forest soils to treatment.

Difficulties of Adjustment by the Individual

The foregoing general theoretical approach indicates the factors which determine the point at which conservation

becomes economic for the individual. The question immediately arises as to whether this level of conservation is economic from the point of view of society as a whole. In the case of fertility depletion alone, the process is theoretically reversible. New equilibria can be established in response to dynamic changes and no permanent losses need result from the adjustments. In the case of erosion, exploitation may lead to permanent reductions in net productivity, and the process is not reversible. Thus, temporary factors such as high prices which may afford a greater comparative advantage to the products of an exploitive system, or high interest rates which make it less economic for the individual to conserve his soil, would then result in permanent losses in net returns extending into the future should these factors not be correctly discounted by the individual.

Entirely apart from the question as to whether society is justified in encouraging conservation at an earlier level than is economic for the individual, society is certainly justified in inducing conservation when it is economic from the individual's point of view as well as from the social point of view. The factors which may cause continued "uneconomic" exploitation were discussed previously, but it may be useful to consider one further illustration based on Figure 4.

Let us assume that at an interest rate of 2½ per cent it is economic for an individual to conserve his soil after twenty-five years of exploitation, and that at this point (W on AB) the gain from exploitation ($2.80 per acre) exactly equals the capitalized value of the permanent loss in expected future net returns ($0.07). In order to enter upon a conservation program with adequate information, an owner operator would have to know the following facts:

(1) That the permanent net productivity of the land was being reduced by the assumed amount, and that this meant a loss of capital assets of $2.80 an acre. This loss in capital

value would have to be recognized separately from other factors causing changes in land values.

(2) He would have to know that the annual gain from exploitation compared to a conservation system had amounted to $2.80 per acre. In other words, he would have to know what his returns under conservation would be, and this involves a complete analysis of the capital costs involved in adopting a conservation system, the changes in land use and practices required, and the effect of these upon crop production, the livestock system, labor requirements, and final net returns.

Besides knowing these facts the operator would have to have the adaptability or managerial ability to handle the new system efficiently, and also he would have to have the initiative and energy necessary to plan and carry out the changes as soon as he became aware that they were needed.

Such information is certainly not available for most farmers, nor is there any great financial gain to act as a spur to individual initiative. If losses in capital value are covered up by rising land values, due to population increases or an expanding foreign market, conservation simply appears to mean a reduction in annual income in the present.

If we consider the case of a tenant operator on an annual lease, the chance that he will adopt conservation without pressure from the landlord is indeed remote. In this case the gain from exploitation is shared between the tenant and the landlord, but the total capital loss will generally be borne by the landlord. When this is true, it is to the tenant's advantage to exploit the soil as long as the exploitive system gives a higher annual return than conservation, regardless of the permanent damage done to the land. To remedy this the landlord would have to be aware of the capital loss involved; he would have to be able to suggest alternatives and accept a lower rent now in order to maintain it in the future. On

the other hand, if the tenant were occupying the land upon a permanent basis he might adopt conservation measures in order to assure himself of a permanent return over the future.

When we also consider that a change to a conservation system may involve adjustments in farm size and intensity, that prices have fluctuated violently over time, that American agriculture has developed historically on an exploitive basis, and that institutional patterns may have to be profoundly changed, the widespread prevalence of uneconomic exploitation is not amazing. Under these circumstances social action is palpably necessary and should benefit both society and the individual.

CHAPTER 8

SOCIETY AND CONSERVATION

Social and Individual Returns

Social Time Preference and Conservation

If we assume that individual freedom and initiative are desirable, then social action which limits individual action, either by removing part of his income by taxation or affecting his actions as a producer or consumer, should be justified by rational arguments which clearly reveal the necessity of social action and the basic causes of the condition to be remedied. Regarding conservation Pigou has stated:

> "There is wide agreement that the State should protect the interests of the future *in some degree* against the effects of our irrational discounting, and of our preference for ourselves over our descendents. The whole movement for 'conservation' in the United States is based upon this conviction. It is the clear duty of Government, which is the trustee for unborn generations as well as for its present citizens, to watch over, and if need be, by legislative enactment, to defend the exhaustible natural resources of the country from rash and reckless spoiliation."[1]

With such a general statement few will disagree except to point out that under democracy the "State," in considering the future generations, reflects the value judgments of the individuals comprising it. Hence it is not in opposition to the individual but reflects those values, which the individual alone can not attain, but which are desired by the majority. The individual often thinks in terms of the "good society"

[1] *The Economics of Welfare, op. cit.*, p. 29.

but lives under institutional arrangements that make his own voluntary actions to achieve the desired end inadequate. Most citizens believe in national defense, but few individuals send small personal cheques to the treasury to buy munitions because of the futility of such actions. They know from experience that not many will act that way, and they prefer to support legislation that will be effective by taxing everyone. Society's reflection of individual value judgments which conflict with their actions as individuals has been interpreted by many conservationists to reflect a difference between social and individual time preference, and this has been used as a blanket rationalization of why society needs to act to conserve our resources. In a previous publication the author has pointed out that this concept obscures rather than clarifies the issues, and outlined some of the conditions under which social action to achieve conservation is justified.[2]

The major objections to using a difference in time preference between society and the individual as a justification for social action may be summarized as follows:

(1) It establishes a universal cause of exploitation, and this obscures rather than reveals the real causes which may be very specific and far removed from a philosophic and moral generalization. If, for example, we say that individual exploitation of southern cotton soils is more rapid than is desirable for society because the individual's time preference (his preference for goods now rather than in the future) is greater than social time preference, we may fail to ask whether there are other reasons why individual exploitation is too rapid and neglect to analyze the basic causes of the divergence between social and private interests. The real causes may be insecurity of tenure, lack of capital, custom, or a population density

[2]Arthur C. Bunce, "Time Preference and Conservation," *Jour. Farm Econ.*, Vol. XXII, No. 3, August, 1940.

that is too great to maintain the level of living without disinvestment.

(2) Because the real causes of exploitation are obscured, public expenditures to control it may be unrelated to them and result in wasteful and unnecessary controls that may conflict with other social ends. Again referring to the exploitation of southern cotton lands, social action to induce conservation may be unrelated to the basic causes if it is undertaken on the assumption that it is necessary because of a difference in time preference between society and the individual. Instead of tenure reforms or supervised migration, subsidies or coercion might be used; subsidies might entrench a policy of permanently subsidizing a maladjusted area, while coercion might still further lower the social status of a depressed population and retard the development of new managerial skills and initiative. Before studying causes we must also analyze the effect of conservation on family income and relate this to the social benefits that will result in order to determine whether there is a real conflict between individual and social interests.

(3) Under most formulations of social time preference, no limits to public action can be established. All exploitation becomes anti-social, and the possibility of making any rational allocation of resources is destroyed. This is probably the greatest weakness of the social time preference arguments. Only if we use an interest rate can we evaluate expenditures or returns in the present with those expected in the future. Society, as well as the individual, has to choose between alternatives existing in time, and some rate of discount must be used. For most public expenditures the current interest rate on government bonds appears to be the logical one to use in social accounting. This enables us to estimate the present worth of expected future returns or, conversely, the future value of present expenditures. Many social expenditures are for intangible ends that cannot be measured in

monetary terms. This kind of expenditure simply represents social consumption and cannot be classed as economic or uneconomic in terms of a productive norm. The expenditure is made to supply a want, and where the results of two expenditures are separated in time, the use of interest charges simply provides us with a more accurate "price" of the two alternatives so that a more rational choice can be made.

The time preference of an individual will not affect his production plans, providing that he can borrow. If his time preference is higher than the rate of interest he will borrow, and if it is less he will save. When credit is not available he may be forced to liquidate the soil resources in order to supply urgent present needs. The basic cause of uneconomic exploitation under such circumstances is the lack of credit. Similarly, extremely high interest rates resulting from monopoly controls or other causes may cause an individual to exploit his soil resources rather than borrow. Both these conditions result in divergence between individual and social net returns and are discussed in more detail later.

Where the concept of a difference between social and individual time preference is used only to denote a difference in the interest rates at which the individual and society can borrow, the term differential interest rates is preferable; interest rates then can be included in the more general category of differences in prices available to the individual and society. Where social time preference is used in an intangible sense or to represent a zero rate of interest, it simply obscures the issues and makes social accounting impossible.

The Conditions Under Which Private and Social Net Returns Coincide

Rejection of the social time preference concept does not mean that social and private net returns coincide. They seldom do, and in previous chapters we have seen the com-

plexity of the problems of adjustment as well as the difficulties the individual faces in knowing when conservation becomes economic. If we contrast the conditions necessary for individual and social net returns to coincide with the conditions that actually prevail, the diversity of the causes of difference may be readily perceived. The essential conditions of harmony may be summarized under four headings:

(1) There must be equality of knowledge between the individual and the specialized groups providing information for the organization representing society as a whole, particularly with reference to future trends. This must also include knowledge of social costs and benefits.

(2) This knowledge must be adequately reflected in present prices determined under pure competition, the individual must be price responsive in his economic activities, and all significant costs and benefits must impinge on the individual.

(3) The intangible ends desired by the individual must be the same as those of society as a whole, and the ends must be attainable by individual action.

(4) There must be fluidity in the possibilities of altering the combination of factors of production so that adjustments in the proportions used may easily be attained in response to changes in prices, costs, and expectations.

In our present economic and social order, however, these basic requirements for an identity of social and individual interests are seldom, if ever, met. In the case of soil deterioration, for example, farmers are often not aware of the fact that erosion is destroying the soil assets, particularly if it is confined to sheet erosion. They treat net income as if it were net returns and make no allowance for the loss in the value of the land. Even if they realize the importance of erosion, they may not know the best methods of control nor the best available alternatives. Similarly, society may have information regarding other social costs resulting from erosion, such

as flood damage, silting of rivers and reservoirs, and costs of relief or resettlement of stranded populations in areas where the land can no longer maintain its present population. In this case the individual cannot calculate any of these costs because they do not bear directly upon him, and where he does not pay them, he would not adjust to them even though he might be aware of them. Apart from information on present conditions, society may be able to make better estimates of probable trends in the future because of its greater technical knowledge available through specialists.

For example, population specialists can estimate fairly accurately the probable population growth over the next decade, given the census data and immigration regulations, and can anticipate the expansion in domestic demand for food products. This and similar information may be available to individuals, but it will affect their behavior as producers only when it is adequately reflected in present and expected prices which form the framework within which production plans are made, usually on expectations confined to a relatively short period of time.

Society, through its legislative actions, also affects the conditions or institutional framework within which the individual formulates plans, and can, therefore, increase or decrease the element of uncertainty attached to individual actions. A law giving security of occupancy, compensation for unexhausted improvements, and compensation for disturbance would change the expectations and attitudes of tenants so that the risks of long-time plans involving liming, legumes, and livestock would be greatly reduced. Similarly, policies affecting trade conditions and prices, particularly in the international field, may increase or decrease individual risks and change the relationship between individual and social interests. Partly because of its control over the institutional conditions, society may also carry risks that would not

be borne by any private individual or corporation when the expectations of profits are small. This is particularly true of very large capital expenditures for such things as canals, large power dams, irrigation projects, and bridges. Private owners of capital cannot be permitted to pass these risks on to each individual in the society through taxation or the control of prices while the government can use these means of sharing or reducing risks.

An obvious deficiency of the necessity of competitive prices mentioned above is the fact that prices are market prices and not long-run "normal" prices. They tend to reflect more immediate factors and may move a long way from the normal level. This has been particularly true of land values. In many cases prices, including interest rates, are not fully competitive and do not accurately reflect future expectations even where these are known. Furthermore, much of the behavior of individuals is not price responsive.[8]

When we analyze the problem of intangible values, an even more difficult task faces us. Value judgments vary widely between individuals, and to assume harmony between all individuals and the abstract entity of the state seems impossible. At the same time, under democracy, the intangible values desired by the majority of the people tend to coincide with those of their representative government. In regard to natural resources the majority may consider that some reserves for future eventualities should be maintained even when there is no apparent long-time economic justification (such as an expected fall in the rate of interest due to capital accretions or an expected increase in population) for such conservation. Conservation in this case may be looked upon as a form

[8] *See* the discussion of periods of production by J. R. Hicks in *Value and Capital*, Oxford University Press, 1938, Chap. XVII, p. 226. He states, "In a state of grave mistrust, people will 'live from hand to mouth'; if they do so, changes in the rate of interest (the moderate changes we are talking about) can have little influence on their conduct."

of insurance against technological changes which may or may not take place. For example, society might decide that selective logging on a permanent yield basis must be adopted in order to maintain lumber resources for future generations. If we assume that at the time the decision was made, prices and interest rates were such that rapid exploitation was the most economic practice, then conservation would mean a lower level of living for the present due to higher costs of lumber (or a lower rate of capital accumulation) and a possibly higher standard of living for the future generations than would otherwise obtain. If, however, technological changes should make it possible to grow slash pine in the southern states and produce moulded pulpwood more cheaply than ordinary board lumber from mature trees, the result of this attempt to protect the resources for future use would be a lower standard of living in the present with the maintenance of forest resources that declined in value as a result of technological changes.[4]

Where an intangible end is desired by the majority in a democratic society, there may be a direct conflict of interests between the government and any minority opposed to the policies. Where the minority is large, opposition and mass evasion of control measures may be so great that the law is either repealed or not put into effective action. For this reason the actions of society through its government cannot deviate very widely from the rather generally accepted values of the people as a whole. Where the opposition is confined to a small number, coercion may be successful, or where the opposition is caused by a minority bearing economic losses, compensation may be used. In formulating public policy for conservation, these conflicts must be considered in order to devise the best means of attaining the desired end.

[4]At the same time society as a whole may reap great benefits from the forests for recreational or flood control purposes. These might not accrue to the individual owner but would be important considerations affecting public policy.

With regard to flexibility in the combination of the factors of production, we have seen that many institutional factors prevent adjustments from taking place easily, particularly at the extensive margins of arable farming; farm size is not easily adjusted, and farm population is relatively immobile; similarly, tax systems and conditions of tenure may seriously obstruct adjustment. All these conditions are important to a realistic analysis of the causes of divergence between individual and social interest.

Conditions Under Which Social Action to Achieve Conservation Is Desirable

The very complexity of the situation makes any examination of the reasons why social action to achieve conservation is necessary and desirable extremely difficult, but only as we understand these reasons can we determine the most appropriate means of achieving the desired end. In broad terms social action to achieve conservation is desirable:

(1) When it would be economic for the individual entrepreneur to conserve but he does not;

(2) When conservation is not economic for the individual but is economic for society; and

(3) When intangible ends desired by the majority of individuals in a democracy can be attained only by collective action. A complete analysis of these conditions and relationships involves the entire contents of this publication, and many of the points presented in the following sections draw upon previous discussions.

Criteria of Social Action When Conservation Is Economic to the Individual

Social action to achieve conservation, when it is economic for the individual to do so, is obviously justified on the basis that it will increase both individual and social net returns.

The major problem is to determine how much should be expended, what methods should be used, and what criteria are available to determine whether conservation is economic or not.

The distinction between deterioration and depletion is important in determining the quantity of funds that should be expended by society to eliminate what is essentially waste. In the case of fertility depletion, society might well expend funds so long as they were effective in increasing the social net income. In an emergency such expenditures may be essential in order to best utilize our resources, but in more normal times the difficulties of measuring the effectiveness of expenditures in achieving their objective would limit the scope of social action to education and possibly subsidies for specific improvements. The use of coercion could hardly be justified unless a serious crisis arose. To develop an effective program, the causes of uneconomic depletion should be fully diagnosed in order that the most appropriate action may be taken. But even if society takes no action, any resulting depletion losses will not permanently impair future returns.

In the case of uneconomic exploitation which results in soil deterioration, not only present net returns but future net returns are reduced and an irreplaceable destruction of capital assets occurs. Society is justified in making expenditures to prevent such permanent capital losses as well as the loss in current net income. In actual practice it is impossible to distinguish between depletion and deterioration when both occur together, but the distinction is analytically useful in determining the areas in which social action is most urgent. Where soil deterioration is occurring public action to eliminate it may have to be more drastic than that which would be justified to deal only with fertility depletion. Coercion of minorities through land use regulations, zoning ordinances, subsidies, and even government-directed migration may be

necessary in order to eliminate the social losses resulting from individual actions.

Public policy and action can be formulated, however, only as we understand the basic reasons why individuals continue an exploitive system *when it is not economic* for them to do so and results in lower net returns than could be obtained from a conservation system. Some of the more obvious causes are outlined below, but more information is needed to determine the relative importance of each of these causes of exploitation in various regions of the United States.

Custom and Individual Adjustments

Custom is one of the important factors determining human actions particularly in relationship to consumption. In industrial production its importance has rapidly declined with the introduction of machinery and rapid technological change. To some extent the same change has occurred in agriculture with the advent of farm machinery, and farm operators are more price responsive in an agriculture which is largely commercial in nature. The development of more price responsive action in farming has not, however, been equally rapid in all areas, and customary methods which are uneconomic and destructive may persist over long periods of time. It is extremely difficult to distinguish the relationship between the dominance of custom and inertia or resistance to change. Even though the operator may realize that his present farm operations are damaging his soil and that a change might make it possible to conserve his soil and increase or maintain his income, he may continue his present system because the benefits seem insignificant compared to the "effort" involved. In many cases yields could be improved and erosion decreased by simply adopting a better rotation and working the land on the contour. Once established the new system may require less labor and permit the same crops to be grown; but the

fact that fences have to be changed and new methods adopted seems to act as a barrier that prevents these adjustments from taking place. In some areas exploitive methods of farming developed when the land was rich in virgin fertility, and a system which was originally economic became uneconomic as the fertility declined; but exploitation has continued because the system which first developed, and the institutional patterns associated with it, act as resistances to change.

Lack of Knowledge and Individual Adjustments

Lack of knowledge is also an important factor associated with uneconomic exploitation and takes many forms. Farmers have not been aware that the productivity of their farms has been decreasing. Improvements in varieties and techniques of management have obscured declines in yields, and many studies indicate that if fertility had been maintained present yields would be much higher than they are. Sheet erosion has been particularly insidious and, as has been reported in a previous study,[5] many farmers were not aware that erosion was taking place until gullies developed and interfered with farming operations. A further factor obscuring the decrease in soil productivity has been the upward trend of land values from 1900 to 1920 during which period, for the United States as a whole, they doubled each decade. These increases in value tended to offset any decline in value which should have taken place as the fertility was removed; at the same time the higher land values tended to make the capital loss from exploitation larger and, therefore, should have made it more economic to conserve the soil.

Although some farmers recognized that their soil was deteriorating, they did not know the steps that should be taken to prevent or reduce it. One of the great advantages of the

[5]Arthur C. Bunce, *The Farmer Looks at Soil Conservation in Southern Iowa*, Ia. Agr. Exp. Sta., Bul. 381, 1939.

Soil Conservation Demonstration Areas has been that they have not only "demonstrated" but also "tested" many conservation practices, and their usefulness in this direction may be even more important as time passes. Even today we are not fully informed as to the best possible methods of conserving all our various soil types.

A still more intricate problem of knowledge develops when we consider the information necessary to decide whether conservation is economic or not. The operator would have to know the size of the annual capital loss and the net income from the conserving system as well as the exploiting system. This involves a complete farm budget analysis, and in reality, few farmers have the necessary facts to make these estimates. Exploitation, therefore, may continue although a careful analysis might reveal that a conservation system would be much more economic.

Insecurity of Tenure and Individual Adjustments

Insecurity of tenure may encourage uneconomic exploitation by creating conditions which prevent the establishment of a system of farming which would conserve the soil. The change to a conserving system, for example, might involve an increase in pasture and meadow and an increase in the roughage-consuming animals; these, in many cases, need a production period of several years, and uncertainty of tenure creates an added risk which must be borne by the operator. Where the investment of capital is involved, uncertainty is a major factor affecting individual actions. Similarly, lack of any provisions for compensation for unexhausted improvements reacts against a long-time plan of land use involving liming, fertilization, and legume production.[6]

[6] For some empirical studies dealing with this problem, *see Economic Phases of Erosion Control in Southern Iowa and Northern Missouri*, by Schickele, Himmel, and Hurd, Ia. Agr. Exp. Sta., Bul. 333, 1935; and also *Socio-Economic Phases of Soil Conservation in the Tarkio Creek Area*, by Schickele and Himmel, *Ia. Agr. Exp. Sta.*, Res. Bul. 241, 1938.

Rationing of Credit and Individual Adjustments

Rationing of credit by various credit agencies may cause uneconomic exploitation to continue by withholding credit for either urgent personal needs (such as education of children, etc.) or for productive livestock capable of using more roughage. This may occur either by maintaining a high rate of interest or by outright limitation of loans. In the case of the loans for urgent personal expenditures, an uneconomic disinvestment may result because of the inability of the individual to relate his time preference to the interest rate by borrowing. In the case of production loans a high rate of interest or rationing may prevent the individual from adjusting his farming to a more profitable and more conservational system.

The four factors outlined above do not exhaust the causes of uneconomic exploitation. There are many others: fluctuations in prices may introduce a further element of uncertainty in investments, and farm size may be an important factor in some areas because the unit of operation may be too small to provide the necessary level of living without disinvestment.

Conclusions

Where exploitation that is uneconomic to the individual occurs, society is justified in initiating action to eliminate it, but the action taken should relate directly to the basic causes operating in any given area. If tenure is uncertain or credit not available, then tenancy legislation or credit expansion may be the soundest method of attacking the problem. If lack of knowledge is a major cause then demonstration and education are most appropriate. If inertia and custom are major factors then either subsidies or coercion might be necessary. It is obvious that there are wide differences between regions in the United States, and any comprehensive

attempt to establish conservation should be based upon information regarding the causes of uneconomic exploitation in the various regions, and areas with regions.

Where exploitation is uneconomic to the individual and also results in other social losses, the case for social action is strengthened. The next section deals only with the case where there is a conflict between individual and social interests because exploitation is economic for the individual but not for society. All of the causes of this divergence in interest also apply to the case where exploitation is uneconomic to the individual, but they are discussed separately in the next section in order to avoid duplication. Where exploitation is uneconomic to the individual, its elimination is advantageous both to the individual and to society; where exploitation remains economic to the individual there is a direct conflict of interests, and the problems of social control are intensified.

Criteria of Social Action When Exploitation Is Economic to the Individual but Not to Society

Even when exploitation is economic for the individual because it maximizes net returns, it may not be economic for society because social net returns may be less than private net returns. Similarly, conservation or improvement not economic to the individual may be economic to society. The causes of divergence between private and social net returns may be classified into three groups: (1) when exploitation involves damages (or conservation and improvement involve benefits) apart from the destruction of the resource involved, which do not impinge upon the individual; (2) when the capital losses or gains do not impinge upon the individual, and (3) when the prices that are available to society differ from those available to the individual. These groups are not mutually exclusive, but they are useful for the purpose of simplifying our analysis and are taken up in the order listed above.

Social Costs and Damages

Since the benefits of conservation or improvement (such as flood control) largely correspond to the elimination of certain damages (such as flood damages), only the damages are outlined here.

Damages caused by floods, due to the increase in flood peaks resulting from an increase in the rapidity and quantity of runoff of surface water, are a serious menace to both rural and urban areas. Silt deposits in rivers, reservoirs, and on lowlands occur at an accelerated rate as erosion develops and may cause large social losses. Roads and drainage ways may be affected both by gullies and sedimentation, and maintenance costs are increased. An increase in the rapidity of runoff may affect the infiltration of water so that the water table and levels of lakes and sloughs may be lowered. All these factors are related to plant growth and wildlife, and in many cases, the water supply for towns and industries is impaired. The difficulty of evaluation lies not only in estimating the total damages but in allocating the damages to specific causes or areas. Whenever such social costs or losses can be related to specific areas, society is justified in attempting to eliminate or reduce them by the most suitable methods of inducing soil and water conservation. Estimates of damages borne by society, or by groups in society, must be made and also of the costs of conservation borne by the individuals who are affected by the controls. Since our basic assumption is that exploitation is economic to the individual, conservation will involve a loss in present income, and this should be balanced against the gain resulting to other members of society.

A less direct cost to society which may result from continued exploitation is the cost of relief or resettlement when the productivity of the land is so reduced that it will no longer sup-

port the present population. This involves not only the farmers but also the town and village populations which have developed as service and educational centers. This problem only arises when there is a serious maladjustment in farm size so that disinvestment takes place to provide the necessary annual income which could not be obtained under conservation measures. Sooner or later, however, the income from exploitation declines, and the population is then forced to adjust. In this case conservation implies more than introducing a new farming system; either farms must be made larger, or a permanent subsidy must be paid to the operators who practice conservation. Preventative measures affecting future settlement must be taken by society through zoning ordinances, and where this condition exists today, a long-time population and land use plan should be developed. Such a plan should embrace not only land use as such, but the possibilities of expanding secondary production enterprises must also be considered. Any expenditure of money to establish conservation when this means a lower income to the present operators may be purely a waste of funds unless steps are also taken to see that the farm unit will provide an acceptable standard of living to the people involved.

The Transfer of Capital Losses

In many cases exploitation appears to be economic to the individual because he is able to transfer the capital loss to society as a whole or to other individuals in society. The simplest case is that of the tenant farmer on a one-year lease, whose objective is to maximize his net income this year and who does not consider the loss in capital assets which is borne entirely by the landowner. The landlord may permit such losses to occur simply because of ignorance or inability to supervise the farm operations and establish a land use program

which will maintain his investment. Under these conditions education of landlords and the development of institutional arrangements encouraging longer periods of tenure and security of occupancy are important means of achieving conservation.

Similar conditions exist in the case of a heavily or over mortgaged farm where the operator is attempting to pay interest and principle payments over too short a period. In this case the operator disinvests his capital in order to pay for it, and if the disinvestment does not reduce net income too rapidly, he may succeed in meeting his obligations and build up the soil after the debt is paid. This may or may not be an extremely wasteful method, depending upon the cost of rebuilding the productivity of the soil. In the case of deterioration, such restoration may be impossible. An increase in the mortgage period to twenty, forty, or more years, might permit the operator to maintain his capital and enjoy a higher income over the whole period. Where the net income of the operator is rapidly reduced, or when the mortgage is too high, foreclosure is inevitable. The longer it is postponed the greater the capital loss will be, and this loss will be borne by the lender.

In the case of wildlife and fisheries, there is no way by which the pricing system can allocate a capital value to what is essentially a "free" good and appears to have no cost of production. The failure to allocate capital values is due to the difficulty of developing private ownership of these resources, and the only alternative is rigid government control of the quantity taken and positive action in re-stocking and propagation. In the case of game a widespread use of suitable shrubs to provide food and cover by individual farmers would increase the numbers greatly. However, if there is no means by which the farmer can sell his interest in this game, there is little chance of his being willing to do much to increase it. Since the public is interested in this phase of conservation,

it is justified in using license fees to pay farmers to cooperate in game production, or permitting them to sell "trespass" permits to hunters on their land. In most of the cases of transference of capital loss to others, specific measures must be developed for each problem involved, and this can be done only as we develop better techniques of social accounting.

Society and Investments

Because society represents the majority of people, it can and does make investments which will not be made by individuals. This may be due to the length of the period of investment, the magnitude of the capital expenditure involved, or the uncertainty of future returns. Society spreads this risk, through its ability to tax, over all persons in the group, and at the same time, society benefits from any intangible services which may result from the investment. The government, representing society, may also affect costs and prices through tariffs, taxes, fiscal policies, franchises, monopoly legislation, etc. For example: The government may borrow money at 3 per cent on the credit of the state and its ability to tax, and invest in any enterprise which is desired by the people; a private firm might have to pay 10 per cent on money it borrowed because of the risk involved. Such action by society is justified when intangible values are involved; when the social costs of such investments are lower than individual costs; or when the social returns are higher than individual returns would be.[7] Interest rates also play an important role in determining the value of resources and have an important bearing upon the divergence between social and individual net returns. This problem is discussed in the next section.

[7]A divergence between social and individual costs and returns may be due to many factors such as society's ability to reduce unemployment relief by providing employment or any of the factors mentioned in the two previous sections. *See* Eric Englund, "What Price Conservation," *Land Policy Review*, Vol. 3, No. 2, March–April, 1940. *Also see* Gunnar Lange, "A Neglected Point in the Economics of the Soil," *Jour. Farm Econ.*, Vol. XXIII, No. 2, May, 1941.

Differential Interest Rates

If the interest rate available to individuals for the purchase of land or other productive investments is 6 per cent from local credit agencies, and the government can borrow money and make loans for 3 per cent, a conservation problem immediately arises. Land yielding a rent of $6 an acre is worth only $100 an acre to the individual, but would be worth $200 an acre to the government, assuming equality of the conditions affecting both parties. Actually, the difference between these rates is partly due to differing risks arising from the fact that loans to the individual are inseparably tied up with his managerial ability and fluctuations in prices. The government, on the other hand, can transfer all these risks to society as a whole through its power to tax, and the creditor is reasonably sure that not only will his loan be repaid but the interest will be met as well. This implies that the interest earned on the current value of government bonds is as close an approximation to the marginal productivity of capital that we can obtain. Investors, therefore, would tend to bid the value of land, having a rent of $6 an acre, up to $200. The difficulty that immediately arises is whether actual land values are more closely related to the rate of interest available to the borrower or to the theoretical rate reflecting the marginal productivity of capital. There are other important factors to be considered relating to the family living, such as independence, "job security" of the owner operator, and social prestige, all of which will enhance the value of ownership. In the case of tenant farmers contractual rent may vary widely from theoretical rent as we have defined it here, and may reflect housing conditions, nearness to good roads and schools, and other similar factors. These are essentially consumption expenditures for family conveniences and may not be related to the productivity of the land. Where contract rents are on a crop share basis they fluctuate with yields and prices, and

these risks are shared by both tenant and owner. Where cash rents are paid they are more stable over time, and the tenant assumes all the climatic and price risks. At the same time, the relationship of the number of tenants seeking farms to the number of farms available affects the relative bargaining power of the tenant and landlord which tends to be reflected in both the level of family living and the rent paid. If we add to these factors differences in managerial ability, the simplifications involved in using a concept of economic rent are revealed. In spite of the simplifications, a useful analysis of the bearing of interest rates upon the divergence between private and social interests can be made on the assumption that rent is a residual and reflects the marginal productivity of land.

If we introduce into this simplified pattern two interest rates, one representing the marginal productivity of capital and one representing the rate at which farmers can borrow, the divergence between private and social net returns can be seen. Let us assume that the interest rate representing the marginal productivity of capital is 3 per cent and that this determines the value of the land because of the mobility of investments; let us also assume that the local rate at which loans are available is 6 per cent because of custom, rigidity, or inefficiency in the banking system. Under these circumstances a farm will earn 3 per cent on its capital value, but a farmer buying the farm will pay 6 per cent on his loan. This is only possible by one of three means: He may either disinvest, he may lower his current consumption of goods, or he may earn a rate of profit on his working capital substantially higher than the interest rate on loans. Which he will do will be determined largely by his level of living. The poorer the level of living, the less is the possibility of saving and the greater the probability that uneconomic exploitation will occur.[8]

[8] The managerial ability to make profits on working capital is, of course, reflected in the level of living and income of the farm family.

One example will indicate these relationships. If the rent from an acre of land is $6 and the marginal productivity of capital is 3 per cent, then the land will be valued at $200. To buy a 100-acre farm would require $20,000, and the local interest charges alone at 6 per cent would be $1,200 a year. The land would yield $600 as its net returns, and the remaining $600 would have to be paid out of the returns to management and family labor. If the earnings for the grade of management necessary to run this 100-acre farm "appropriately" are $2,000, then the saving of $600 a year might be possible. If, however, the managerial ability were such that it could handle only 50 acres effectively, the interest payment would be $600 and the returns from the land $300; this leaves $300 to be made up. Assuming management and family labor returns to be $1,000, it might be extremely difficult for the operator to save the $300 needed to pay the local interest charges. If to the interest is added an amortization charge to liquidate the debt over a 5 to 10 year period, the impossibility of the poorer manager becoming an owner without exploiting his capital assets, is seen.

One solution of the problem would be tenancy with security of occupancy which would avoid the necessity of the farmer reducing his level of living in order to purchase a farm; this has been advocated and adopted extensively in England. Whether such a solution is acceptable in this country depends upon the value the operator places upon ownership because of the security and prestige which may be associated with it. Since we postulated interest differentials, or loan limitations, due to custom, rigidity, or inefficiency, the most direct solution is to make loans on land available at as low a rate as is possible consistent with the marginal productivity of capital and the particular risks involved.

If we assume that the Federal Land Bank has made loans available to farmers at the lowest rate justified, an almost

identical problem arises when different mortgage periods are considered. Instead of contrasting a 3 and a 6 per cent interest rate, we could contrast the effect of ten-year and thirty-year mortgage payments in relationship to the possibility of repaying the loan without exploiting the land. From 1932 to 1935 the average term of farm mortgages for the United States was 7.2 years for insurance companies, 2.9 years for individuals, 1.9 years for banks, and 4.3 years for others.[9] This is one indication of the shortness of the repayment period for an investment which might well be spread over much longer periods of time and related to the farmers' ability to pay.

A further effect of excessive interest rates, or capital rationing, is the reduction of investments in land improvements or livestock which may be necessary in order to change from an exploitive to a conservation system. This would cause the exploitive system to continue long after it had become economic for the individual to adopt a conservation program. In both cases the pressure to exploit the soil is caused by the difference between the rate of interest available to the individual and the rate reflecting the marginal productivity of capital, and this exploitation may be economic and necessary for the individual but not for society.

Action designed to prevent exploitation must be directed at the cause. For operators with high managerial capacity, longer mortgage periods, or lower interest rates on mortgages and conservation investments, may be justified, provided that their managerial and labor returns are large enough to permit the saving of sufficient funds to cover interest and amortization charges. Where managerial and labor returns are so low that such savings cannot be made, tenancy associated with reforms

[9] Donald C. Horton, Harold C. Larson, and Norman J. Wall, *Farm-Mortgage Credit Facilities in the United States*, U.S.D.A., Misc. Pub. No. 478, 1942, Table 62, p. 168. Table 63 indicates wide regional differences, and the authors point out that the low figure for banks is partly due to the classification of production loans (usually short-term) as mortgages. pp. 165–68.

giving security of occupancy and compensation for improvements may be the soundest long-time program.

Impinging upon this purely theoretical picture we find a host of institutional factors. Farm population is relatively immobile, farm size and population patterns are rather stable and based upon historical developments, and rent, as we have seen, may have little relationship to the marginal productivity of the land. Partly due to these complexities abnormally high local interest rates exist in many areas, and the basic problem lies in determining the proper charge for risks due to fluctuations in prices and managerial errors. Government programs aimed at stabilizing farm income by an ever-normal granary or by subsidies to low income groups have important implications to conservation. Crop insurance may eliminate some of the risks, and this would justify an interest rate to farmers more closely approaching that at which the government can borrow. Subsidies may not eliminate risks, but they reduce the pressure to exploit the soil resulting from a lack of income adequate to maintain an acceptable level of living.

Differential Labor Costs

Differential prices available to the government and to the individual also occur when the government but not the individual has control of unemployed resources in a period of depression. A typical example of this occurs in the case of labor. If, in one area, terraces and dams involving a large use of labor are necessary to control erosion, the cost might be so high that it would be uneconomic for the individual to make the expenditure at current wage rates. If society, however, has accepted the responsibility for assuring a minimum standard of living for the unemployed, the actual costs to society of using this labor for constructive purposes, is the difference between the wages paid and the amount allowed for relief. This might make the social cost of erosion control structures

much less than that which would be paid by the individual. To determine whether a proposed program is economic or not, we would have to know whether the value of the resource saved would be greater than the *additional* social expenditure involved. If it is, then society and the individuals using the labor benefit. If net income under the conservation system is affected, this also would have to be taken into account.

The major problem of the use, by society, of unemployed resources lies not in determining whether they should be used in constructive enterprise, but in determining the most economic use. Unemployed labor, for example, might be used for the building of terraces on farms or for building a high school in the town, and the only way an economic decision can be made is by comparing the value of the high school with the value of the terraces (built at an equivalent cost) in preventing soil impairment. Such decisions are being made continually, and social returns can be maximized only as we learn to make and use estimates more accurately. One indirect method that society can and does use to measure this importance is to ask the individuals who benefit to contribute in some measure to the government expenditures. Where these contributions to the total cost of a project are made by various groups on a competitive basis, an indication of the value of alternatives is obtained. For this to be useful in conservation work, the individuals would have to have some knowledge of the magnitude of the capital losses, the effect of the control measures in reducing them, and any change in annual net farm income that might result.

Conclusions

Regardless of the causes of exploitation that is uneconomic to society, social action to eliminate it is justified, but the corrective measures should apply to the basic causes associated with any given area or problem. These measures may be

direct or indirect, depending upon whether conservation is a specific objective or whether the actions are directed to other major ends and resource utilization is affected only indirectly. It is obvious that there are wide differences between regions, areas, and even farms in the causes of exploitation, as well as differences between the kinds of resources being exploited. Only as we understand the causes more fully can we adopt the most effective methods of attacking the problems.

Criteria of Social Action When Intangible Ends Are Desired by Society

In the previous sections we have dealt with problems which involved financial gains or losses and which, theoretically at least, essentially represent problems of measurement in terms of money. We must now attempt to analyze the problems involved when intangible ends become social objectives supported by a majority through political agencies. In essence group action is necessary only in those cases where individual action is incapable of attaining the desired end.

A typical problem of this nature is that of billboard advertising which destroys natural beauty. Where a billboard creates a driving hazard it can be removed under the police powers of the state, but if it simply destroys a beautiful vista it is more difficult to do anything about it. Apart from the interested business men, it is difficult to find anyone who desires advertising along highways, and it seems reasonable to claim that the vast majority of citizens prefer scenery to advertisements for soap, gasoline, or cigarettes. The only reason that this kind of advertising persists and grows is that the advertisers believe it increases sales, and they, therefore, are willing to pay the landowner for the use of his land for this purpose. The value of the scenery to the public has no way of expressing itself through the pricing system and is an intangible end. In this case the solution appears simple; legisla-

tion could limit the property rights of individuals to sell or lease advertising sites outside of specified areas or restrain the advertisers from erecting the billboards. This would mean a loss in income to a few landowners, and a case might be made for some form of compensation. Since the loss in income from advertising would be very small compared to the total income from farm land, and because competitive advertising is often waste, the arguments favoring compensation seem weak.

There are many other social values of a similar nature; picnic areas, virgin forest strips on highways, recreational values of hunting and fishing, and forest camping areas, etc. Apart from these rather specific values there are broad general concepts such as individual freedom, security in both an economic and military sense, and equality. Conservation itself may fit into this group of broad intangible ends, and when it does, it simply reflects the desire of the people to think more broadly than in economic terms alone.

Many of our difficulties in dealing with these intangible values lies in the fact that our economics have been cast in terms of a productive norm. In our individual life we are both producers and consumers. As producers we are concerned with equating marginal costs with marginal returns to maximize income. As consumers we purchase the things we desire and have no objective means of measuring the expected satisfactions, so that we look at the prices of alternative purchases and buy that which we *think* will yield the greatest satisfaction. There are, however, many things which we as individuals cannot buy, and these range all the way from scenery and recreational areas to traffic controls to eliminate danger. Essentially, expenditures by the government to attain intangible ends represent social consumption expenditures desired by the majority of the people. They may reflect national pride or a desire to have open air recreational facilities available to all in order to counteract the influence of urbanization

in separating man from his natural environment of earth and sky and living things. Where the services from social expenditures are not sold, the only criterion of which expenditure is best lies in the decision of the people, through their representatives, as to which they want most. The problem of social accounting, therefore, is simply the correct pricing of alternatives in order that more informed choices may be made. Where expenditures or returns vary in time the use of the interest rate at which the government can borrow simply represents a means of estimating alternative prices and has nothing to do with the question of whether an expenditure will "pay" or not. If the objective is desired urgently enough it will be obtained regardless of the price, but it is essential that the cost be known so that comparisons may be made.

The Criteria of Rational Evaluation

In order to make any rational evaluation of the appropriate means society should use, and how far society should go, a certain minimum of information regarding both the ends sought and the means to be used must be available. These requirements may be briefly stated as follows:

(1) The end sought must be stated in such specific terms that progress towards its attainment may be evaluated.

(2) The relationship of the stated end to other desired ends must be known in order to analyze conflicts.

(3) The means that may be used must be evaluable in terms of their ability to achieve the specified end.

(4) The relationship of the means as they affect other ends must also be known.

Unless these requirements are met any rational analysis of social action appears impossible, and the broader the end the smaller the chance of intelligent action. Broad non-specific ends, such as "equality," have to be broken down into more specific concepts (e.g., equality as a political person at a given

age, equality of opportunity to receive education, equality in law, or equality of income distribution defined in terms of ranges of differences desirable and acceptable to the majority).

The Definition of Objectives

The idea that all conservation is good seems to have little value for the formulation of rational social action. As we have seen, conservation means different things, depending upon whether it is a fund, flow, or biological resource we are dealing with. Under a given set of conditions either exploitation, conservation, or improvement may be economic in the case of land, and conservation is simply a point that separates exploitation from improvement. Because exploitation and improvement may be rapid or slow, an infinite number of points could be picked between the two extremes, and conservation occurs at the point where exploitation ceases and improvement has not yet begun. In some areas and under some conditions either exploitation or improvement may be the better policy for the nation to adopt. If we ask, "When should this country have started to conserve its soil?", we are forced to admit that, while much of the early exploitation was wasteful, much of it was economic both for the individual and society. The broad objectives of soil conservation can be analyzed more rationally if we establish detailed statements of the objectives. These might be classified as follows:

(1) To achieve conservation or improvement in those farming areas where it is economic for the individual to do so.

(2) To achieve conservation or improvement on those farms or areas where it is not economic for the individual but it is economic for society.

(3) To achieve conservation or improvement on those farms or areas where it is not economic for the individual but is desired by society to attain intangible ends.

(4) To use the means best suited to achieve these ends when

complementary or conflicting relationships with other ends are considered.

Social policy directed toward achieving the first two of these objectives should seek to attack the most urgent problems (in terms of social losses) first. The third objective creates analytical difficulties of a special kind because there is no way of evaluating the importance of intangible ends in relation to each other through the pricing system, and our only available guide is the precedence that is given in the allocation of funds by the decision-making group. However, once the funds are allocated the most suitable means must be selected, if the funds are to be used wisely, and the means selected must take into consideration other ends.

Conflicts of Ends and Means

In all cases the question of whether or not conservation is economic for the individual is of paramount importance. If it is not economic, then coercion or a permanent subsidy may be necessary. If coercion, by limiting property rights, is adopted without compensation, this conflicts with the freedom of the individual to maximize his personal income. If a subsidy is used, funds so spent cannot be allocated to educational purposes to establish conservation in those areas where it is economic to the individual and where no permanent subsidy is needed. Only as we estimate the effectiveness of alternative expenditures to induce conservation can the most efficient conservation policies be formulated.

Budget allocations for conservation are made in competition with other objectives of the government. Conservation must compete with relief, education, and military expenditures. The final allocation of funds should reflect the urgency of the various problems to society as a whole. The total conservation budget must then be broken down and allocated to achieve more specific ends which may be either economic or

intangible in nature. To some extent these ends are bound to overlap in practice and can be separated only on a theoretical level. In reality the specific ends will range all the way from purely intangible ends, such as beauty, to the economic end of eliminating the annual damage of $5,000 to a reservoir from silt deposits. To achieve these specific ends are many means which may be used separately or in conjunction with each other. The ends sought mainly impinge upon the individual through the means used, and his reaction will depend upon the relationship of the means used to attain conservation to his other personal ends such as the maximization of his net returns and desire for individual freedom.

At the legislative level, conservation as an end competes with other social ends for funds. When detailed conservation policies are formulated, the needs of various areas, specific objectives, and alternative means must all be evaluated in order to make the most efficient use of the limited funds. At the same time the relationship of the means to be used to attain conservation to other objectives and means must be analyzed to prevent duplication or conflict. Education to achieve conservation on those farms where it is economic may be associated with our general educational system at very little cost. On the other hand, any policy which attempts to achieve conservation by education where individual loss is involved may be futile. Similarly, actions which tended to raise the price of intertilled crops relative to conserving crops, might completely negate a conservation policy which included a reduction of intertilled crops as a desirable means of reducing erosion.

Conservation ends and means, therefore, are closely related to many other social policies and actions because they all impinge upon the individual. Conservation policy, therefore, must be formulated with reference to all other actions that are being developed to assist agriculture, and the policies

of action agencies not specifically authorized to attain conservation objectives should consider the relationship of their programs to conservation.

These problems of policy formulation are discussed further in Chapters 11 and 12 after the character and limitations of various means of social control over land use have been reviewed and the problems of measurement have been outlined.

CHAPTER 9

METHODS OF SOCIAL CONTROL OVER LAND USE

The Classification of Social Controls

Social control in its broadest sense applies to any influence exerted by society on the individual. This influence may be unconscious and involuntary as is the case of customs, mores, and many social institutions whose existence is traceable to uncritical acceptance of traditional methods and procedures of doing and thinking. Social control may also be a consciously planned guidance of individual actions to achieve definitely stated objectives. The first may be called *informal* or moral control because the objectives and means are subjective and are often related to ethical values which may or may not be explicitly stated. The second type may be termed *formal* control because the ends and means are objective and explicitly stated. The last fifty years have seen a great extension of formal controls in the realm of economic and social planning, while the importance of informal controls has declined as mobility and individualism has increased.[1]

Given the aims to be attained, the basic problems of social control are, as Professor Ross[2] has pointed out, the determination of the best method of control, and the way in which the measures should be imposed. In the specific case of inducing conservation, the methods should be directly related to the specific causes of exploitation. As we have seen, these causes

[1] *See* Helen Everett, "Control, Social," *Encyclopaedia of the Social Sciences*, The Macmillan Co., New York, 1937, Vol. 4, pp. 344–48.

[2] E. A. Ross, *Social Control*, The Macmillan Co., New York, 1910, Chap. XXXI.

vary greatly between regions, states, areas within states, and even between farms in the same area. Therefore, the means used must vary accordingly, and any national program should be both broad and flexible in order to be most effective in attacking the basic causes. In many areas there will be found a complex of several factors, and action along several lines may be essential to achieve permanent results.

Because the means used to attain various ends all affect the individual, the most useful classification for our purpose is one based upon the way in which the methods used impinge upon him. Such a classification also permits an analysis of the relationship of the means used to the causes of exploitation which are also directly related to the individual. Social action may affect individual action through persuasion, through the price system, through subsidies, or through coercion which involves changes in property and contract rights. These four basic means of control have many subdivisions. They are not equally important, and the emphasis placed upon any one will vary according to the political ideology of the state and the nature of the problem involved. Many of our action programs involve the use of more than one of these means, but their relative importance varies. Within each of these four means we may distinguish between direct actions, which are used for the specific end of achieving conservation, and indirect actions, which are used primarily to attain another end but which indirectly affect land use and conservation. These major categories of means, the causal factors they may be used to counteract, and their limitations are discussed below.

Social Control Through Persuasion or Education

The Farmer

Education covers a wide field of activities and ranges all the way from newspaper publicity to demonstration projects

covering a watershed. There has been a rapid growth of direct conservation education during the past five years, but much remains to be done, particularly in emphasizing economic aspects. Direct conservation education could be one of the most effective methods of inducing action where continued exploitation is uneconomic to the individual and is largely due to ignorance. And yet education may be an extremely slow method. More effective and rapid action will result if education is supported by an additional incentive such as a subsidy. This applies particularly to the spread of knowledge among farmers through county agricultural planning committees, the press, the radio, and all the other methods of adult education used today. The farmer may realize that conservation farming is economic and that he should modify his present methods. But if, during the transition period, there is a temporary drop in income, a good deal of extra work involved, or some capital expenditures required, education alone may not overcome inertia in the majority of cases. Education under these circumstances needs some other form of social action which will at the same time appeal to the farmer's self interest.

Direct conservation education of farmers must deal concurrently with two problems; it must show that conservation is actually economic, and it must show how it can be achieved on the individual's own farm. This means that it must be specific and practical for the local conditions prevailing, and it must embrace farm management as well as technological information on the physical means of controlling erosion. The growth of Soil Conservation Districts represents the development of a means of cooperative action and at the same time an extremely effective educational technique. If we look upon the technician as a teacher, his development of conservation planning skills with groups of farmers, each developing a

program for his farm, is an almost perfect example of direct education.[3] The major problem is that of developing techniques which will permit a wider coverage by the limited personnel available. The careful use of "land use capability classes"[4] is one such technique, and if simpler procedures for making conservation maps could be developed, the educational process might be speeded up.

An experiment with soil mapping technicians working with groups of farmers, so that the farmers themselves make their own conservation maps, might well be made in several areas to determine how far and how accurately this educational technique could be used. With reference to the expense of this detailed educational approach, the fact is important that, once the farmer has established his own conservation plan and put it into operation, no long-time expenditures are involved. The new pattern of land use and practices will become customary, and the techniques will be passed on from generation to generation, and there may be no need for a permanent subsidy.

The School System

A less rapid but important phase of direct conservation education is that which may take place in our school system. Classes in agriculture in high schools should all include erosion control as an important part of the curriculum, particularly in areas where erosion is serious and conservation is plainly economic. Such courses should include farm budgeting and methods of estimating capital losses as well as descriptions of the major control measures applicable to the area. In the lower grades only a beginning in conservation education has

[3]Administratively, this technique is not called education because education is usually a prerogative of the Extension Services of the States; conflicts between agencies may be avoided by a careful formulation of policies to prevent overlapping and duplication. *See* the discussion of Policy Formulation in Chapter 12.

[4]*See* E. A. Norton, "Land Classification as an Aid in Soil Conservation Operations," and particularly the "Discussion" by G. A. Pond both in *The Classification* of Land, op. cit.

been made, and the outstanding work at present is that being done by the National Wildlife Federation. This organization has sponsored the writing of four conservation books[5] to be used in all grades from three to eight. Distribution through the school system is being attempted by encouraging various civic groups to become the "conservation sponsor" of a particular school or grade. The books are so designed that they may be used in a wide variety of courses from reading to biology and involve only a change in emphasis rather than content. The development of conservational attitudes regarding the preservation of our agricultural land resources as well as of wildlife, scenery, and recreational facilities is one of the most urgent educational problems; this may best be done through working with the younger children, but as yet only a modest beginning has been made.

The Extension Service

The Extension Services of the various states have done excellent work in educating farmers to the advantages of conservation, but in many cases the county agent, unless he is in a county where the Soil Conservation Service is operating, knows little about the techniques of conservation or how to assist a farmer to make an estimate as to whether conservation would actually pay or not. To offset these shortcomings we need courses in land use and soil conservation at the land-grant colleges,[6] and a simple budget analysis that the county

[5] The titles are *Would You Have Lived When—?* (for grades 3, 4 and 5); *Raindrops and Muddy Rivers* (for grades 4, 5 and 6); *Plants and Animals Live Together* (for grades 5, 6 and 7); *Nature's Bank—the Soil* (for grades 6, 7 and 8); published by the National Wildlife Federation, 1212 16th St. N.W., Washington, D. C.

[6] Apart from the regular courses in these subjects, special summer courses of this nature were offered at Iowa State College in 1939. These courses carried graduate credit which could be used toward advanced degrees and special arrangements were made to enable county agents to attend.

In Ohio a Conservation Laboratory for teachers was conducted in 1940 and 1941. The courses covered the major fields of conservation and also methods of teaching conservation to grade school children; graduate credit was given. This type of work needs to be greatly expanded.

agent could use with the farmer in making estimates of the economic relationships.[7] The greatest opportunity open to the extension service appears to be that of coordinating and making full use of existing conservation agencies in the whole field of conservation education. Leadership training institutes for A.A.A. Committeemen and other farm leaders could be established and Soil Conservation Service technicians called upon to present specific instruction.

Demonstration Projects

Under the Soil Conservation Service program, demonstration projects and cooperative county projects have been established to show that conservation of soil resources actually can be achieved. To some extent these projects have had to develop practices most suited to a given area by the trial and error method, and their permanent acceptability to the farmer can only be demonstrated after a longer period of time has elapsed. The weakness of such demonstrations from an educational point of view lies in the fact that they can only cover relatively small areas and the cost is high. Farmer tours of inspection may do a great deal to increase the educational influence of such projects, and if all high school students taking agriculture could visit at least one project area, that influence would be greatly increased. In spite of the weaknesses of such demonstrations from an educational point of view, they have been valuable in testing the practicability of practices and demonstrating the ability of farm operators to maintain them. In the future, valuable information may be obtained from surveys conducted after all supervision and control is withdrawn. Entirely apart from soil conservation, many of these projects "conserved" a good deal of unemployed labor by embodying it in dams, waterways, and terraces and, in many

[7] One of the weaknesses of many farm budget analyses is that no place is given to the important problem of estimating the loss in the capital value of the land as a result of soil deterioration.

cases, showed that undertakings, which would certainly not be economic to the individual, were economic to society when unemployed resources could be used.

Indirect Education and Informal Controls

Education having an indirect effect upon conservation is widespread. The teaching of the principles of farm management, studies of wildlife, nature study, geography, agronomy, and soils all carry in some degree references to conservation. Probably an expansion of the conservation content in all these courses could be attained, without eliminating any of the present subject matter, by a simple adjustment in emphasis. This type of indirect conservation teaching can be developed through our present educational system without any increase in the present budgets.

There is also the problem of social attitudes toward the land and agriculture. Professor Zimmerman[8] has shown the importance of local responsibility and informal controls in developing attitudes to conservation in Klein Lengden, Germany. In the United States, however, there has been a great deal of mobility not only of tenants seeking new farms within the states, but also of retired farmers moving from one state to another. Village populations have been mobile, and in many areas, there are not the closely knit community relationships extending over generations that we find in European villages. The land is a means of making money, and there is little "reverence" for it and little or no community interest in the economic production of the individual. Whether these relationships and attitudes will be affected by the development of county agricultural planning committees and community cooperation in solving problems is a matter of speculation. However, it seems certain that changes in attitudes will only

[8] Carle C. Zimmerman, "Soil and Men—Blut und Boden," *Land Policy Review*, Vol. II, No. 4, Aug., 1939, p. 18.

take place as the interdependence of the individuals and the community is recognized. Whether such changes can occur with a highly mobile population and tenancy is problematical; how much stability is desirable and how much mobility is necessary to maintain a progressive dynamic society are questions still requiring an answer, but the depression and curtailment of our rapid economic expansion all emphasize the need for greater security and stability in the future. As this develops, the growth of informal controls should be anticipated, and definite action to encourage conservation attitudes should be taken. In this development both sociology and social psychology have important contributions to make, and from the point of view of conservation, our present informal controls need to be studied, and the possibility of modifying them in order to further conservation ends should be explored.[9]

Other forms of informal control, more direct in nature, are the pressures that may be brought to bear upon individuals by the Federal Land Banks, the Farm Security Administration and landlords who may require adherence to a conservation plan in order to protect their equity. In this case the rights of the borrower or tenant to benefit from improvement of the land should be protected by some form of compensation for unexhausted improvements.

Social Control Through Prices

There have been no direct attempts to induce conservation through manipulation of prices. To use this method of stimulating individual action, we would need to know more about the responses of individuals to price changes. The simplest method would be to manipulate the prices of farm products

[9] For example, the traditional plowing-match stresses straight lines and the covering of all trash and stubble; conservation plowing-matches have been developed which stress plowing on the contour and leaving trash or stubble on the surface to prevent soil washing. Some work of this nature has also been done by the Forest Service in fire control; where community firing of brush had become a social custom it was offset by introducing other community activity.

so that conservation farming would have a comparative advantage over exploitive farming. If this were done there would be immediate repercussions on farm incomes, supplies of products, and retail prices. Such a method of control could be advocated only when the difficulties involved in estimating the costs and anticipating the results have been explored much more fully.

Far less drastic, however, is government action which reduces the price of lime and fertilizer by reducing the costs of production or distribution of these products. This implies that no subsidy is necessary. Where this can be done, there appears to be little justification for using the program as a direct method of achieving conservation, but the service should be made available to all farmers; in this case it becomes one more example of indirect action.

One important action affecting prices and directed to improving the general welfare of farmers has been the development of the Federal Land Bank System. This has lowered the rates of interest available to farm borrowers and has important indirect effects on conservation by making it more economic to the individual.

The most important government agency influencing farm prices has been the A.A.A. Its indirect effect upon conservation (through affecting prices and quite apart from the effect of subsidies) is determined by the degree the measure changed the relative comparative advantage of exploitive and non-exploitive crops. To the extent that the comparative advantage of exploitive crops has been increased or maintained, the program has affected conservation adversely. On the other hand, to the extent that the A.A.A. has raised or maintained the general price level of all farm products it has discouraged the exploitation which results when land values decline, mortgages are foreclosed, and investment is curtailed. These generalizations are subject to the limitations outlined in Chap-

ter 5, *Price Changes and Conservation*, and need not be repeated here. The final effect of the induced price changes on conservation can be analyzed only in terms of specific areas. A tentative hypothesis which should be investigated is that conservation has been encouraged in those areas producing surpluses of exploitive crops and discouraged in deficit areas. It is impossible to separate the effect of these price factors from the effect of acreage reductions induced by the A.A.A. parity payments, and these are discussed in the following section.

Social Control Through Subsidies

The Agricultural Adjustment Act

A direct payment to a farmer for adopting conservation practices may be an effective method of control. Where used, however, the payments must be for positive conservation actions rather than for negative actions as is the case for most of the payments under the A.A.A. Where the payment is made for the reduction in a specific acreage of an erosive crop without strict limitation on other crops that could be grown, one erosive crop may be replaced by another as, for example, when soybeans replace corn under the A.A.A. program.[10] This method of direct payment is limited in scope by its cost and the fact that the change in land use is not necessarily permanent. Where exploitation without the subsidy is economic, the induced change will probably be only temporary; where the use of a subsidy overcomes inertia and induces conservation which is economic to the individual, the change will tend to be permanent and the subsidy may be discontinued as soon as conservation is established.

The greatest weakness of the A.A.A. from the point of

[10] The importance of this is indicated by W. Wilcox, who has shown that in 1929–33 there were 26.5 million acres of intertilled crops of which 25 were corn and 1.5 soybeans; and in 1939 there were 27 million acres of intertilled crops, 22 corn and 5 soybeans. Increases in grass were at the expense of small grains. *Iowa Farm Economist*, Vol. VI, No. 5, May, 1940, p. 12.

view of conservation has been the general policy of limiting payments for conservation practices to a sum not in excess of the costs. This effectively prevents the use of these subsidies to overcome the forces of inertia and custom. This is largely the result of conflicting concepts embodied in the act. Production control with "parity" payments to cooperators may be used to achieve three ends: (1) reduce supplies of specific crops in order to raise prices; (2) soil conservation; and (3) redistribution of income. These ends are not fully compatible because, for example, to reduce corn production we must reduce the corn acreage in the most productive areas, while to achieve conservation the poorest land needs to be taken out of corn production, and the best land, which does not suffer from erosion, should be left to produce all the corn it can.[11] At the same time, a low price for corn will reduce its production on poorer land, encourage hay and pasture crops, and permit corn to be imported when needed for feed. A desirable redistribution of income may or may not result from acreage changes aimed at either conservation or reduction of supply. One criterion of a just redistribution of income is need, and yet where the good land is taken out of production the payments largely go to the farmers with a relatively high income. On the other hand, because low incomes are often associated with poor land and lack of capital, payments in areas where conservation is seriously needed may coincide more directly with the need for increased income. In spite of this, there is not sufficient evidence to justify the assumption that conservation and income deficiency payments are identical, because the level of living is also related to the size of the farm and the family. Conservation payments, however, must consider the ability of the farm to provide an acceptable level

[11] In the lake states, for example, "Corn acreage increased in spite of the A.A.A., partly because of the corn loan which raised prices in 1939 and 1940." *See* O. H. Brownlee and T. W. Schultz, "No Production Control," *Iowa Farm Economist*, May, 1941, p. 12.

of living without disinvestment, or the conservation program will not be maintained in the face of economic pressures. Whether subsidies under the A.A.A. can become effective means of achieving conservation will depend upon the basis of allocation and the importance attached to the conflicting ends.

In all cases of subsidies the cost of the measures in relation to the amount of conservation achieved must be a primary consideration, and this is closely related to the permanence of the changes introduced. If we spend large sums to reduce the acreage of erosive crops and then also permit the prices of these crops to rise so that their comparative advantage is increased, the program may be self-defeating from the standpoint of soil conservation.

The Soil Conservation Service

The Soil Conservation Service has not made use of cash payments to induce farmers to adopt a conservation program, but it has used subsidies in the form of free labor from C.C.C. camps, the services of skilled technicians for mapping and planning, and materials such as lime, fertilizer, and seed. Where the S.C.S. plan called for a reduction of exploitive crops, the A.A.A. payments encouraged the farmers to accept five-year agreements with the Department of Agriculture; how important this factor has been, it is difficult to say, but 42 per cent of a sample of Iowa farmers cooperating with both agencies stated that the parity payments were "very important," and only 19 per cent stated they were "not important."[12] It seems reasonable to accept the general thesis that where conservation is economic in that it will just maintain the present farm income and reduce the rate of disinvestment, some form of subsidy will help to overcome inertia especially where the practices that are needed involve changes

[12] *The Farmer Looks at Soil Conservation in Southern Iowa, op. cit.*, p. 129.

in the techniques of farming. Where a conservation plan increases farm income, the need for any subsidy declines. In both cases, however, the subsidy need only be of a temporary nature and cover the period of adjustment; the amount paid should be related to the total change required, the period over which it takes place, and the amount of disorganization resulting.

Where conservation is not economic to the individual but is desired by society, some form of permanent subsidy or informal or formal restraint may be needed to maintain conservation on a permanent basis.

The Conflict of Agencies

A third agency concerned with conservation is the County Agricultural Planning Committee. These committees have developed land use recommendations but have no control over funds (except in a few experimental areas), and their effectiveness will be directly related to their ability to initiate and control action programs. This again is dependent to a large degree upon the ability of the Committee to call upon the services of technicians and to direct subsidies according to their local needs. Where Soil Conservation Districts have been formed, a similar problem exists except that the district has the authority to request the services of technicians to assist in developing an action program. Neither of these agencies has any direct control over the allocation of A.A.A. funds except as their recommendations are accepted at the state and Federal levels. Where the two organizations function in the same county an inevitable conflict of powers develops and three logical solutions appear. The county committee may be designated as the controlling agency for the area with S.C.S. personnel and A.A.A. payments being allocated to the committee to be used by it in developing the desired land use and conservation action program, and no district board would be

needed. The conservation district board, on the other hand, might be given these powers, and in that case the function of the county committee largely disappears. A third alternative is the development of a cooperative enterprise through some form of agricultural council representing both the district and county organizations. If A.A.A. payments are made on a basis that emphasizes conservation more than production control, the need for a solution of these conflicts in the agencies administering subsidies will increase.

In developing a solution to the problem of allocation, certain basic principles regarding subsidies to achieve conservation may be summarized. (1) The more economic conservation or improvement is to the individual, the smaller is the need for cash subsidies. (2) The greater the degree and speed of change, the greater is the need for both cash and service subsidies. (3) The more serious the problem of soil deterioration or erosion, the greater is the need for service subsidies for planning erosion control. (4) The unification of the various programs should be such that the basic causes of exploitation are remedied and the largest amount of conservation achieved at the lowest social cost.

Apart from the S.C.S., the County Committees, and the A.A.A. are the Farm Security Administration, the Federal Land Banks, and the Extension Service, all of which have important indirect relationships to conservation through education and informal controls and should be related to a unified program. The present means of cooperation and their relation to actual achievement might well be studied in order to develop improvements in the future. Such a study should also include an analysis of other forms of subsidies such as tax rebates on crop land placed under permanent vegetative cover, low interest loans for conservation investments, and subsidized low prices for lime, fertilizer, and seed where these are neces-

sary to get the program into operation. It appears doubtful whether any single solution, applicable to all areas, can be developed. Much greater flexibility in all programs is desirable so that the form of coordination best suited to the problems involved may be developed in each area.

The use of subsidies is limited by their cost to society, and in the case of indirect subsidies, the difficulty of relating the social cost to the amount of conservation achieved makes any social accounting very complex.

Social Control Through Property and Contract Rights

Liberty, Equality, and Democracy

Liberal thinkers of the eighteenth century often looked upon individual property rights as one of the means of checking the influence of the state and the king. This was a reaction to despotic control where the sovereign and the state were synonymous. In many cases, however, they failed to realize that while it might be beneficial to society to reduce the influence of the state under autocracy, this might not be true under a democracy when the state represented the people. The framers of the Constitution of the United States, like their contemporaries amongst the English and French liberals, were very much concerned about the individual's freedom of action and embodied the concepts of liberty and equality in this document. These two ends, however, are partly inconsistent because equality, to be absolute in an economic sense, implies an equal distribution of property which would destroy the liberty of the individual to acquire property.

The framers of the constitution emphasized liberty, and property and contract rights were accepted as essential rights of the citizens. Historically, we have seen a constant conflict

between individual liberty and the right of the state to control. Both sides claim to represent "Democracy," and this results from a failure to distinguish between individual freedom and democracy. Democracy means the rule of the people directly or through their representatives, and this rule can only be effected by the use of majority decisions and the corresponding coercion of a minority where necessary. This inevitably means a limitation of the freedom of the individual, and these limitations progressed rapidly as society became more complex and more interdependent. On the other hand, the limitation of the freedom of some individuals may expand the liberties of others; the relationship is well expressed by Professor Commons in the phrase "collective action, controlling, liberating, and expanding individual action."[18]

Limitation of property rights does not, therefore, conflict with the concept of democracy, but in many cases it represents the logical result of attempts to achieve it; it does, however, represent a limitation of individual freedom. The writers of the constitution recognized that there must be some limitations of property rights, and the three main types foreseen by them were (1) taxation, (2) eminent domain, and (3) those rights of the states which were later embodied in the concept of the police power plus the similar rights of the Federal government to regulate commerce and promote public welfare. The rights of the individual were protected by the 14th amendment stating that he "shall not be deprived of life, liberty, or property without due process of law." It is through the interpretations of conflicts that the concepts of property and control have been changed and developed by the Supreme Court. The Court's function of acting as a check upon legislation developed out of the necessity of resolving conflicts between Federal, state, and individual rights.

[18]John R. Commons, *Institutional Economics*, The Macmillan Co., New York, 1934, p. 92.

Eminent Domain and Public Ownership

Eminent domain represents the right of the state to acquire the property of an individual when it needs to do so. It is directed against a single person and his property, and compensation has to be paid. It can not be used to regulate the use of property by an individual but only to change the ownership. In regard to conservation, the main use of eminent domain is in acquiring public ownership where this is deemed expedient and necessary.

Public ownership gives the most complete form of social control over land use in that all the property rights become vested in the state. The main limitations to this method of control lie in the fact that it is exceedingly costly (except when confiscation without compensation is resorted to and then it may be unjust) and is only adapted to those uses which do not require a great deal of intensive supervision. It is particularly applicable to forest and grazing areas where land is cheap and may revert to government ownership through tax delinquency, and where supervision is relatively simple. In the case of arable farms, the cost would be extremely high and supervision difficult.

Taxation

Easements represent the right of an individual to obtain access to his property over that held by another, through a court decision and the payment of compensation. This is similar to eminent domain in that the withholding power of the individual is restricted. Taxation, like eminent domain, also takes something away from the owner, but it differs in that taxation is directed to a group and not to an individual and does not affect any of the remaining property rights. Taxation might be used more widely as a method of controlling land use, providing that it is directed towards all persons

in a stated group or is related to specific services rendered. It is doubtful if punitive taxes aimed at persons who did not conform to a specified land use pattern would be upheld by the courts while a high property tax with rebates permitted for cooperation in a conservation program might be accepted.

The Wisconsin forest crop law, with an annual tax of 10 cents an acre and a 10 per cent tax levied on the cut, represents a movement towards a taxing system related to land use. Similarly, woodlot tax exemption or reduction laws current in many states might be expanded to include permanent vegetation of all kinds. How far this instrument could be used would depend upon the attitude of the Supreme Court and its interpretation of the "reasonableness" of the measure. In general, the taxes or tax rebates would have to be related to easily definable land uses and could not be based upon such an intangible concept as conservation; in spite of these limitations there appears no reason why tax rates on land might not be differentiated on the basis of whether it was used for intertilled crops (or specific crops such as corn, cotton, or soybeans), small grain, rotation meadow, or permanent pasture. Contrasted to the present taxes in many counties, this would appear to be a much more logical basis of taxation. Lower taxes on non-exploitive crops relative to those imposed upon exploitive crops would tend to raise the comparative advantage of a conservational system of farming. To a large extent the use of differentiated land values within a farm, or the use of slope and soil type classes, would have a similar effect.

The Police Power and Zoning

The police power, which was originally vested in the states, has grown in importance as the concept of property as an absolute right has moved towards the concept of property as a social institution through adjudication and legislation. In the United States the police power is characterized by two con-

cepts; it aims to secure and promote the public welfare, and does so by restraint and compulsion. It differs from eminent domain in that the owner keeps his property but is subject to regulation in the use of it and receives no compensation. The regulations are usually negative but may also be positive. Originally the "bill of rights" appears to have been designed to check executive power and be a procedural rule so that any individual could claim a hearing before a court. Conflicts over the powers of the states, however, led to the interpretation of laws by the Supreme Court, and finally the laws themselves became subject to judicial review to determine whether they were in harmony with the constitution or not.[14]

This has meant that the courts in this country have limited the powers of the legislatures, and the exercise of the police power has developed subject to two checks; first, the regulations must be directed to health, morals, public safety, or general welfare, and secondly, they must not be unreasonable in the eyes of the courts.[15] The basic problem lies in enacting measures that will further public welfare and at the same time protect the individual from loss. In contrast to the development of restrictions upon legislative powers as developed in this country, most European democracies have made no attempt to limit legislative powers but have permitted the courts to award damages when an act affected the value of property held by an individual. Today the application of the police power to control land use is much more feasible than it was ten years ago, because of the gradual acceptance by the Supreme Court of the idea of social control.

The major application of the police power to land use problems has been in city zoning ordinances where the power

[14] For an excellent historical background, *see* W. B. Hastings, "The Police Power of the State," *Proc. Am. Phil. Soc.*, 1900.

[15] The final decision is made by the Supreme Court. As Felix Frankfurter puts it, "The Supreme Court mediates between citizen and government; it marks the boundaries between state and national authority," *Encyclopaedia of the Social Sciences. op. cit.*, Vol. XIV, p. 474.

has been delegated by the state through an enabling act. The question as to whether these ordinances may be retroactive or not has not yet been settled; in some cases state supreme courts have decided for a retroactive application and in others against it. The police power has also been used to regulate private forestry, and as early as 1908 the Supreme Court of Maine agreed that forest owners are required to handle their property in such a way as not to injure public interests, and gives the state power to regulate lumbering, to protect streams, and maintain the productiveness of the forests.[16]

The most important application of the police power affecting non-urban land use has been the development of zoning by counties in Wisconsin and Minnesota. Enabling acts gave the counties the right to establish land use zones, usually three in number: forest zones in which residence and agriculture is not permitted, recreation areas in which residence but not agriculture is permitted, and open areas in which no restrictions apply. Methods of holding public hearings, determining boundaries, and hearing complaints have been established, and the problem of non-conforming users remaining in the zoned areas has been attacked through land purchases and resettlement. The major benefit of zoning is that maladjustments in land use are prevented; its use to eliminate present maladjustments in agricultural land is limited by the difficulties of defining "zones," except in broad terms, and the difficulties that arise in making it retroactive.

The application of zoning or other statutory legislation aiming at the achievement of conservation is limited by two basic considerations: the enactment must be such that it deals with specific factors; it must also be enforceable at a low cost and with as little coercion as possible. For this reason,

[16] *See* Henry L. Graves, "Public Regulation of Private Forests," *Annals Am. Acad. Polit. Sci.*, May, 1909.

the delegation of authority to local groups is probably essential because they are best able to judge the practicability of the measures and the willingness of the majority of farmers to accept them. This method of control is particularly suited to areas where exploitation results in social damages. It might also be used in connection with other methods of control such as subsidies in order to prevent the development of exploitive farming in the future. Where soil conservation districts have the right to force a minority to cooperate to promote the general welfare, a typical example of an extension of the police power is revealed.

The right of the state to delegate the powers to pass land use ordinances has been accepted in some states, and the constitutionality of such acts have been upheld by federal district courts and state courts. Legality alone, however, is not the sole criterion of a useful law; it must also be enforceable, and the larger the minority opposed to the measures the greater is the difficulty of enforcement, and the measures may collapse. A balance between resentment against control, because of its limitation of freedom, and the urgency of the social need must be made; once the controls are established they tend to become part of the institutional framework and are accepted like the weather and taxes.

Contract Rights

Limitations on contractual relations have followed a pattern similar to limitations upon property rights and have developed in the direction of protecting persons with weak bargaining power; the abolition of slavery, the legalization of unions and cooperatives, elimination of child labor, and wages and hours legislation represent the major developments.

In the field of land use, tenure and mortgage legislation modifying contractual relationships have important indirect effects upon conservation. Insecurity of tenure operates

against conservation, and legislation which limits the rights of the landlord and tenant to terminate a lease upon short notice, which extends the length of the lease, or establishes compulsory arbitration of disputes, all tend to give both owner and tenant greater security, and this encourages long-time planning. Similarly, legislation giving the tenant the right to claim compensation for unexhausted improvements, and the landlord the right to claim damages, also encourages conservation by giving greater security to investments in soil-building practices and crops. In some areas legislation of this nature should run concurrently with other conservation measures if conservation is to become permanent.

The problem of mortgage payments is associated with two factors; the interest rate, and the rapidity with which the capital is repaid. Legislation eliminating excessive interest rates resulting from monopoly, inefficiency, or custom may encourage conservation by making it more economic for the individual. Since the establishment of the Federal Land Bank system, however, the major field of adjustment lies in relating the ability of the borrower to pay to the length of the mortgage. This may be done by legislation which automatically extends the mortgage period when income is reduced through loss of crops due to drouth or pests or through a decline in prices. This would relieve the pressure to disinvest which occurs when fixed cash payments remain high while income declines. Much legislation which was originally considered for an emergency might well become a permanent part of our institutional pattern, and compulsory extensions of the mortgage period appear to be of this kind.

Problems of Conservation Planning

When we attempt to relate the various means of social control to the various social and economic causes of exploitation, the complexity of the problem and the need for co-

operation between all agencies dealing with agriculture is revealed. The problem of conservation of all resources is further complicated by the fact that the method of control must also vary with the type of resource involved. Conservation of our soil resources, when it is economic for the individual or society, does not imply lower economic returns now, but rather the stabilization of returns at their present level, and an increase in present prices is not a necessary concomitant. In the case of exhaustible (fund) resources, conservation implies a reduction in the present rate (unless the present rate is the most economic one) of use and higher prices for the commodity in the present. As Hotelling[17] has shown, this will occur under monopoly conditions; there is, therefore, an economic basis for public ownership of exhaustible resources as well as for those flow resources, such as fish and game, when capital values cannot be allocated through private ownership. Where public ownership is *not* feasible, rigid social control under the police power, with private monopolies closely supervised by the state, provide an alternative solution.

This does not imply that private monopoly and public monopoly would achieve the same results. A public monopoly has the advantage of returning to society (in social services or lower taxes) all surpluses above costs resulting from the higher prices. To some extent these results may be achieved by the use of a high income tax or by a severance tax when private monopoly is permitted. Which is the most practical solution will depend upon political and administrative factors. In the case of commercial fishing, licenses to take stated numbers of fish might be auctioned to competing fishing companies or issued at a nominal sum in conjunction with a high excess profits tax. For recreational purposes, fees for licenses should be low and the numbers taken limited as is done by existing game laws.

[17] Harold Hotelling, "The Economics of Exhaustible Resources, *op. cit.*

The problem lies in finding the most practical method of reducing a too rapid rate of use and at the same time preventing the increase in consumer prices from creating excessive profits for private individuals. This may be done through public ownership, through private monopoly under government supervision and special taxes, through competitive bidding for government controlled privileges, or through price fixing and rationing. The selection of the best method of control turns on the type of resource and also the present economic conditions under which exploitation is taking place. These considerations are touched upon here to show that soil conservation is only one of many conservation problems and to indicate the limited though related scope of this study.

There can be no final answer to many of the problems outlined in this chapter until we develop techniques of making estimates and methods of measurement which will provide the necessary factual background for social accounting and policy formulation. Also, it may be pointed out, factual material is of little value unless programs and policies are formulated with insight into the complexity of the relationships involved. The development of conservation over the wide areas in which it is needed will not be achieved rapidly; it is a long-time program, and as such it may well be sound social economy to spend both time and money in experimentation with various methods of social control and the evaluation of their results.

CHAPTER 10

PROBLEMS OF MEASUREMENT IN CONSERVATION PLANNING

The Necessity for Social Economics

We have reached a transition period in our economic and social development. The era that is passing emphasized liberty of action by individuals and by nations; it has been an era of rapid growth of population and wealth, of rapid exploitation of vast new resources, and of exploitation of the weak, both individuals and nations. It has been an era in which we placed great reliance upon a natural harmony supposed to result from the automatic reconciliation of conflicts through competition. At the same time there has been a decline of competition as a regulating force both between individuals and nations, and protectionism has become a first principle of attaining and maintaining profits. The era has also seen the growth of an expanding concept of democracy in which equality has once more become an important principle of action. On the other hand, we have witnessed the rise of authoritarianism and use of coercion as one method of solving the basic social conflicts arising from insecurity and inequality. With the growing complexity and interdependence of our economic and social structure has come the realization that individual actions have a profound social significance; that actions which appear economic to the individual during the production period being considered may be very uneconomic from the point of society as a whole. Tariffs, monopolies, patents, franchises, and curtailing production when prices

are low, all appear to benefit individuals, but often they may involve serious social costs in terms of higher prices and unemployment. Similarly, maladjustments in land use may involve high relief loads, tax delinquency, and, in some cases, the costs of moving a stranded population. The old faith that automatic adjustments will take place in response to the workings of a flexible price system in a competitive economy has largely been destroyed.

One reaction to the problems thus raised has been to throw out all theory and deal pragmatically with each maladjustment as it occurred; in many cases this has led to oversimplification and a neglect of relationships that are of basic importance in any scheme of social planning. Ends have not been clearly stated, and means have not been closely related to the basic causes of the maladjustments. Temporary emergency measures and long-time adjustments have been confused, and palliatives have appeared better than more radical measures designed to attack the root of the problem because they eased the pain more rapidly.

A second reaction has been that of the so-called "theorists" who have been so aware of the complexities of the problems involved that no action appeared safer than any action. Usually they have been pessimistic and anticipated chaos, or futility, or dictatorship as a result of man's blind attempts to solve problems too complex for his mind to grasp fully.

Both these attitudes seem too narrow. Social control of economic matters is increasing and will probably continue to increase in the future, but the controls used will vary all the way from making a flexible price system function more efficiently, to the use of coercion and the limitation of property rights. The economics of today, therefore, must deal with individual economics, social economics, and the basic causes of divergence between individual and social net returns if it is to be useful in the formulation of social policies. Similarly,

social planning should make use of relationships revealed through theoretical analyses in order to develop the most reasonable policies. The causes of divergence between action and theory is largely a matter of insufficient data upon which a theoretical relationship can be satisfactorily proven. Action has usually been taken to alleviate an immediately urgent need often expressed and backed by a pressure group. Social action directed at preventing the development of a problem is in its infancy, and it is in this field of long-time planning that theory may make its greatest contribution. Where social action is undertaken to meet an immediate problem, and facts are not available to make a fully informed decision, it is essential that we develop techniques of estimation so that we can evaluate the results achieved in order to modify the program in the light of further information. In this sense planning becomes a continuous and changing process in which action should lead to information upon which more intelligent action may be developed. This implies flexibility of specific action programs and the willingness to change. In many cases quantitative measurement may be impossible, and we are forced to accept qualitative judgments of "more" or "less." Flexible action programs also imply that planning must be based upon judgment in evaluating alternatives, because the very complexity of the interrelationships prevents any single program of action from providing a complete solution. This, as we have seen, is particularly true of the problem of soil conservation.

The Objectives of Conservation Planning and the Estimates Involved

In the discussion of society and conservation (Chap. 8), emphasis was placed upon the necessity of stating social objectives explicitly in order to evaluate the effectiveness of the means used in attaining them. It is obvious, however, that

stating ends more explicitly and breaking down broad generalizations will be of no assistance to action planning unless the end as stated is determinate. For example, the distinction between fertility depletion and soil deterioration which has been emphasized so strongly is useless for practical purposes unless it can be applied to areas as a basis for directing social action. This distinction has been made in the case of Iowa by the State Committee on Agriculture,[1] which has divided the state into two areas, A and B, on the basis of the reconnaisance erosion survey map. The area A consists of the relatively flat areas of the state where erosion has removed less than 25 per cent of the topsoil, and it is considered to be an area where fertility depletion rather than soil deterioration results from exploitive cropping. Area B consists of the rolling and rough areas where more than 25 per cent of the topsoil has been removed and where soil deterioration is serious. On the basis of these distinctions, the Committee recommended that subsidies, educational efforts, and action programs to achieve conservation be directed to area B. This does not mean that area A has no conservation problem but that, at the present time, the problem is much more urgent in area B and should be attacked there first in order to make the best use of available funds. This practical distinction is based upon estimates of the rate of erosion and the seriousness of its implications to the communities involved. It could be successfully applied to other states and regions so that we would obtain a clearer picture of areas where action is most urgently needed.

In order to obtain an over-all view of the problems involved in developing an effective program of soil conservation, we may review the four objectives previously outlined and list under each the essential information needed to make them useful guides for the formation of policy.

[1] Iowa State Committee on Agricultural Programs, *A Unified Agricultural Program for Iowa*, mimeo. C. P. 178, Ames, Ia., May, 1941, *see* pp. 43–58.

Estimates Necessary to Determine Whether Conservation Is Economic for the Individual

The first named objective is to achieve conservation in those areas where it is economic for the individuals.[2] For this to be useful, we must be able to determine whether conservation is economic or not for the individuals concerned, and this in turn involves a budget analysis[3] which will show:

(1) The capital loss resulting from continued exploitation.

(2) The changes in land use and practices needed to control erosion.

(3) The capital expenditures involved.

(4) The effect of the changes upon crop production.

(5) The effect of changes in feed production upon the livestock system.

(6) The effect of the changes upon annual costs of production, including labor.

(7) The net effect upon the farm income.

The greatest difficulty in making these estimates lies in the fact that the necessary physical data are not available when a program is first initiated. In spite of this limitation, most farmers have a rough idea of the effects upon income of a conservation program before deciding to adopt it. As the program develops, more information on the effect of various practices upon yields can be accumulated as a basis for more accurate forecasts. Budget analyses of this nature are also valuable in determining the most economic of alternative conservation plans.

Analyses designed to show whether conservation is economic or not for the individual and the evaluation of alterna-

[2] This assumes that if conservation is economic for the individual, it is for society, and this will hold true except for a war emergency when society might favor exploitation that would be uneconomic for the individual.

[3] For a more complete discussion, *see A Method of Estimating the Economic Effects of Planned Conservation on an Individual Farm, op. cit.*

tive conservation plans is an essential part of planning, but the study of methodologies and factors to be considered is more logically classed as research. This is a typical example of the very close interrelationship between action and research that develops out of the growth of public action.[4] However, as will be seen, it is only one of the phases of conservation research that is needed and is closely associated with the whole problem of farm management. Greater accuracy in making these budget estimates will depend upon the reliability of the records of physical factors kept by the Operations Division of the Soil Conservation Service, the use of sound budgeting techniques, and the proper evaluation of alternatives. In some cases, an alternative plan may be dependent upon the development of facilities not at present available, as for example, the opening up of market outlets for milk.

In making budget estimates it is essential that both primary and secondary production be considered. This is important for two reasons: A reduction in the intensity of primary production may lead to a change in the feed available on the farm, and unless some economic method of using the new feed supply is developed, the farmer may suffer an unnecessary loss of income. Of more importance, however, is the relationship between the intensity of secondary production and farm size, and the possibility of making a small farm provide a more adequate income by intensifying secondary production, thereby utilizing family labor more fully and possibly increasing managerial ability.

Similarly, consideration must be given to the elasticity of production because a system of conservation farming with high elasticity is much less likely to be disrupted by price fluctuations than one that is highly inelastic. In practical estimates no quantitative measures can be given to this con-

[4] See Neil W. Johnson, *Tailoring Conservation Research to Fit the Needs of Farm Planning*, Mimeo. F. M. 9, June, 1940, U.S.D.A., Washington, D. C.

cept, and we have to deal in terms of more or less when considering alternative plans and production changes that may take place in response to changes in prices.

The land use capability classes as developed by the Soil Conservation Service may be extremely valuable in indicating the limits of cultivation under conservation for various soil types, slopes, degrees of erosion, and practices. These classes set an upper limit of cultivation if disinvestment is to be avoided and give a physical basis which may be used in the development of conservation plans and budgets. Like other tentative standards that are established, the classes should be revised in the light of more accurate information that will be available as the conservation program is established more widely. It is essential that the limitations of these physical land classes be kept in mind; they represent the "permissive" factors of land use, and for each class there are numerous alternative uses which may range from permanent pasture to a three-year corn, oat, sweet-clover rotation, contour strip-cropped on terraces. Which of the alternative uses is best is an economic question. The budget analysis, therefore, can be made only when we have the physical information to determine what the *alternative* land use systems for conservation are, together with yield and price information that will enable an economic analysis to be made.

It is impossible to separate the effects of exploitation of virgin soil resources from the effects of prices and costs in determining the intensive and extensive margins. Maladjustments in land use patterns as indicated by low levels of living, high relief loads, high tax delinquency, and soil erosion may result from the fact that virgin fertility was available or from price relationships favoring erosive crops. Under such circumstances the introduction of conservation farming under the present institutional arrangement of farm size, taxes, population density, and rents may be a waste of public funds

where it does not remedy the basic maladjustments. If the conservation plan does not provide an acceptable level of living, exploitation will probably be re-introduced whenever it will yield even a small increase in net income, and a permanent conservation system can be firmly established only when it is coordinated with changes in institutional and farm size patterns.

The determination of whether conservation is economic to the individual or not is also of basic importance because of its relationship to the type of social action needed to eliminate exploitation. This problem of relating means to basic causes is discussed under the fourth suggested objective of conservation planning.

Estimates Necessary to Determine Whether Conservation Is Economic for Society

The second suggested objective of conservation planning is to establish conservation on those farms or areas where it is not economic for the individual but is for society. This assumes that budget analyses have shown that conservation is not economic to the individual and will therefore reduce his net returns, but because of factors that do not impinge upon the individual, conservation is economic for society. The causes of this divergence between social and private net returns can be determined only by concrete analysis of the problem in specific areas. However, they may be classified into three main groups as suggested in Chapter 7. These causes may be summarized as (1) Social costs of exploitation or benefits of conservation which do not impinge upon the individual; (2) Capital losses or gains not borne by the individual; and (3) differences in the prices available to society and the individual, including costs of conservation and interest rates.

The basic problems of measurement lie in determining which of these major causes are resulting in social losses, how

large the social loss from continued exploitation will probably be, the value of any social benefits from conservation above the elimination of actual losses, and the allocation of the estimates to areas. The most suitable means of attaining the end at the least cost must also be considered, but because these questions apply to all social action we shall consider them separately. It is in this field of social accounting that many of our unsolved problems are to be found, and any adequate treatment would involve a separate monograph for each particular problem discussed.[5] For illustrative purposes, we will consider three hypothetical problems of social accounting in order to indicate the estimates involved under simplified conditions.

Damages Borne by Society

An example of the first group of causes making for a divergence between social and individual net returns would be the flood damage in a city resulting from the rapid flow-off of water from a given watershed and caused by the exploitive method of farming in the area. In order to make a sound social analysis of this problem we would have to estimate:

(1) The average annual damage from floods.

(2) What changes in land use and practices would be necessary to reduce the rapidity of water flow in the watershed in order to prevent floods under the prevailing rainfall conditions.

(3) The effect of these changes upon the net income of the various farm classes (by size and type of farming). This would involve a sample study of the area by the budget method previously outlined, and the question of whether all farms could

[5] *See* A. N. Garin and G. W. Forster, *Effect of Soil Erosion on the Costs of Public Water Supply*, U.S.D.A., S. C. S., EC. 1, July, 1940. There is also a large amount of material available for analysis and study in flood control reports for specific areas.

continue to provide an adequate family income under the new system would have to be studied.

(4) What the cost of the program would be in terms of subsidies or land purchases, and other alternative action programs that might be used.

(5) What other social values might be expected from an increase in game or recreational areas created by the conservation plan, and what future social costs resulting from erosion might be avoided.

For a small watershed such estimates might be made relatively easily. But as the area of drainage becomes larger and its boundaries further removed from the focus of the damage occurring, the problem becomes increasingly difficult because physical measures and estimates are less reliable. In spite of the difficulties, such estimates have been made and action programs initiated.[6] Past and current experiences are accumulating masses of data which will provide information for more accurate estimates in the future. The compilation, tabulation, and analysis of these types of data, together with improving techniques of estimation, is an important function of government which must be shared by both research and operations personnel; theory through its analysis of conditions and relationships can play an important part in suggesting the necessary information needed for the complete solution of specific problems and in evaluating the significance of empirical data that might be obtained or is already available.

The Transfer of Capital Losses

When we consider capital losses which do not impinge on the individual as a general cause of divergencies between individual and social net returns, we find that this is most

[6] *See* the report of the Muskingum River flood control project in Ohio. "*Working Together in the Muskingum Valley*," *a Coordinated Conservation Program by Federal, State, and Local Agencies*, mimeo., 1939. Also *History and Development of the Muskingum Watershed Conservancy District Project Ohio*, mimeo., March, 1938, Zanesville, Ohio.

serious in the case of such biological resources as fisheries, game, and forests.

Many examples of capital losses not borne by the individual occur where there is no way of allocating a capital value to the resource. This is true of fisheries, game (including fur-bearing animals not in captivity), and the recreational uses of forests and streams. In these cases exploitation may destroy the possibilities of future incomes in terms of goods or services. In order to determine social policy we must know, in the case of fisheries:

(1) the value of the flow,

(2) the kind and quantity that may be taken without reducing the yield, and

(3) the costs of control, including propagation and law enforcement. Much of this problem is biologic in nature, and fairly rapid progress has been made in developing social controls to restrain competitive exploitation, even when Nations rather than individuals are concerned.

In the case of soil there is the outstanding example of the tenant farmer who is exploiting the resource at the expense of the landlord. This may result from the landlord's ignorance, custom, or the purchase of land for speculative purposes with an early sale anticipated. The social loss is borne largely by individuals, and in order to analyze the importance of this to society we would have to estimate:

(1) The annual capital loss resulting from the exploitive system.

(2) The decrease in net income that would result if conservation were adopted.

(3) Whether exploitation was economic after the capital loss was deducted from the net income.

This requires a budget analysis of tenant farms by the method previously outlined. Where it could be shown that conservation would be economic when capital losses are con-

sidered, tenure reform and education of landlords might be sufficient to eliminate exploitation so that the costs of introducing the conservation system would be low. Where conservation appeared to be uneconomic even when capital losses were considered, coercion or subsidies might have to be used if the exploitation was creating other damages or appeared undesirable from a social point of view.

Differential Prices

Differential prices available to the government and the individual were listed as the third cause of deviation between individual and social net returns, and differential interest and wage rates were discussed in some detail in Chapter 8.

Differences between prices available to the Government and the individual reflect rigidities and lack of equilibrium with full-employment conditions. If society has control over unemployed resources of capital or labor, the cost to society for any given project is essentially an opportunity cost. In the case of unemployed labor a minimum amount is allowed for relief; and if the labor is employed by the government, the cost of the labor is the wages paid less the relief costs. A private individual employing labor must pay the going wages, and the costs of a conservation program involving hired labor would be much higher.

The problem society must solve is that of allocating the unemployed labor to projects that will give the largest social returns and of using the labor for projects that would not be privately economic when the total labor costs were charged against them. In formulating conservation policies, therefore, unemployed resources should be directed first of all to those areas where conservation would be uneconomic to the individual at current market prices. If this policy is not followed, the resources might be used in areas where conservation would be economic at current rates. This would tend to

reduce the private employment of such resources, and those areas needing subsidies would be left to continue exploitive uses. This general guide to policy must be modified in such a way that expenditures are allocated only to areas where conservation is economic at the lower rates (in terms of social opportunity costs), and where it will continue once it is introduced. Similarly, the policy assumes a continuous educational process and anticipates the adoption of conservation in those areas where it is economic at current prices.

In choosing between alternative expenditures we would have to determine:

(1) The additional cost to the government of using the unemployed resources.

(2) Whether conservation, once it is established, would be economic and provide an acceptable level of living.

(3) The willingness of the individuals in an area to bear additional costs (above the use of the unemployed resources) that may be necessary to establish the conservation system; or their willingness to contribute part of the costs involved in using the unemployed resources.

(4) Whether conservation would be economic without any subsidy, and whether education and the modification of institutional resistances alone can be expected to lead to the adoption of conservation.

The importance of making budget analyses of individual farms must be emphasized, and these analyses need to be made before decisions regarding the allocation of resources are made. Such estimates can be only tentative, but they can indicate whether or not the conservation system is likely to be accepted. Just as we have made reconnaisance erosion survey maps for each state, so should we make a reconnaissance survey of the economic feasibility of conservation. Such a survey, which might well make use of a vast amount of information already collected, would be extremely valuable as an

aid in selecting the areas to which unemployed resources should be directed. Only as this is done can there be any reasonable assurance that the conservation program will result in an economically appropriate land use pattern. If the analysis shows that under the conservation program and the present farm size pattern an acceptable level of living cannot be maintained, then the expenditure of conservation funds or the use of compulsion would not be justified unless a coordinated program of land use to correct other maladjustments is initiated at the same time.

Apart from the economic effect upon the individual farm operator, the question of social costs not borne by the individual must also be investigated because of their bearing upon the type of control that is justified.

If the survey shows that conservation is not economic because exploitation yields higher individual and social net returns *when all costs are considered*, conservation funds should be spent only after all exploitation that is uneconomic to society has been eliminated. If the survey indicates that conservation is economic for society but will not provide sufficient income to the farm family, the costs of alternative programs must be considered. This may involve moving the population, or part of it, from the area. The size of the farms may be increased, or the whole area might be allowed to revert to wilderness, or be reforested. All federal and state agencies concerned with land use and population would need to cooperate in making the decision. Only if the costs of alternative solutions were higher would the expenditure of funds for conservation on the individual farms under their present pattern be justified, and some form of a permanent subsidy to a stranded population might have to be developed.

If we apply these general principles to any one specific problem, the complexity of social accounting is revealed because, in analyzing a single problem, several causes may

be related to it. In the flood control problem previously mentioned, a survey might reveal that insecurity of tenure and landlord ignorance were responsible for a great deal of socially uneconomic exploitation, and that because there was unemployed labor available the social costs of establishing conservation would be lower than individual costs. This would have the effect of reducing any subsidies that might have been necessary to offset individual losses, and also it would reduce the costs of the control program. In spite of the complexity of the problem, society does allocate funds to one flood control project in preference to another, and decisions that one project is "more" economic than another have to be made. If we neglect the importance of political considerations, it does not seem impossible to evaluate the economic importance of various social expenditures providing that there is time to make the necessary surveys and estimates. In many cases more accuracy can be attained only by spending larger sums to obtain the relevant information, and we are immediately faced with the question of deciding how much should be spent upon this phase of social planning. If extremely careful and detailed studies of all the factors were made, the cost might be more than the social expenditure involved. The cost of making estimates, therefore, must be related to the size of the expenditure contemplated and also to the detail necessary to establish a priority between competing demands. Further research into these problems of social economics is needed, and should include techniques and theory as well as the accumulation of empirical data.

Evaluating Conservation as an Intangible End

The third objective of social policy is to achieve conservation on those farms or areas where it is not economic for the individual, but is desired by society to achieve intangible ends. This is one of the most widely publicized ends of con-

servation. It is couched in terms such as "national defense," "love of the soil," "harmony with nature," "future generations," and "America the beautiful." It ignores all the problems of measurement by making conservation an ethical concept; all conservation is good, and if it happens to be economic, so much the better; but economic or not, it is good.

This attitude to conservation is not only an expression of social groups but is found in individual farmers who take pride in maintaining their farms at a high level of productivity. These are the good husbandmen who view their lands with a critical eye; to them a gully, a weedy pasture, a broken fence, or a broken door in the barn is a personal offense; farming is more than a means of making money, it is an art. This is the antithesis to the farmer who boasts that he has ruined three farms and made enough money to retire to California. Where this "pride of workmanship" exists there is no conservation problem except when sheet erosion insidiously removes the topsoil, and when this is recognized, conservation methods are eagerly accepted. In the case of the individual, there is no economic problem because the personal satisfaction from being a good husbandman outweighs any lowering of income through increasing the costs of production.

If this is true for the individual, is it necessarily true for society as a whole? If all farmers had this attitude, it would, of course, be true for society also; but we know that this attitude is not widespread, and many farmers think more in terms of income than in terms of maintaining their soil. This is partly due to the fact that customary methods of farming brought over from areas of gentle rains did not prevent erosion in areas of great rain intensity; it is partly due also to the fact that conservation farming with long rotations could not compete with exploitive grain farming with cheap land and stores of virgin fertility. If the individual does obtain more satisfaction from a higher income rather than from a pride in his

husbandry, then social action to induce conservation when this would lower his income would only be justified when there was some external factor to be considered.

The use of conservation as an intangible end often *ignores* the problems of measurement, but it cannot *eliminate* them. We must continually keep in mind the basic question of whether conservation is economic for the individual. Where conservation is economic, for the individual or for society, the concept of conservation as a desirable intangible end simply strengthens the justification of social action; it also justifies a bias favoring conservation when the estimates are indeterminate. The basic problem of social policy is to determine how far society should go in inducing (or compelling) conservation when it appears uneconomic but is still desired for intangible ends. To make any rational allocation of funds for this purpose, it is necessary to know (1) what the social cost in terms of a decline in income would be, and (2) what are the specific intangible ends desired, how they rank with reference to other intangible ends desired by society, and how much money society can reasonably spend in relationship to the benefits of the conservation program.

It is the second problem that presents the greatest difficulties in social accounting. With reference to the conservation of wildlife, and forest, lake, and river areas, the intangible end of recreational facilities is fairly explicit, and we can obtain indications of the importance of this end through the number of people using the facilities. One broad general guide to social expenditures for these purposes might be that they should be related to the use made of the facilities by the public; such "consumption" expenditures should provide, as far as possible, those facilities which can be used by all classes in society. This is particularly important in serving the recreational needs of people in large centers of population. For low income groups with two weeks vacation, camping areas

in virgin forests over a thousand miles away may have little value unless cheap transportation facilities are available. The same amount of money spent in an area one hundred miles away might be very much more desirable in terms of increasing the use of recreational facilities. In determining the expenditures of federal, state, and local governmental agencies for such activities, we have to rely upon the reflection of public opinion through the democratic process with its accompanying appendages of pressure groups representing special interests. Whether we can refine this process through the use of public opinion polls on specific questions is an interesting possibility, and there seems no sound reason why such polls should not be used more extensively in the future.

When we turn to the problem of conserving our farm lands to attain an intangible end, it is much more difficult to state explicitly what this end is. Many of the appeals for public support use the concept of preserving our land for future generations, and this may be an intangible end to which many will give support; however, when we support conservation that is economic for the individual or for society, we are at the same time preserving the land for future generations, and the general use of this intangible end may simply mean that all conservation, whether it is economic or not, is equally desirable for society. This is certainly not true, because conservation that is economic increases the social net returns while the elimination of economic exploitation will decrease social net returns, and this decrease must be included as a cost when evaluating the desirability of alternative ends. It would seem logical that general conservation policy should be directed toward achieving conservation in those areas where the increase in social net returns will be greatest and that it should progress to the less economic areas. Finally, when all economic conservation has been achieved, conservation of farm lands that is uneconomic for the individual and for society

might be justified on the basis that we wished to reduce our social net returns now in order that future generations might benefit from our sacrifices. When we have actually achieved all the conservation that is economic, there may not be a great deal of exploitation left, and if population continues to increase, not only conservation but improvement and reclamation by drainage, irrigation, and increased use of fertilizers will become economic. It is because there is considerable substitutability of capital for land that we need have little fear of future generations of Americans paying very high prices for food because we have ruined our patrimony. Long before the level of living is seriously lowered, conservation and land improvement will be so much more profitable that economic motivations will tend to overcome the forces of inertia and custom. This does not mean that we will achieve more if we take no action to induce soil conservation now. On the contrary, such steps are highly desirable but at present all our efforts should be directed to those areas where they will be most economic.

Relating Methods of Control to Causal Factors

The final objective of conservation policy is to use the means best suited to attaining the three ends discussed above when complimentary or conflicting relationships to other ends are considered. This objective may be divided into two parts; the selection of the means and the analysis of conflicts; these can best be discussed separately.

The selection of the most appropriate means of attaining conservation in various areas depends upon our insight into the basic causes of exploitation. The question of whether conservation is economic or not for the individual is of basic importance because where it is economic the conservation system will tend to be permanent once it is established; where it is not economic for the individual but is for society, the

conservation system will not be maintained by the individual after it is established unless society maintains some form of permanent control. This may be achieved by means of an annual subsidy, by buying the land in the area and renting it under specific agreements regarding land use, or by limiting the property rights of the individual by law so that exploitive use is prohibited. In the latter case, compensation for any loss in land value might be desirable, and the government then becomes a part owner of the property rights; a clause limiting the land use could be inserted in all transfers of title and the control becomes permanent. A similar result could be obtained through zoning ordinances or tax rebates for the recommended land use.

The question of whether compensation should be paid to the individual when conservation is not economic depends upon the cause of the difference between individual and social net returns. If the difference is due to damages to society through floods or reservoir siltation, the elimination of such losses will reduce the tax burden on one section of the community (usually the urban areas), and where conservation reduces farm income, this burden should be shared by the section of the community receiving benefits.

Where exploitation is economic because the operator does not bear the capital losses, there appears to be no justification for the payment of compensation. In the case of landlord ignorance and insecurity of tenure, the education of the landlord to maintain the productivity and value of his land so that net returns are maximized, will benefit both the tenant and the owner. In order to increase intensity, which tends to offset any decline in rents due to restrictions on the land use, greater security of occupancy and compensation for unexhausted improvements should be introduced at the same time. Where the capital loss is borne by society as a whole, as in the case of fishing and hunting, restrictions on the actions

of competing individuals using these resources will permit a permanent flow over time and benefit them as well as consumers, and compensation under these circumstances is not necessary.

Where conservation is economic to society but not to the individual because of differences in prices, social action that reduces interest rates or subsidizes individual conservation costs through the use of unemployed resources may maintain or increase individual returns and compensation is not justified. In some cases the individual might reasonably be expected to bear part of the costs when the action results in an increase in his net returns.

When conservation is economic for the individual and he continues to exploit his resources, the basic problem of policy consists in selecting the methods of control which will overcome the resistances at the least cost to society. Education, subsidies to overcome inertia, and coercion through law may all be used separately or, as is more general, in combination with each other. If a law limiting the rights of individuals to use their land as they pleased met with widespread opposition, it might be completely ineffective because of the difficulty of enforcing it. This can largely be overcome by local land use regulations to which the majority of the persons involved agree.[7]

When we attempt to bring all these problems of measurement together, for the purpose of making decisions, the essential need of dealing with relatively small areas is revealed. National, regional, and state programs directed towards achieving conservation must be so flexible that the program can vary not only with regard to details but also with regard to the means employed. At present we know far too little

[7] *See* E. A. Foster and H. A. Vogel, "Cooperative Land Use Planning—A New Development in Democracy," *U.S.D.A. Yearbook of Agriculture*, 1940, pp. 1138–56.

about the causes of uneconomic exploitation, and the experimental use of various means would add greatly to our knowledge. County agricultural planning committees located in similar areas might adopt different programs for a period of five years and the results evaluated at the end of the period; one area might emphasize education and individual farm planning, another might develop land use and practice regulations, a third might use five-year contracts and complete planning by technicians, while a fourth allocated A.A.A. payments purely for the introduction of conservational land use and conservation practices. Until more information is available, however, action programs will have to be based upon a rather crude analysis of the various factors involved and judgment as to the best methods to be used. Experience will provide further data for improvements in both analysis and judgment, provided that adequate records of results are maintained by the action agency.

Analyzing Conflicts Between Means and Ends

Soil conservation is only one of many problems of agriculture. As has been pointed out, action programs affecting prices and changes in tenure conditions have important implications for conservation. The development of greater security of tenure and other tenure reforms represent aims which are complementary to the end of conservation. On the other hand, price changes which increase the comparative advantage of erosive crops may directly conflict with the development of conservation. The importance of these complementary and conflicting ends to conservation vary between areas and are related to the particular crops and soils involved. Improved tenure conditions in the corn belt may lead to a less exploitive land use pattern and increased livestock production, while in some areas of the South cotton production has such a high comparative advantage over the nearest alternative crop

that a change in tenure might have little or no effect upon land use.

In an analysis of the effects of price changes or nationwide programs affecting acreages of specific crops, in their relationship to conservation, statistics must be broken down by counties or smaller units and related to the conservation problems of the area. Changes in national or state acreages of corn or grass crops are of little value in determining the effects of these changes on conservation, because they are not related to the seriousness of erosion which varies greatly within large areas; even county figures may be misleading if the area contains large differences in topography and soil type. For the purposes of conservation analysis we need a small sample of farms representing erosion problems in various areas so that the effect of other programs and price changes on land use can be studied. The results should improve the overall conservation planning and indicate land use changes that may result. Sample census farms might be classified on the basis of erosion and topography and used for this purpose.

When we turn to the relationship of less tangible ends such as personal liberty and the sanctity of private property which may conflict with social controls, particularly those involving limitations of property and contract rights, measurements become largely a matter of polling public opinion. In this field also, variations between areas will occur, and what would appear to be a reasonable control in one place might seem to be unwarranted interference in another. Attitudes change over time in response to publicity efforts, so that basic and permanent relationships are difficult to discover. In this realm, county agricultural committees might well function as agencies which would obtain the reactions of farmers to specific proposals in order that conflicts may be avoided. These committees also may perform a valuable function in evaluating the effect of price changes and action programs on

conservation so that they may play a part of growing importance in determining national conservation policies and minimizing conflicts between various means and ends.

Measuring the Effectiveness of Various Means of Control

As we look to the future, progress in achieving soil conservation over the wide areas where it is economic will be related to our ability to appraise the effectiveness of the various means that are used. In many states, soil conservation demonstration areas are already on a maintenance basis after five years of intensive work and the development of "complete" conservation plans. The question immediately arises as to what the effect of this work will be in another ten or twenty years. Will the land use patterns and practices introduced spread to other farms or will there be a gradual retrogression to the old exploitive system? No immediate answer is possible, but periodic surveys will be valuable in determining what practices and rotations are not being maintained and why. At present, soil conservation districts are the major instruments of soil conservation activities and give every indication of becoming permanent parts of our agricultural organization; they are, however, too new to indicate how far the farmers will go in adopting complete programs or how many of the farmers will actually put the plans into practice. As experience with districts develops, analyses of resistances will become important and the allocation of technicians may need to be supported by conservation payments to assist the farmer in making the necessary adjustments and possibly also by tenure legislation giving greater security of occupancy. At present little is known about the effectiveness of various means of control in relation to their costs, and progress can be made only as we develop

more accurate records of both the costs and final results of the programs in physical and economic terms.[8]

From these general relationships we may now turn to a more detailed application of the principles to the specific problem of relating conservation to a period of expanding production necessitated by war demands. In this analysis the close relationship between physical and economic problems is made clear.

[8] For an example of this type of information, *see* R. E. Uhland, *Better Harvests Through Conservation Farming*, Soil Conservation Service, U.S.D.A., March, 1941.

CHAPTER 11

WAR AND CONSERVATION

Prices and Production in a War Economy

In a war economy the prices of many products are not determined by consumers' demands; this is true of the multitude of military goods, guns, airplanes, vitamin tablets, green vegetables, and many more. Military experts direct production into various channels on the basis of efficiency of each product in defeating the enemy; this is the supreme social end existing at that time.

Changes in prices have little to do with the directions of industrial production. If we want more tanks, we plan their production in physical terms and alternatives—more tanks and fewer battleships, farm machinery, or motor cars; we do not simply advance the price of tanks and depend upon the normal business responses of individual firms to produce more.

This change is of vital importance to agriculture now because food is in a category similar to war materiel when it is used to help the United Nations. The difficulty of planning agricultural production compared to industrial planning lies in the large numbers of small competing firms with a relatively fixed productive plant. One problem of establishing "reasonable" prices lies in the great variations in costs and levels of rural living. A further complication arises from the large consumers' demand that impinges on the market and affects prices; there is no consumers' demand for guns, and the government and the firm determine prices. In industry a conflict between consumers' demands for cars, refrigerators, and so on, is solved by rationing materials and a reduction in the

supply of consumers' goods; this has to be followed by rationing consumer goods, price controls, and tax or other measures that will prevent inflation resulting from a reduction of the supply in relation to the demand.

Because of the difficulty of differentiating between consumers' goods and defense goods in agricultural production, because the raw materials of agriculture (land, labor, and capital) cannot be allocated to the production of defense or consumer goods, and because defense needs are purchased on the open market in competition with consumers' demands, production in agriculture must largely be directed through price controls with a system of voluntary or economically induced cooperation between farmers and Government agencies. Thus develops the complex problem of whether agricultural production can be stimulated sufficiently to provide a supply large enough to meet both defense and consumers' needs without undue increases in prices.

The effect, on land use and erosion, of using price changes to direct the production of agricultural products will depend upon the kind of crops that are needed to meet war demands. If we needed only increased production of hay and pasture, higher prices for these crops and their products would favor conservation because the comparative advantage of these nonerosive crops would be increased. However, the present indications are that we will need greatly increased quantities of concentrate feeds, including corn, for increased production from our dairy herds and for feeding more hogs to heavier weights. We will also need to expand the acreage of soybeans very rapidly if we are to produce sufficient oil. If the increased production of the erosive crops is stimulated through increased prices, the comparative advantage of an exploitive system over a conservation system may be greatly enhanced, and serious damage to the soil resources may result unless additional measures are adopted.

Where price controls are used, the price offered must anticipate the future supply response by at least one growing season in order to avoid rather violent fluctuations in production. If, for example, the requirements of soybean oil are expected to be doubled by the fall of 1942, the market price in the fall of 1941 and spring of 1942 may be left to competitive conditions at the time, but the price to be offered in the fall of 1942 should be guaranteed in the spring at a level that will stimulate production to the necessary output. This appears to be the function of a "floor" below which prices will not be allowed to drop, and it is essentially a means of spreading production risks over the whole population.

Emergency Conservation Planning

In responding to price guarantees, the farmer needs to know the minimum prices he can expect and the probable duration of the time of maximum production. *If the expected period is short, he may maximize production by depleting his soil resources, or if the period is longer, production may be maximized by maintaining or even increasing the fertility.* A five-year period does not now seem to be too long for production plans if we consider the necessity of building up stores of food for post-war use in Europe.

Contrasted to this relatively short-run period, conservation planning considers long-time permanent production, and hence may conflict directly with war-time planning. Where this occurs, the war economy must always take precedence, because the values we are fighting to preserve are more vital than the resources used up to achieve victory. In this case present emergency production becomes all important. A conflict between conservation planning and war planning need not always arise, nor should conservation be abandoned. The degree of conflict will depend upon the type of products needed and the methods used to obtain the increase. In many

areas a conservation plan will increase production over a five-year period as well as stabilize it over the indefinite future.

From the point of view of conservation, we must consider the effect of increases in erosion-inducing crops, such as soybeans and corn, and support those means of increasing production that will cause the least permanent damage to our soil resources. Increases in roughages and a larger production of milk, beef, and sheep may well be associated with increased conservation.

Conservation policy during an emergency, therefore, should be different from a permanent policy in two major respects. It must consider a shorter time period, and it must consider adjustments that may be necessary after the emergency. The objectives can be stated as directing the use of land resources so that production over the period is maximized, and selecting from alternative means of increasing production, those which will minimize the destruction of our land assets during and after the war.

If we assume a five-year period and the need for a considerable increase in erosive or depleting crops, conservation plans should delineate the areas where increases may take place with the least capital loss over the period being considered.[1] Similarly, increases in hay and pasture should be encouraged in areas where they are most needed for conservation.

This applies not only to regional differences, however, but also to fields within farms. The basic distinction to be made is the difference between soils where only fertility depletion occurs, causing no permanent loss, and soils where depletion and erosion occur under intensive cultivation. In Iowa, as was pointed out earlier, this distinction between depletion and deterioration was made by the State Subcommittee on Con-

[1] For an analysis of this problem, *see* U.S.D.A., Bureau of Agricultural Economics, *Farming Adjustments in the Corn Belt and Lake States to Meet Defense Needs and Post-War Problems*, mimeo., Milwaukee, Wis., November, 1941.

servation. Similar distinctions may be made in all states, and the areas where fertility depletion causes no permanent damage to the land should be treated differently from the areas of soil deterioration or erosion. Similarly, the land areas of a farm may also be divided into these two major classes and differential treatment developed.

The necessity for treating these areas differently lies in the fact that increased prices for erosive crops will tend to maximize production and income in areas subject only to depletion but this may not be true for areas subject to deterioration. The reasons for this divergence, together with suggestions for corrective policies, are outlined below.

Government Policy for Areas of Fertility Depletion

For the sake of brevity, we will designate areas of fertility depletion as class A land and areas of soil deterioration as class B land. The objective of war planning for all lands is to assist the farmer to maximize the physical production of required crops over the period of the emergency through the most efficient combination of the factors of production.

On class A lands this might be done by using the following measures: (1) Prices could be guaranteed in advance by at least one growing season and adjusted to bring out the required production of specific crops. (2) Special "incentive" payments could be made for specific practices which would increase production.

During the emergency period many farmers with class A lands might increase their production and income by shortening their rotations to include more corn or soybeans. A three-year corn, oats, sweet clover rotation might be changed to a two-year corn, oats and sweet clover, or to a three-year corn, soybeans, oats and sweet clover rotation. Yields might be maintained or increased by the use of larger amounts of lime and fertilizer. Even though the soil fertility is actually reduced

over the period, it may be restored again after the emergency is over and, so long as the more exploitive system does not reduce yields during the emergency so as to lower the total output of the required crops, this system should maximize the farmers' income over the five-year period. It is because economic returns may be the major incentive to increased production that guaranteed prices over the current crop year play an important part in directing production.

For this increase in production to occur, however, it is essential that all restrictions over the acreage of intertilled crops on class A land be removed. Instead of benefit payments, such as those made for meeting corn acreage allotments under the present A.A.A. program, some means of preventing increased returns from leading to inflated land values (such as special taxes or deferred commodity payments) may be desirable. To the extent that farmers on class A lands can increase their income by increasing the production of intertilled crops, the need for increases of these erosion-inducing crops on class B land is lessened. Hence, pushing intertilled crops to the limit on class A land is one means of conserving class B land.

Similarly, conservation payments for seeding class A lands to grasses or legumes may actually be detrimental to the conservation of class B lands by reducing the production of intertilled crops on non-erosive soils. These payments restrict the production of the needed crops and act to negate the effect of increased prices. For this reason cash payments on class A lands should be limited to practices which will increase the production of those crops needed during the war period.

Government Policy for Areas of Soil Deterioration

When we turn to the problem of maximizing production on class B lands, the conditions are more complex, and increased prices cannot be depended upon to achieve the desired re-

sults. This is true for several reasons:

(1) Many farmers make production plans covering only one year and make no allowance for the destruction of the soil due to erosion. This may mean that increased exploitation will permanently reduce the productivity of these lands and create serious post-war adjustment problems.

(2) In many areas of class B land, increases in intertilled crops would not result in increased erosion provided that certain conservation practices such as terracing, contouring, and strip cropping were adopted. The adoption of these practices, however, requires special skills and may also involve cash outlays. A program to induce the adoption of these practices is, therefore, essential to offset the danger of increased erosion.

(3) Instead of increasing the acreage of intertilled crops, farmers on class B lands might increase their production of hay and pasture. This, however, may involve considerable expense for liming, fertilizing, and re-seeding during the first year, while the acreage of clean-tilled crops can be expanded with very little cash outlay. At the same time, more roughage-consuming livestock may be needed in order to make use of the increased quantity of roughage feed. This again may call for capital outlay for livestock, facilities for handling them, and increased purchases of concentrate feeds.

As a result of these factors, a withdrawal of Government control over acreages in these areas of soil deterioration might simply result in an increased production of intertilled crops and a decline in the production of roughages because the former could be achieved at little increase in costs when disinvestment in land resources is not taken into account. This is undesirable for two major reasons: (1) It may result in a relative underproduction of roughage crops and roughage-consuming animals and their products; (2) When the cost of

disinvestment and the associated costs of post-emergency adjustment are considered, the social net returns may be much less than they would be from an intensified non-exploitive system.

To some extent, the dangers of withdrawing Government control over the acreages of intertilled crops on class B lands might be reduced by using price controls to increase the returns from roughage crops compared to the returns from exploitive crops in these areas. Even large price differentials, however, might have little effect in overcoming inertia and stimulating investment in a short period of time. At the same time the administrative difficulties of having differential prices related to classes of land would be an almost insuperable obstacle to this method of control.

Because of these and other difficulties, Government price policies are limited to guaranteeing minimum future prices in order to expand the production of those crops needed in larger quantities without regard to their relationship to erosion. Under these circumstances a withdrawal of Government acreage controls on class B lands might easily result in destroying or disturbing conservation systems already established on many farms. In order to prevent this (and also to assist the further development of conservation plans), Government policies apart from price guarantees are needed to maximize social net returns from class B lands.

Government controls over the use of these lands may, as we have seen, take many forms including a limitation of property rights, various kinds of subsidies, and tenure legislation. Limiting property rights through zoning ordinances and land use regulations are appropriate means for preventing the development of serious maladjustments in the future; they may only be used, as was indicated in Chapter 9, to designate broad classifications of land use such as grazing areas, forest

areas, and agricultural areas. They can do little in an emergency to stimulate increased production. Where subsidies or land-use regulations are used, they must meet two basic requirements in an emergency; they must result in the production increases required during the emergency period and, at the same time, eliminate the socially uneconomic exploitation of the soil resources. In other words, they must be based upon positive control over erosion and increases in production and not upon the control of acreages of specific crops based on historical criteria. Under these circumstances payments are needed to encourage such practices as terracing, contour farming, strip cropping, field reorganization, liming and fertilizing, improvement of hay and pasture lands through renovation, and adapting the crops grown to the physical resources of the soil. Payments might also be made for improved livestock production through better sanitation, feeding of balanced rations, and the use of good stock.

Because these class B lands are subject to erosion, the acreages of erosive crops such as corn and soybeans must be related to the conservation practices adopted. Since payments for keeping such acreages below a stipulated figure may not be associated with any improved production methods, acreages of these crops might be controlled by making deductions from other payments for excessive plantings. This would mean that for class B lands the permissible acreages of intertilled crops would have to be related to the use of erosion control practices such as terracing, contouring, and strip cropping.

In order to do this, class B land could be broken down into three classes corresponding to the degree of erodibility. The most erosive class would be suitable only for hay and pasture. The remaining two classes would represent land suited to cultivation with the acreages of intertilled crops related to

both the erosiveness of the soil and the erosion control practices used. For any given area of such lands, several possible alternative bases of earning payments and deducting penalties could be related to the operator's ability to maximize his income. One farmer might wish to use all possible conservation practices in order to have as large an acreage of corn and soybeans as possible and raise hogs and poultry; another might use no conservation practices, grow very little corn or soybeans, and raise dairy cattle. The size of the farm would be an important factor in determining which alternative the farmer would choose; on smaller farms the more intensive system would probably be adopted while on larger farms a more extensive system may be desirable.

Apart from subsidies, social action to give security of occupancy is extremely desirable, because this increases the ability of the operator to invest in both land improvements and livestock. This is important when larger amounts of roughage are required and an exploitive corn-hog system offers an immediate increase in income with much less risk for a tenant with an annual lease.

Some Practical Problems

When we turn from generalizations regarding class A and class B lands to the problem of developing action programs suited to individual farms which include both classes of soil, certain practical problems must be solved.

If the farmer is to maximize his income from class A lands by growing any quantity of intertilled crops that seem most profitable to him over the emergency period, no general depleting acreage can be established for the farm as a whole. Similarly for class B lands, various alternatives may be available. Which is the most desirable depends upon the operator's preference, the conditions of his occupancy, and the size of

the farm. Such flexibility of land use is desirable, but raises many objections because the conditions of allocating payments and planning are too complex and indefinite.

The Soil Conservation Service has been developing individual farm plans based upon detailed conservation surveys, and in the soil conservation districts, much of the planning is now done by the farmers themselves in group meetings led by SCS technicians. One of the major difficulties, however, is to make the detailed conservation surveys and prepare the land use capability maps as rapidly as the area incorporated in districts expands. During an emergency, higher prices may encourage an expansion of erosive crops, *and the need for more rapid planning becomes urgent.* Essentially the great need is for the type of individual farm planning that has been developed by the Soil Conservation Service with a simplified land classification that would enable trained township committeemen to cooperate with the farmer in developing a production and conservation plan for his farm and earn payments that would be related to his attainment of a suitable plan. Such a simplified classification would have to be developed for various areas and regions, and the following is suggested as one which might prove feasible in the Corn Belt; adjustments for local conditions such as soil types and special problems would have to be made.

A Simplified Classification

According to an analysis of the relationship of slope classes to erosion, the most important single factor determining the rate of erosion in Iowa was the steepness of the slope.[2] This suggests that a simple criterion for classifying land according to its erodibility within a given area of similar climate and associated soil types would be the percentage of slope. This

[2] For the detailed figures upon which this conclusion is based, *see* the author's article, "War and Soil Conservation," *Jour. of Land and Public Utility Econ.*, Vol. XVIII, No. 2, May, 1942, pp. 127 and 128.

characteristic has the further advantage of being easily determined without specialized scientific training. Using slope as the single criterion of erodibility, Corn Belt agricultural land could be grouped into the following tentative slope and land use classes.

Class 1. Nearly level land. Subject to slight or no erosion. Land use and practices may be determined by the farmer in relationship to other physical factors and prices. This would correspond to the areas of fertility depletion previously referred to as class A land.

Class 2. Slightly sloping land. With no conservation practices, not more than 25 per cent should be planted to intertilled crops in any one year; with contouring, $33^1/_3$ per cent might be in such crops; and with terraces and strip cropping, 50 per cent could be in intertilled crops.

Class 3. Rolling land. With no conservation practices, not more than 20 per cent should be in intertilled crops each year; with contouring, 25 per cent might be in such crops; and with terraces and strip cropping, $33^1/_3$ per cent could be in intertilled crops.

Class 4. Steeply sloping land. Not suitable for cultivated crops but may be used for permanent hay or pasture with cultivation limited to that necessary to establish new seedings.

These four classes would vary between areas and should be related to broad soil groups and climatic conditions. This simplified classification is suitable only for areas where topography is the controlling factor in determining erodibility, and for other areas different factors would have to be used.

The advantage of using as simple a classification as possible during an emergency lies in the fact that farm planning may be greatly facilitated. Class 1 land may be used any way the farm operator thinks most profitable; no payments for conservation practices and no acreage restrictions on intertilled crops would be made. Class 4 land could be kept in permanent

cover and payments earned only for liming, fertilizing, and re-seeding or forest practices; deductions from the total farm payments could be made for each acre cultivated except for re-seeding purposes. This leaves only class 2 and 3 lands which need be considered in detail by representatives of the action agencies responsible for the production and conservation program. Alternative payments for various conservation practices and various acreages of intertilled crops could be chosen by the farmer.

Payments and Land Use Controls

Under any such plan the conservation payments and deductions must apply to the farm unit as a whole so that deductions for excess acreages of intertilled crops on one piece of land could be made, where necessary, from conservation and other payments made on the same farm unit. Other payments that might be included would be for disease control, scientific feeding methods, field reorganization requiring the moving of fences, and the planting of trees and shrubs in forest and game areas.

One of the major problems that would inevitably arise would be that of allocating optional land use programs on fields that contained land of more than one class and which should be used differently. The fact that we have a square survey applied to a curved landscape has resulted in many rectangular fields containing, in some cases, all four classes of land.

In many cases a sound land use program cannot be applied to the present rectangular field layout and simply to subdivide the present fields would result in areas too small to be worked efficiently with modern machinery, especially if farmed on the contour. Field reorganization could be encouraged in two ways, by a direct payment for such reorganization based upon the rods of fencing that had to be rebuilt in order to make

a conservation land use plan possible, and by the classification of mixed fields so that the permitted acreage of intertilled crops is reduced by failing to rearrange them.[3]

Skills and Action

In developing a broad conservation and production program of this nature, the various action agencies would have to cooperate closely, with each contributing the special skills and techniques they have developed.

While the conservation plans may not be so complete as those being developed within conservation districts, they might be very much more widespread; at the same time the allocation of conservation payments within the districts would speed up the introduction of more complete plans. It is a question of evaluating an intensive procedure against an extensive one in the allocation of funds and personnel.

For the production program to be successful it would be necessary to maintain contacts with all farmers to obtain forecasts of planting intentions in order that price guarantees could be closely associated with probable supply and demand conditions. These contacts would also be useful for making any adjustments in production that may be called for in the post-war period.

Why Changes Are Needed

The justification of a more extensive approach to conservation during a period of emergency lies in the fact that it permits increases in production in response to prices and at the same time directs the increased production of intertilled crops to those lands which will not be permanently damaged by excessive cropping during the emergency. It also encourages the farmer to maximize his income on erosive soils according

[3] For detailed suggestions of such a classification, *see* "War and Soil Conservation," *ibid*, p. 130.

to his preference, his size of farm, and the degree of erodibility of the land involved. In an emergency it is essential that each farmer use his skills of production to the fullest extent, and this can be done only when there is flexibility in the farm plan.

Conservation does not imply any narrow land use. There are usually several alternatives possible, and thinking in terms of alternative conservation possibilities will impress upon farmers the fact that erosion is a basic consideration in farm planning. Finally, this extensive approach uses funds to increase efficiency and achieve or maintain an appropriate land use pattern which is flexible within limits and which will reduce erosion rather than increase it during the emergency. A further consideration, that can only be mentioned here, is the probability that funds will tend to flow to the areas of poorer soils where lack of capital may be a serious obstacle to the improvement and intensification of both primary and secondary production. To the extent that this is true, an increased allocation of funds to these areas may permanently raise the level of living of the rural population.

Post-War Adjustments

One of the greatest advantages of developing these flexible individual farm plans is that the three basic factors of soil, operator, and prices are brought together and given consideration. This forms a logical basis for further adjustments that may be needed after the emergency is ended. What these adjustments may be will depend upon the post-war organization of Europe and the world, particularly with respect to tariffs and agricultural policies, and whether we are able to maintain a high level of industrial employment.

If interdependence, exchange of goods, and a rationalization of European agriculture are accepted, we may again be exporters of grains, cotton, and lard with part of the European

grain areas turning to the production of dairy products, fresh meats, and fruits. If economic nationalism again dominates the people of Europe and America, we may face the necessity of curtailing our production of these products. Some adjustments both in Europe and in this country are inevitable and the procedure outlined above would provide a better basis for making more satisfactory adjustments because any necessary crop controls could be related to the physical resources involved. This would eliminate the conflict between conservation and production control that exists in the present AAA program. Any expansion of depleting crops on a percentage or historical basis is unsound from a conservation point of view. At the same time, percentage reductions of specific crops for the purpose of adjusting production are not related to the relative importance of that crop to the balance of the farm as a whole or its relationship to commercial production. Because it is necessary to harmonize production adjustments and conservation during the emergency, the basis for a sounder adjustment program in the future might be developed now. Such a production adjustment program might include acreage payments for commercial crops to stimulate necessary crop changes, the ever-normal granary, and price guarantees over one crop year supported by loans. Conservation payments could then continue to be made only for positive conservation measures or, as may become desirable, for actual land improvement.

As has been emphasized earlier, the development of conservation plans in areas where basic maladjustments between farm population and land exist is unsound unless these maladjustments are remedied. In many areas we need a recombination of the factors of production and shifts in the intensive and extensive margins. This may occur by increasing capital or land inputs relative to farm labor; secondary production may be intensified where labor is not fully employed,

or where farm size is increased with a less intensive primary production. To the extent that war demands create alternative employment for farm labor, adjustments in farm size may be facilitated. Where this occurs, the changes should be considered permanent, and some method of preventing further maladjustments from developing should be adopted. The post-war pressure of unemployed labor upon the land may be very great or slight depending upon our ability to maintain a high level of industrial employment. As we have seen, it is relatively easy to intensify agricultural production but exceedingly difficult to reverse the process; controls to meet this post-war problem should be developed now and might take the form of land use regulations, zoning ordinances or public ownership.

After the last world war one of the most serious problems facing agriculture was the deflation of land values following the price crash in the summer of 1920. From the pre-war period (1912–14 = 100) the index of estimated land values for the United States rose to a high point of 170 in 1920 and then declined steadily until 1931 when it was 106 and only slightly above the base period. Following the depression, the land value index fell to a low of 73 in 1933; since then it has slowly risen and reached 86 for 1941.[4] There has been no rapid increase in land values in 1942 and the high income received by farmers in 1941 has partly been used to reduce their mortgage indebtedness.[5] Whether land values will rise during the present war will depend upon the ability of the government to prevent the prices of agricultural products from rising to abnormally high levels, both directly by price control measures and indirectly by stimulating increased production.

Because a collapse of land values leads to pressure to exploit the soil in order to meet fixed charges, increased production

[4] U.S.D.A., *Agricultural Statistics*, 1941, Table 710, p. 583.

[5] U.S.D.A., Bureau of Agricultural Economics, *The Agricultural Situation* April, 1942, p. 23.

now, even at the expense of depleting fertility, will be of value in avoiding future exploitation. This is true to the extent that expanded production can avoid price increases. Similarly, other actions during the emergency which prevent inflation are of direct value in preventing increased exploitation in the post-war period.

CHAPTER 12

THE FORMULATION OF PUBLIC POLICY AND ACTION

Problems of Policy Formulation

Professor Hammar has pointed out that any national conservation policy must consider the relationship between different resources, and that "conservation refers to a concern of humanity for the level of production that may be maintained from the *totality of resources* at its command."[1]

Thus the conservation of one resource at the expense of exploiting another may not be harmonious with a true conservation policy. Conservation policy, therefore, must not consider one resource separately but only in its relationship to others. He also points out that the key problems concern availability, substitutability, and recoverability and proceeds to develop a resource classification based upon these criteria.[2] Because of the complexity of these interrelationships, Professor Hammar advocates the formation of a Department of Conservation and states:

"A first task of such a Department would be to determine and thereafter to establish, as best it could, a balanced conservation policy and program. Many agencies of the presently constituted Department should probably be transferred to such a new Department. Indeed, it is difficult to understand how an even handed policy of conservation can be achieved if conservation activities are to remain scattered as they are at present. Furthermore, under present circumstances no agency concerns itself deeply with

[1] Conrad H. Hammar, "Society and Conservation," *Jour. Farm Econ.*, Vol. XXIV, No. 1, Feb., 1942, p. 109.
[2] *Ibid.*, pp. 110 and 111.

resource reserves, and with such broad matters as substitutability, restorability, and recoverability and likewise, no agency makes the needed continuous study of rates of exploitation and consumption which are after all the backbone of conservation policy. Because of too little attention to such matters in the past, the nation remained too long ignorant of the depletion of its forests, awoke only at a late date to the depletion of its soil and does not even yet take seriously the problem of oil and mineral depletion and so on.

"Likewise no arm of government as now constituted is charged with determining when the policy of conservation should be restrictive and when expansive or developmental. As a result the nation's conservation policy becomes too much a matter of propaganda with an over-emphasis upon precautionary policy supported by a persistent pointing to horrible examples of past missuse and a tendency to dwell at great length on the economics of past mistakes."[3]

This is a clear statement of the necessity of formulating conservation policies from a broad point of view. In previous chapters the interrelationships between conservation policies and other agricultural action agencies has been indicated and the need for cooperation in policy formulation emphasized. From the point of view of soil conservation, however, it is doubtful if an agency such as the Soil Conservation Service should be taken out of the Department of Agriculture, where it is in close contact with all other agricultural agencies, and placed in a Department of Conservation dealing with coal, oil, water power, and other non-agricultural resources. Unification of conservation policy formulation is essential, but this need not involve a union of soil conservation agencies with other agencies to be developed to conserve oil and coal.

In a democratic society budget allocations for specified projects are controlled by elected representatives of the people, and the size and purpose of the allotment reveals the judgments of these representatives as hammered out through committee proceedings, in which are reflected economic pres-

[3] *Ibid.*, p. 119.

sures, political pressures, and value judgments. In this process, pressure groups and special interests all attempt to obtain decisions favorable to their cause. Once a project or program has been started, the administrative agency itself develops an interest in perpetuating its work and increasing the allocation of funds for its use.

When funds are first allotted to a project the end stated is usually broad in scope since there may be very little information available upon which intelligent judgments can be made. Once the program is in operation, however, information that forms a better basis for judgment is collected by the administrative agency and presented to obtain the most favorable action by congress or its committees. Since all agencies tend to compete for limited funds this desire to retain public confidence encourages efficiency and the formulation of policies that will meet with the greatest public approval. At this level, the statements of ends to be pursued are necessarily broad and couched in common sense terms, rather than in exact language; policy formulation must include, therefore, not only a selection of means, but also to a large degree a redefinition in more exact terms of the ends to be pursued.

It is in this institutional framework that we must ask the question, "Who shall determine policy, define the specific ends, choose between alternative allocations of funds, and select the means to be used?" Essentially it is the problem of relating planning, action, and research in such a way that the ends and means of the different action programs shall supplement rather than conflict with each other. For this to occur it is essential that planning or policy formulation be centralized in one body and not left to individual agencies that might initiate programs which would tend to conflict with those of other agencies.

This problem is important particularly in the case of an objective stated in such terms as "the conservation of our soil

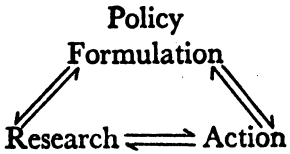
and water resources." Conservation becomes a term with moral connotations; it may become purely physical in content and become completely divorced from any economic interpretation. In the general law allocating conservation funds we find no key as to what conservation objectives shall have precedence, and policy formulation, therefore, has a very wide scope. Again, in the case of soil conservation, we find that numerous other programs can be used to further this broad end. In some cases policies adopted by other agencies might result in an increase in soil and water losses. In the Agricultural Adjustment Act, conservation as an end is associated with the end of attaining "parity prices," and the possibility of conflicts between these ends is, as we have seen, inherent in the one agency.

If we are to develop a dynamic process of social planning, the various action agencies must develop methods of evaluating the results of the programs in order that improvements in policies may be made as the personnel becomes more experienced in dealing with the problems involved. For this process to take place, flexibility of specific action programs must be maintained, and it is essential that those formulating policies avoid the development of rigidities.

Research has three functions: (1) discovering facts and relationships that lay the foundation for intelligent policy formulation; (2) analyzing the results of present action programs in order that policies may be improved in the light of experience, and (3) investigating specific problems that are encountered by the agencies designated to further conservation policies.

The three functions of policy formulation, action, and research must be kept independent but interrelated if public policy and action for conservation is to become progressively more effective in attaining the desired end. The relationship may be visualized in the form of a triangle with policy formu-

lation, action, and research at the corners connected with each other by a two-way flow:



Where research is dominated by an action agency, its whole effort may be devoted to solving immediate practical problems with no time given to more fundamental problems needing investigation in order to improve policies. Independent analysis of current actions that imply criticisms may not be permitted or the findings may be suppressed. Where policy formulation is dominated by an action agency, bureaucratic inertia and personal preference, based upon familiarity with current policies and procedures, may prevent adjustment and changes from occurring. On the other hand, the experience and advice of the action agency is essential to those formulating policy.

So far this discussion has centered upon public policy and action at the federal level where certain basic policies and decisions must be made. At the other end of the chain linking congressional actions and results is the individual farmer upon whom the action programs impinge. He may play an important part in policy formulation, or he may simply be a neutral participator. In general it may be said that individual participation in policy making can be achieved either by an organized flow of ideas and criticisms from the farmer to the planning group, or by such a decentralization and flexibility of action that local groups can initiate policy and direct it. The county agricultural planning committees represent an organized flow from farmers to the Bureau of Agricultural Economics. A soil conservation district represents a decentralization of authority and planning. The effectiveness of

either of these methods in bridging the gap between individual and social interests will depend upon the ability of the individuals to see the social interest and the ability of the policy makers to understand and appreciate the individual's problems; it will depend also upon the kind and degree of conflict that exists and the basic causes underlying the divergence between individual and social interests.

The development of specific programs most suited to the solution of particular problems is not a simple task that can be done by some group completely separated from the action agencies. Essentially, policies must be developed with the action agencies cooperating with other agencies at the federal level. This may perhaps best be done by having final decisions regarding policies rest in a board in which all the interested agencies have representatives. To provide analyses of problems and programs, an independent fact-finding or research agency should be maintained, and its funds should be completely independent of other administrative units.

The Functions of Economic Research

In this complex picture of policy formulation, action, evaluation, and policy modification, research in the economics of conservation has several important fields of endeavor that may be classified as follows:

(1) Analysis of basic relationships of importance to conservation policy; this involves both theoretical and empirical studies.

(2) Analysis of farm management problems associated with conservation planning in local areas.

(3) Analysis and measurement of social costs and benefits and the development of techniques of social accounting.

(4) Analysis of all programs affecting land use and studies of the effects of price changes on conservation.

(5) Designing experiments in social action and the evaluation of results in terms of specific means used.

(6) Analysis of resistances to the adoption of conservation by individuals.

Only as research assists us to answer the inumerable problems that have been raised in this monograph can it become effective in laying the foundations for a progressive formulation of social policy.

One example of the kind of problem that research must assist in answering is presented here purely for illustrative purposes. It is often claimed that the solution of our agricultural difficulties, including conservation, lies in establishing more self-contained farm units with much less dependence upon fluctuating prices. Such small units, it is sometimes claimed, would permit city families on relief to become self-sustaining citizens producing their own necessities. Dr. Bennett outlines the problem in the following question:

> "How many of our farm families, in difficult financial circumstances today, would be better off tomorrow under an altered agriculture that placed subsistence above market cash, and substituted scientific methods for habit in the use of land?"[4]

This is a realistic question, and the social scientists should be able to assist in answering it. In some cases the advocates of the self-contained farm have adopted a philosophy of ruralism which they wish the nation to pursue as a general agricultural policy. In the realm of value judgments, we must accept the opinions of the majority of the people affected as the final criterion of policy. These opinions are indicated through the ballot and also through actions. An analysis of census data shows that the United States has grown progressively less "rural farm" ever since its foundation. We also know that it is the young people who move to the cities and

[4] H. H. Bennett, *The Land We Defend*, U.S.D.A., Soil Conservation Service, July, 1940, p. 13.

that many older people return to country towns. People apparently have preferred to go to the city because they believed the opportunities were greater. They could have stayed at home and subsisted, but they chose not to. Rural or urban life may be "better" for individuals but hardly for society as a whole. We have rural slums as well as city slums and city art and culture as well as rural. From an analytical review of values as expressed in action, it seems doubtful if a retreat to ruralism is desired by a majority. Any national effort to move in this direction may, therefore, meet with great resistance and fail. If an increase in rural population is desirable then rural life must, apparently, be made more attractive; efforts in this direction are certainly needed, but we may question whether attractiveness is associated with a low cash income.

When we consider the problems of "an altered agriculture that placed subsistence above market cash, and substituted scientific methods for habit in the use of land," we again find that certain trends can be measured and used as a basis for the formulation of policy. In general, the scientific method has been associated with increased commercialization of agriculture. The use of tractors to replace horses has increased rapidly, and in 1939 double the number were in use as compared to 1930; in the North Central region 78 per cent of all farms over 100 acres had tractors. The reason for this trend is that "the cost of horse feed and its alternative value for dairy and poultry production encourage the replacement of work-stock with tractors."[5] This implies increased commercialization because products must now be sold to purchase the tractor and the gasoline.

In the case of contouring, the acreage has increased from about half a million acres in 1937 to about 5 millions in 1938, and it is estimated that if two-thirds of the rolling corn land

[5] U.S.D.A., *Technology on the Farm*, Aug., 1940, p. 10.

were contoured there would be an increase in corn production of about 50 million bushels.[6] The present indications, therefore, are that farming in the United States is becoming more commercialized and will probably continue to do so in the future. The production of more subsistence on the farms is unquestionably one way of raising the level of living on a large number of farms, but there appears to be no reason why this should be at the expense of cash income. In round figures, 50 per cent of our farms produce only about 10 per cent of our commercial surpluses, and any large movement to break up commercial farms and increase the number of subsistence farms would probably create a serious shortage of raw materials. Family labor is limited, and the time that is spent producing subsistence must be balanced against the time available for the production of marketable surpluses. Since many of these trends are measurable, they must be studied if national policies are to be in harmony with them.

An analysis of trends of action cannot, however, be taken alone as a measure of the values desired by those involved. Trends of action only reflect individual choice when the choice is freely made and there are alternatives available. There is a great deal of difference between the trend of increased commercialism in agriculture and the growth of unemployment in cities, even though they may not be entirely independent. Similarly, the general migration of young people from rural areas to cities is not the same as the forced migration of farm families "tractored off" the Oklahoma fields.

Public policy can be constructively related to these trends only as we probe deeper into the basic causes behind them. In the case of subsistence farming there appears to be no serious barriers that prevent a family from practicing that way of life if it desires to do so. On the other hand, the growth of agricultural pressure groups seeking to stabilize prices and

[6] *Ibid.*, p. 29.

income indicates that there is a deep-seated desire amongst farmers for a secure money income.

A third point, often implied by advocates of less commercial farming, is that a greater emphasis on subsistence will be associated with greater conservation. In the future this may be true, but at present it is doubtful if the point could be proven. In many areas in the South the most severe erosion is associated with small subsistence farms and a pressure of population upon the resources. Conservation in these areas appears to imply a reduction of the number of people on the land and an increase in the size of both farms and income. At present it is also questionable whether there is any direct relationship between erosion and commercialization on farms in any given area, but this is a factor that might be measured and need not be left in the realm of intuition and belief. One factor that is associated with erosion is an erosive crop with great comparative advantage, and this places an emphasis upon cash crops, such as corn, cotton, or tobacco. Diversification in this case may well be associated with increased conservation. At the same time diversification often increases the production of foods such as milk, poultry, or meat which may be used to supplement the family living and increase the subsistence obtained from the farm. This need not necessarily imply a retreat from commercial agriculture because it may be associated with an increased cash income from sales.

One great advantage of subsistence farming is that it insulates the individual family from the effect of depressions and price changes and, where such insulation can be obtained without lowering the level of income so that farming is not attractive, it is desirable. This holds true for all levels of the economy; being "self-contained" on a family, community, or national level eliminates the effect of interdependence with other families, communities, and nations. At the same time it may lower the level of living by eliminating the advantages of

exchange and specialization. In a world where war periodically destroys exchange and creates booms and depressions, some people prefer a retreat to a more self-contained economy in place of exchange and insecurity. The alternative is to develop a more stable economy with world cooperation and unity under law so that these disturbances are mitigated. This also is an alternative which may help to solve the problem of unemployment and insecurity in urban centers.

Although these intangible values cannot be measured directly, many of them are reflected by the actions of individuals in a society in which freedom is maintained. Where trends can be measured as is possible in the case of migration, increasing commercialization as indicated by the use of tractors and other equipment, changes in crop production and diversification, farm abandonment, tax delinquency, and relief, they must be considered in the formulation of conservation policies. Once the trends are established, the basic causes must be analyzed in order that effort and money are not wasted attempting to achieve conservation by means which are incompatible with other values deemed desirable by the people.

Some may claim that this type of analysis is not research but policy formulation; this may be true, but research workers in the social sciences should, through their knowledge of theory and their ability to analyze relationships, be able to assist in this key function of democratic planning.

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There are several bibliographies that may be used to supplement the very restricted number of references listed below. In order to avoid duplication, only the references cited in the text or bearing directly on problems of methodology or theory as related to the narrow field of the economics of soil conservation are included. For those who wish to obtain a background of soil science I suggest Dr. Charles E. Kellogg's book *The Soils That Support Us* (The Macmillan Co., New York, 1941, 370 pp.). For details regarding the physical aspects of erosion and erosion control, there is Dr. Hugh Hammond Bennett's encyclopedic work *Soil Conservation* (McGraw-Hill Co., New York, 1939, 993 pp.).

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