AN ABSTRACT OF THE THESIS OF

Katherine L. Beale for the degree of Master of Science in Agricultural and Resource Economics presented on April 23, 1984.

Title: Estimating Values of Alternative Public Land Allocations: A Critical Analysis of Applied Theory and Methods.

Abstract approved: _____
Frederick W. Obermiller

The Forest and Rangeland Renewable Resources Planning Act of 1974 provides for development of long term plans for managing the nation's public land resources. Every five years, the Forest Service publishes a new "RPA Program" which discribes the estimated marginal benefits and costs of the many alternative land uses and the estimated present net value of several alternative land management plans. This study provides a critical review of the economic theory and methods used in developing such value estimates.

A general review of welfare economics describes the theoretical ideal of efficient resource allocation, and emphasizes the disparity between situations in which the ideal is attainable and the situation actually faced by public land management agencies. Application of economic theory requires many restrictive assumptions. If conditions are assumed which do not actually hold true, it becomes uncertain whether the efficient allocation of resources suggested by economic analysis represents the optimal solution. The assertion that any

given allocation of resources is more efficient than any other may also be questioned, since some effects on social welfare are difficult or impossible to measure in dollar values.

In addition to the theoretical limitations of economic efficiency analysis, the value estimates presented in the RPA Programs are influenced by limitations imposed in legislative decisions, and by policy decision which provide for implementation of specific empirical methods. The influence of such political decisions on ecomomic analysis of public land management alternatives is reviewed briefly in this study. Some areas of conflict between economic theory and political decisions are noted, and the assumtions which resolve these conflicts are discussed.

Two public land use values described in the 1980 and Draft 1985 RPA Programs are selected for critical analysis. Several alternative methods of estimating the total or marginal social benefits associated with each land use are outlined. The sensitivity of the estimates to the choice of empirical methodology is demonstrated by comparing various value estimates developed for the two RPA Programs with the estimates actually used in the program. It is concluded that the estimates of social benefits, when combined with projected future benefits and estimates of current and projected agency costs, do not provide a unique, unambiguous, or optimal economic ranking of land management alternatives.

Estimating Values of Alternative Public Land Allocations: A Critical Analysis of Applied Theory and Methods

by

Katherine L. Beale

A THESIS

Submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Master of Science

Completed April 23, 1984

Commencement June 1984

APPROVED:

Associate Professor of Agricultural and Resource Economics
in charge of major

Head of Department of Agricultural and Resource Economics

Dean of Graduate School

Date thesis is presented April 23, 1984

Typed by Elnora Thomas for Katherine L. Beale

ACKNOWLEDGEMENTS

Many people have contributed to the completion of this study and to my personal development as I worked on it. I am most indebted to Dr. Frederick Obermiller for his support and guidance, and for his patience with my alternative approaches to his ideas. Dr. Jack Edwards gave freely of his time, and often provided a sense of depth and perspective along with his responses to my questions. Dr. Bruce Mackey also contributed advice and encouragement.

I am also grateful for the many hours of discussion with my classmates and officemates, and for the word processing by Elnora Thomas. Finally, I want to acknowledge the continuing support of my husband Jim, who has listened to hours of commentary on economics with admirable patience.

TABLE OF CONTENTS

INTRODUCTION

Management of Publicly Owned Lands 1

Research Scope and Objectives 3

Research Organization 7

REVIEW OF THEORETICAL AND APPLIED WELFARE ECONOMICS 9

Distinction Between Pure and Applied Theory 9

Theoretical Development 10

Theory of Second Best 12

The Kaldor-Hicks Criterion 14

Theory of Applied Welfare Economics 16

Aggregate Economic Surplus 17

Hicks' Variations and Willig's Response 21

Discount Rate Problem 23

Valuation of Non-Market Goods 26

Assumptions vs. Reality 30

REVIEW OF LEGISLATION AND POLICY 34

Relationship of Law and Economic Analysis 34

Legislative Background 35

Land Management Legislation 35

Wildlife Management Legislation 37

Policy Review 39

History of Grazing Fee Policy 39

Theoretical Inconsistencies of RPA Program Values 42

Costs Versus Producer's Surplus 46

TABLE OF CONTENTS (continued)

Grazing Value Policy 48

Wildlife and Fish Recreation Use Value Policy 49

Implications of Legislation and Policy 52

VALUE ESTIMATES 56

Alternative Methods of Estimating Range Forage Values 57

Hay Price Method 58

Private Rental Rate Method 59

Value of Marginal Product Method 60

Value of Grazing Permit Method 61

Ranch Budget (Linear Programming) Method 63

Comparison of Various Estimates of Grazing Values 67

Alternate Methods of Estimating Big Game Use Values 69

Unit Day Value Method 69

Contingent Value (Survey) Method 71

Travel Cost Method 73

Comparison of Various Estimates of Big Game Use Values 75

Use of Value Estimates in the RPA Programs 78

SUMMARY AND CONCLUSIONS 82

Summary 82

Conclusions 85

Recommendations 87

BIBLIOGRAPHY 89

LIST OF FIGURES

Figure		Page
1	Aggregate Economic Surplus	19
2	Deriving Demand From Changes in Value of Marginal Product	29
3	Total Willingness-To-Pay	43
4	Draft 1985 RPA Program Definition of Consumers' Benefit	44

LIST OF TABLES

Table		Page
1	Livestock Grazing Values in 1978 ($/AUM)	65
2	Livestock Grazing Values in 1982 ($/AUM)	66
3	Big Game Use Values ($/RVD)	76

ESTIMATING VALUES OF ALTERNATIVE PUBLIC LAND ALLOCATIONS: A CRITICAL ANALYSIS OF APPLIED THEORY AND METHODS

CHAPTER I

INTRODUCTION

Management of Publicly Owned Lands

A growing body of legislation and policy recommendations provides for allocation of federally owned land resources among alternative uses. Maintenance of the productive capacity of the land and allocation of some benefits to all user groups (including hunters, recreationists, and the timber, mining, and livestock industries) is mandated. As the relative scarcity of the land resources increases, competition among the various user groups grows, federal land management actions are debated and criticized, and ever more complex management procedures are required.

The bulk of the responsibility for carrying out the complex task of public land management has been assigned to two agencies of the federal government; the Forest Service (United States Department of Agriculture), and the Bureau of Land Management (United States Department of the Interior). The goals which land management agencies must accomplish include: satisfaction of the requirements mentioned above -- maintenance of the land's productive capacity and provision of some benefits to all users; evaluation of the social benefits and

costs of alternative acceptable allocations of the land resource; consideration of the fairness of changes in the distribution of costs and benefits (implying that estimates of distributive impacts must be developed); and selection of a combination of land uses.

Specific procedures must be developed and used to accomplish each goal. While the procedures differ somewhat between agencies, they share consistent theoretical, methodological and legal foundations. The procedures followed by both agencies may be generally categorized as: economic analysis, environmental analysis, political input receiving and processing, and decision making. Economic analysis can provide estimates of social benefits and costs, which are developed using the theory and methods provided by welfare economics. Another form of economic analysis, known as impact analysis, provides estimates of changes in the distribution of benefits of costs among sectors of society. Environmental analysis, which is rooted in the biological sciences, provides estimates of changes in the land's productive capacity. The political information processing and decision-making categories share foundations in the theory, methods, and laws which make up the democratic process, although the actual procedures used may differ between agencies.

Continuing political conflicts among user groups testify to a social need to monitor the procedures used in evaluating land management alternatives, the decision making process, and the consequences of allocative decisions. The land management agencies depend on this continuing critique, and particularly on academic review and

revision of economic analysis, for guidance in refining their decision making procedures.

Research Scope and Objectives

Economists approach the analysis of social benefits and costs by first separating efficiency analysis or analysis of social costs and benefits, from impact analysis. Each type of analysis represents an application of a different set of theory and methods. This research focuses almost entirely on efficiency analysis. The role of impact analysis as a partial solution to problems which result from certain simplifications required by efficiency analysis is discussed briefly in Chapter II.

Common sense and basic management principles suggest that once a procedure or method has been developed and tried, it should be reviewed in order to test whether or not it satisfactorily accomplishes its original goals. The goals of economic efficiency analysis are to estimate social benefits and costs, and to provide decision makers with a ranking of alternatives based on estimated and projected benefits and costs. This study provides a discussion of whether the social benefits of alternative land uses are actually estimated, and whether the ranking of alternative National Forest management plans based on the estimated present and future benefits and associated costs of these land uses is unambiguous enough to be considered valid input in the decision-making process. The related question of whether the same quality of economic analysis might be

achieved at less expense is addressed briefly in the conclusion to this study.

Theoretical and applied welfare economics provide the means for accomplishing the objective of estimating social benefits and costs under different conditions by proposing assumptions which simplify the complex, real-world problem to a level which can be analyzed. The simplifying assumptions fall into two general categories; those justified on theoretical grounds, and those justified on mathematical or statistical grounds. Both types of assumptions introduce inaccuracy or ambiguity. The final value estimates are accurate and unambiguous only to the extent that the assumptions reflect the real world. The degree of inaccuracy resulting from statistical justifiable assumptions can sometimes be quantified, as, for example, the standard deviation represents the degree of inaccuracy in the assumption that the mean of a sample represents a typical member of the population. In the case of theoretically justifiable assumptions, however, only qualitative discussion of uncertainty can be provided. Often, in the process of using economic estimates as input in the political decision making process, qualifications regarding inaccuracy and uncertainty of value estimates are ignored.

While each land management agency has its own established procedures for computing benefit and cost values, the Resources Planning Act (RPA) Program has provided some standardization of values. The program is administered by the U.S. Department of Agriculture. As specified in the Forest and Rangeland Renewable Resources Planning Act of 1974, an assessment of supply, demand, and

price relationships for all publicly owned resources is provided every ten years, with an associated management program undertaken every five years. The information published in these reports, supporting documentation, and academic research provides a wealth of secondary data for land management agencies, academic researchers, and interested citizens. Since this body of information represents the most extensive analysis of values in use by the land management agencies, the empirical data and methodologies to be reviewed in this thesis are selected from RPA value studies and supporting academic research. Theoretical and legislative background are developed in a literature review.

Due to time and budget constraints, it is impossible to examine estimates of the benefits and costs of every public land resource. Selection of values for comparison in this review is relatively arbitrary, given the diversity of the data base. Examination of wildlife use values, particularly big game use values, and livestock grazing values is chosen because these two sets of value estimates serve to illustrate several problems inherent in comparison of benefits resulting from alternative land allocations. These problems include:

1) Comparison of values for unpriced (non-market) goods with values for goods which are exchanged in a competitive market
2) Comparison of values which are derived indirectly from consumptive uses of land resources - livestock or game directly consume land resources such as forage, but value to society occurs as a result of people's use of the animals.

3) Comparison of land allocations to uses which are competitive or complementary - livestock and game may compete for forage, which implies that the allocative decision should account for this interrelationship.

Each of these problems is implicity or explicitly recognized in the RPA Programs or supporting documentation. Only the first of the three is solved to any great extent, however. The solutions (or lack thereof) to all three problems are discussed further in later sections of this thesis.

This study focuses primarily on the estimation of social benefits resulting from the two land use allocations. The economic theory and agency policy decisions which relate to cost estimates are described, but empirical analysis of cost estimates is not presented because the Forest Service uses accounting costs instead of economic estimates of costs in the RPA Programs. These costs are described further in Chapter III.

Specific goals of this study are as follows:

1) To provide a concise review of the basic principles of theoretical and applied welfare economics, with emphasis on required simplifying assumptions.
2) To discuss the implications of the assumptions in terms of the contribution of economic efficiency analysis to public land management decisions.
3) To briefly describe the impacts of land and wildlife management legislation and policy on economic analysis of values.

4) To provide a review of empirical studies used in establishing estimates of economic values for the selected allocations of public land, giving a comparison of values estimated by various methods.

5) To reach logical conclusions regarding the limitations of economic analysis as used in providing estimates of the relative ranking of alternative land allocations presented in RPA Program documentation.

6) To discuss the policy implications of the conclusions.

Research Organization

The theoretical background of national economic efficiency analysis is reviewed in Chapter II. The fundamental assumptions required by welfare theory are described, and the development of methods by which general welfare theory may be applied to analysis of real world problems is outlined. The chapter concludes with a discussion of the difference between what is assumed and what exists, and some comments on the implications of the disparity.

Legislation and policy governing the management and distribution of the public domain also influence the economics of public land allocation. Chapter III provides a brief review of the major trends in management of public lands, the legislation and policy which provides for fees to be charged for certain land uses, such as livestock grazing, and the laws concerning wildlife preservation and habitat provision. Policy decisions which determine how values are

to be estimated and how the estimates will be used in land management decisions are also reviewed. The implications of legislative and policy decisions in terms of economic analysis are noted.

Chapter IV provides descriptions of various methods of estimating the benefits reviewed by society as a result of public land allocations to livestock grazing and to wildlife habitat and forage. Value estimates developed using various methods proposed for use in recent RPA Programs are listed, and the estimates actually provided in the 1980 and 1985 RPA Programs are also reviewed.

In the final chapter, a summary of the various sections of the thesis provides a basis for conclusions about the use of economic efficiency analysis in public land management, particularly in the case of the alternative land allocations described in this thesis. The usefulness of critical analysis and review is illustrated in a brief exploration of policy implications.

CHAPTER II

REVIEW OF THEORETICAL AND APPLIED WELFARE ECONOMICS

Distinction Between Pure and Applied Theory

Welfare economics can be defined as "that branch of study which endeavors to formulate propositions by which we may rank, on a scale of better or worse, alternative economic situations open to society" [Mishan, 1960, p. 199]. These "propositions" can be regarded as belonging to two categories: pure theory and applied theory. Pure theory consists of propositions which describe idealized, hypothetical situations in which social choices could be ranked. Applied theory, on the other hand, consists of methods which are used in actual decision making processes. The division between the two is unclear; faced with an ever-increasing social need for logical decision making processes, economists have developed generalizations which allow the theoretical ideals to guide the applications.

This chapter will review the development of each of the two realms of welfare economics, providing a description of the major concepts of each area and their underlying assumptions. Following these two subsections, a summary section will provide an analysis of the implications of the various assumptions, in terms of the inaccuracy and uncertainty resulting from each, as they relate to the values to be compared in this thesis.

Theoretical Development

Vilfredo Pareto [1896] is generally credited with the original criterion by which the ranking of social welfare states can be accomplished; he suggested that a policy change is desirable if (and only if) at least one person is made better off while no one is made worse off as a result of the change. Under this criterion for improvement, the Pareto optimum (or equilibrium) state, in which no change could improve the existing social state, can be defined as one in which the following conditions are satisfied [Just, Hueth and Schmitz, 1982; Randall, 1981]:

1) The marginal rate of commodity substitution between any two goods is the same for all consumers, indicating efficient consumption.
2) The marginal rate of technical substitution between any two goods is the same for all producers, indicating efficient production.
3) The consumers' marginal rate of substitution between any two goods equals the producers' rate of technical substitution between those goods.
4) In order to have efficient trade, the price ratio of the two goods must equal the marginal substitution ratios.

It can be shown that if a perfect, competitive market existed, Pareto equilibrium could be attained; that is if consumers are utility maximizers, producers are profit maximizers, and both

producers and consumers act competitively, taking prices as given, a Pareto equilibrium state could also exist. In terms of economics, perfect markets require several additional conditions which are generally assumed to exist [Randall, 1981; Just, Hueth and Schmitz, 1982, Obermiller, 1984]:

1) All consumers are assumed to have diminshing marginal returns to utility for all goods.
2) All producers are assumed to have diminishing marginal returns to production for all inputs, in the profit maximizing range of production.
3) All consumers and producers are assumed to have full access to information, and to be rational and consistent.
4) Ownership of goods and products is assumed to be specified, exclusive, transferable, and enforceable.
5) It is assumed that no consumer or producer has a significant degree of control over the market.

Each Pareto optimum state is dependent upon an underlying distribution of wealth; if income distribution changes, a new optimum may be reached. States which relate to different income distributions are considered incomparable, by the Pareto criterion, as are situations in which one or more people are made worse off. Similarly, the "goodness" of suboptimal states (second best states) cannot be compared.

Obviously, these qualifications as to which situations can be ranked, and what conditions must be achieved in the Pareto equilib-

rium state, eliminate most real world applications of Pareto's criteria. Many decisions must be made which make at least one person worse off, or change the distribution of wealth. Markets are often controlled by one or a few producers, a dilemma central to the allocation of public land resources managed by federal agencies. Often, goods are transferred between consumers without benefit of a market structure regulating either quantity supplied or exchange price, again as in the instance of public land resources. Imperfect specification or enforcement of property rights may result in prices which do not fully reflect costs of production.

Theory of Second Best

A theory which describes the real-world failure of welfare economics was developed in 1957 by Lipsey and Lancaster. Randall [1981; pp. 135-136] gives several ways of stating this "theory of second-best" in general terms:

> "1) If there is introduced into a general equilibrium system a constraint that prevents the attainment of one of the conditions of Pareto efficiency, the other conditions for Pareto efficiency, although still attainable, are in general no longer desirable.
>
> 2) Given that one of the conditions for Pareto efficiency cannot be fulfilled, an optimal situation (in efficiency terms) can be achieved only by departing from all the other conditions for Pareto efficiency.
>
> 3) There is no a priori way to judge between various situations in which some of the conditions for Pareto efficiency are fulfilled while others are not. It is not necessarily true that a situation in which more, but not all of the conditions for Pareto efficiency are fulfilled will be superior to one in which fewer are fulfilled."

The theory of second-best seems to suggest that no solution to the problem of applying social welfare analysis can be found; since distortions in the competitive market system do exist, particularly in the area of public land resource allocations. Opinion on the matter differs considerably among economists, however. Mishan [1982, p. 108], for example, asserts that the economist:

> "need not be too inhibited by the second-best theorem. For no matter what the allocative condition of the economy at large, a Pareto improvement is effected if . . . . the value of the marginal product of the factor to be employed in (use) X exceeds its opportunity cost."

Davis and Whinston [1965] respond to the theory by arguing that as long as the mathematical functions defining economic interaction are separable, (meaning that the interactions of one market with other portions of the economy are finite and can be defined mathematically if they are significant), efficiency improvements can be made by applying Pareto criteria to the aspect of the economy under consideration. Fulfillment of the requirement of separable functions is virtually impossible to prove, but it provides a means which makes welfare analysis conceptually possible by allowing the economist to ignore distortions in markets not under consideration. However, even when economists allow themselves to make the assumption that the particular aspect of the economy which they wish to analyze is separable from the rest of the economy, the problems of comparing changes which affect the distribution of incomes and of determining efficient levels of production in imperfect markets remain.

The Kaldor-Hicks Criterion

The distributional problem was discussed in the literature long before the theory of second best was postulated. The Kaldor-Hicks criterion, developed in 1939, provides a means of ranking welfare states which make some people worse off and some better off [Kaldor, 1939; Hicks, 1939]. This criterion is based on the argument that if the assumption is made that all individuals have equal marginal utility of income, or if a system of weights is derived which describes a social welfare ranking, choices can be made on the grounds that if the gainers can compensate the losers, and still be better off, then the alternative represents an improvement over the status quo. Scitovsky [1941] pointed out an important corollary to the Kaldor-Hicks test: the economist must also ask whether the losers can bribe the gainers not to make the change, and still be better off than they would have been after the change. These theories are advantageous in that they greatly broaden the range of problems which can be addressed by welfare economics, but they also increase the potential distributional impacts of choices made under the expanded criteria.

Additional assumptions which enable the economist to ignore distributional consequences are often applied: the economist can either assume that "the effect of any one project on the distribution of income (may be) considered inconsequential", or that "the overall distributional effects (may be) thought to be neutral, and may therefore be disregarded", or that any adverse distributional effects can be undone without cost [Weisbrod, 1968, p. 182].

While these assumptions are very convenient, they are obviously unrealistic. Yet, without them, the economist is in a position of recommending a different distribution of income, which negates the efficiency tests, unless actual compensation is agreed upon by gainers and losers and paid.

The dilemma described above illustrates the fundamental unsolved problem of theoretical welfare economics: no consistent way to rank social choices which accounts for distributional consequences has been found. Years of research have been devoted to attempts to conceive of a theoretically plausible social welfare function, and to explanations of why it can't be done [Georgescu-Roegen, 1954; Little, 1950; Van Kooten, 1982; and others]. Arrow's impossibility theorem and the debate it inspired provide an illustration: Arrow [1951] develops a rigorous proof of the argument that given certain rules of democracy and consistency between individual and social ranking, it is impossible to reach a consistent social consensus about the meaning of social well being. Other analysts show that Arrow's paradox occurs very infrequently, or not at all when there are a large number of voters and/or alternatives [Randall, 1981; Tullock, 1959]. The important point is that this debate has centered on the possibility of existence of a social welfare function. A social welfare function which can be consistently applied to various problems has not been developed. Economists are forced to resort to assuming away the fundamental problems in order to proceed with their logical analysis of allocative choices. Mishan [1973; PP. 747-748] has summed up the pessimists' view by saying that the social welfare

function is "but a pleasing and nebulous abstraction. It cannot be translated into practical guidance for economic policy."

Theory of Applied Welfare Economics

Despite the theoretical contradictions outlined above, and given the necessary qualifying assumptions, a methodology called cost-benefit analysis has been developed which provides an estimate of the net value to society of changes in the supply of, or demand for, various commodities, particularly when the goods are exchanged in perfectly competitive markets.

Imperfect markets are dealt with in various ways, depending on the conditions and on the point of view of the analyst. In the case of public land allocation to various uses, the government attempts to allocate on the basis of competitive market values at least to some extent. This attempt is economically justified, given that the government is interested in social welfare maximization, since profit maximization on the part of a monopolist leads to a "deadweight loss" of benefits to society [Just, Hueth and Schmitz, 1982]. Oligopoly also leads to loss of social welfare, as compared to perfect competition [ibid., p. 220]. The analysis in this thesis, therefore, is confined to discussion of methods of estimating values and prices which would arise under perfect competition.

Aggregate Economic Surplus

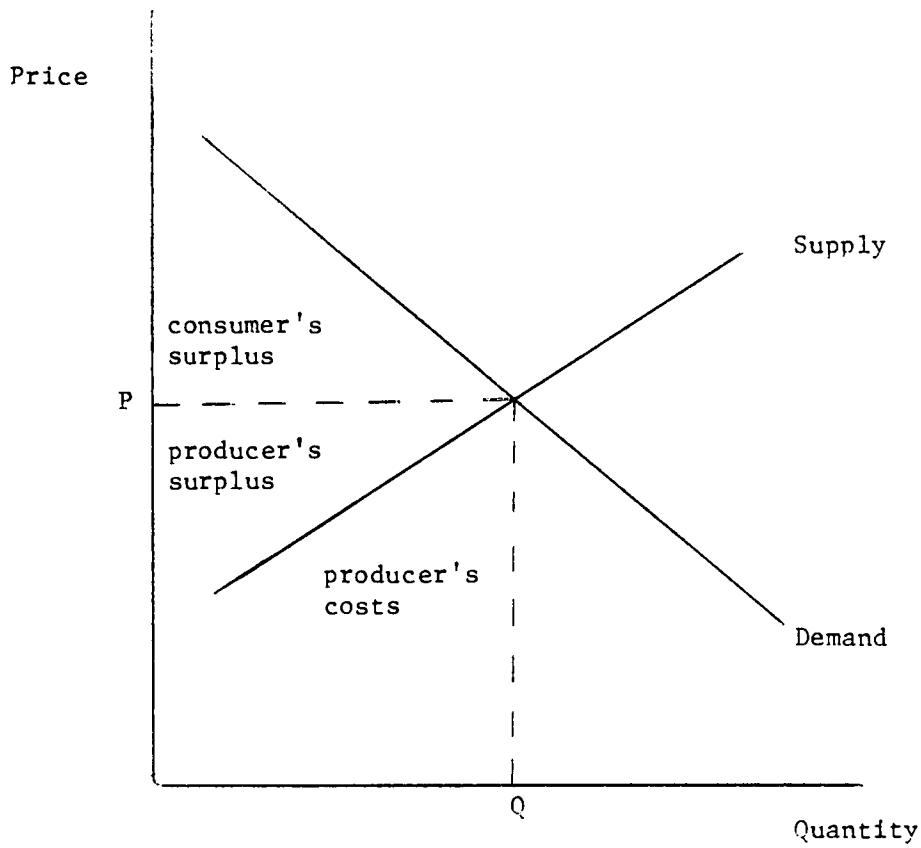
Empirical estimates of demand for a commodity describe a relationship between the commodity's price and the quantity which consumers would be willing to pay for it. The demand is specified as a function of some set of variables, including price of the good, prices of related goods, income levels of consumers, tastes and preferences, etc. The assumption of separability mentioned in a previous section is used to justify limitations of the number of variables; empirically, the statistical method chosen indicates insignificance for some variables which may have then been excluded. Given that the conditions of all factors except price of the good are assumed to remain constant during the time frame to which the analysis applies, the area under the demand curve and above the market price (Fig. 1) provides an estimate of the surplus value received by consumers; or the amount of social welfare which results because all consumers except the marginal, or last, buyer, would have been willing to pay more for the good than the amount which they did pay, the market price.

Similarly, producers also receive a surplus of value. The upward sloping supply curve, which is a function of price of the good and some (assumed constant) set of input prices, technology, number of producers, etc., describes producers' willingness to sell their product. Again, for all but the marginal producer, a positive surplus of value is realized at the given market price (Fig. 1).

The total of producers' and consumers' surplus provides a dollar

value estimate of the total benefit to society which results from production and sale of a particular commodity. Changes in net benefits received by society are estimated by computing the benefit-cost relationship (a ratio or difference) between estimates of positive and negative changes in aggregate economic surplus.

A perfectly competitive market supplies the greatest aggregate economic surplus. In general, market imperfections imply that the price level does not fall at the intersection of supply and demand. Furthermore, it is worth emphasizing that the use of dollar values in estimating changes in social welfare implicitly assumes that the current distribution of income is acceptable, and that the marginal utility of income is constant. More explicitly, if total utility is the true social welfare measure, empirical application is impossible. Only "money measurement" of welfare change is possible [Just, Hueth and Schmitz, 1982, p. 76]. Also, without the "ceteris paribus" assumption (holding all other variables constant) the estimate of consumers' surplus is not unique. With multiple price changes, for example, the net change in estimated consumers' surplus will depend on the order in which the effects of each price change are computed [ibid., p. 76]. Freeman [1979] notes that the estimated market demand curve is unique only if there is no change in the distribution of income among the individuals which make up the aggregate demand curve (unless one assumes that the income elasticity of demand for the good in question is the same for all individuals). The use of the ceteris paribus assumption in social welfare maximization may be compared to an attempt to find the maximum of a function in



P = competitive market price
Q = competitive market quantity
aggregate economic surplus = consumer's surplus + producer's surplus

Figure 1: Aggregate Economic Surplus

several variables using only one partial derivative; which is mathematically incorrect.

The general explanation of measurement of social welfare changes given above does not cover several crucial questions which must be addressed before proceeding toward empirical application of cost-benefit techniques. These include:

1) Should the value of social welfare changes be measured relative to the consumers' and producers' initial welfare position or their subsequent welfare position?
2) Should a time dimension be incorporated into the analysis? If so, what discount rate should be used?
3) How should changes in social welfare be measured if the commodity in question is not exchanged in a market?

Each of these questions has been the topic of numerous journal articles, book chapters, and students' papers.[1/] The first question may be considered a theoretical issue, although it has definite empirical implications, which will be discussed briefly in the following section. The latter issues move further into the realm of empirical questions, but the theoretical aspects of each will be discussed briefly in this chapter. Empirical measurements and problems will be taken up in Chapter IV.

1/ See [Currie, Murphy and Schmitz, 1971; Just, Hueth and Schmitz, 1982; Mishan, 1982] for further reference.

Hicks' Variations and Willig's Response

The measure of consumer's surplus described above is the one most commonly used in empirical applications. Hicks [1943, 1956] is credited with contributing a theoretical refinement of the simple consumer's surplus measure, based on distinction between the initial and final welfare position of the consumer, and subdivision of the price, or welfare gain or loss which is realized. These distinctions are described as follows [Randall, 1981; Currie, Murphy and Schmitz, 1971]:

1) "Compensating variation" is the amount of compensation, paid or received, that will leave the consumer in his initial welfare position following the change in price, if he is free to buy any quantity of the commodity at the new price.
2) "Compensating surplus" is the amount of compensation, paid or received, that will leave the consumer in his initial welfare position following the change in price, if he is constrained to buy at the new price the quantity he would have bought at that price in the absence of compensation.
3) "Equivalent variation" is the amount of compensation, paid or received, that will leave the consumer in his subsequent welfare position in the absence of the price change, if he is free to buy any quantity of the commodity at the old price.

4) "Equivalent surplus" is the amount of compensation, paid or received, that will leave him in his subsequent welfare position in the absence of the price change if he is constrained to buy at the old price the quantity he would have bought at that price in the absence of compensation.

These measures yield various estimates of willingness to pay or sell for an individual consumer. Logically, these distinctions could be extended to the aggregate case - the sum of the individuals' welfare gains or losses. However, since it is difficult to test consumers' responses under the various constraints, economists are reduced to the unsatisfactory situation of having to simply assume that the difference between these rigorous consumers' surplus measures and the simple consumers' surplus is negligible.

Willig [1976] relieves the situation somewhat by showing that where the consumers' income elasticity is within plus or minus 1.0, and the change in consumers' surplus is less than five percent of income, the compensating variation is within two percent of the measured consumers surplus. Since, with competition, all individual surplus chances will be in the same direction, Willig's proof can be applied to the aggregate case, and the empirical use of simple consumers' surplus is somewhat vindicated (Just, Hueth and Schmitz, 1982]. Martin, Tinney and Gum [1978, p. 5] commented further on this issue: they note that "it is difficult to estimate a statistical demand function to such a degree of precision that a two or three percent change in value would have real meaning".

Statistical estimates of demand do not always support the conclusion that income elasticity is near zero, however. Davis [1963] found that household income is a significant variable in willingness to pay for deer hunting. As Schuster and Jones [1983] point out, reasoning that Marshallian consumers' surplus (MCS) approximates the Hicksian variations implies that willingness-to-pay (WTP) should be fairly close to willingness-to-sell (WTS); WTS slightly over-estimates while WTP slightly under-estimates MCS. Empirical studies do not confirm this; WTS is shown to be significantly higher than WTP [ibid., p. 5; Bishop and Heberlein, 1979; Gordon and Knetch, 1979]

Discount Rate Problem

The application of economic analysis to real world problems such as analysis of alternative land allocations requires that any estimates of value be adjusted to incorporate a time dimension. Benefits and costs to be received in the future are considered less valuable than those received immediately, and this change in value over time is accounted for through the use of a discount rate as follows:

$$PV = \sum_{i=1}^{n} \frac{Vn}{(1+r)^n}$$

where: PV = present value
Vn = net benefits expected in year n
r = discount rate

The issue of what discount rate to use is quite controversial, although in practice the discount rate to be used in economic analysis of public decision choices is often determined politically. A

brief review of economists' theoretical arguments about how the discount rate used for analysis of social benefits and costs should compare to the market (private investor's) rate of discount (as indicated by market interest rates) is presented below.

Pigou [1932] and Ramsey [1928] sparked considerable debate among economists by proposing that if social decision-making follows the lead of private decision makers in applying a market determined discount rate, the level of public investment will be too low to provide adequately for future generations. Pigou argued that investment in resource conservation should be undertaken by the state even when the yield is lower than that required to attract private investment, particularly in decisions involving non-renewable resources [Krutilla and Fisher, 1975]. Opponents of Pigou's hypothesis feel that:

> "no public project should be undertaken (which) would generate a rate of return less than the rate of return experienced on the private use of funds that would be precluded by the financing of the public project...." [Howe, 1971, p. 10]

Marglin [1963] discusses the problem in more theoretical terms, distinguishing three different approaches that justify the use of a social rate of discount which is lower than the market discount rate. The first approach follows Pigou's line of reasoning; the government should authoritatively adjust its investments to account for the preference of future citizens. A second argument falls in the category labeled "schizophrenic"; consumers and citizens may be thought of as having two separate sets of preferences -- one for themselves and one for society. While they may prefer immediate consumption for themselves, they also prefer that society

provide for future generations. Marglin's third hypothesis is that individual's satisfaction may depend partially on the consumption of others, including future generations, thus indicating a separate social discount rate. Arrow and Lind [1970] contribute an additional point: risks associated with public projects, when divided among a large population of taxpayers, are felt by each taxpayer to be negligible in contrast to the sense of risk apprehended by the private investor. Therefore, the total discount rate for social projects may be lower.

Both sides of this theoretical debate have produced logical arguments for their case. Economic theory, therefore, does not provide a definitive answer to the question of whether the market discount rate should be used in analyzing public projects, or whether it is acceptable to use a lower discount rate. Obviously, no indication is given as to how much lower the rate should be, if a lower rate is decided upon. Discount rates to be used in public policy analysis are selected by the agencies in question. In recent years, range of from four to ten percent has generally been found to be acceptable.[2/]

As a final note to this discussion, it is interesting to consider briefly the implications of discounting in relation to two assumptions discussed earlier in this chapter. One of the fundamental conclusions regarding theoretical welfare economics concerns the inability to deal effectively with interpersonal utility com-

---

2/ The rates used in the 1980 and 1985 RPA Programs are discussed further in Chapter IV.

parisons, or changes in income distribution. Discounting explicitly ranks consumption of future generations lower, and serves to redistribute income to the present generation, by reflecting the present generation's preference for more immediate consumption. The second interesting point is that in applied welfare analysis, it is noted that value estimates are commonly developed from a demand curve which is based on a ceteris paribus construct; all variables except price are assumed constant. Estimation of future values from such static analysis obviously introduces inaccuracy, which is further compounded by discounting back to a net present value with a somewhat arbitrary discount rate.

Valuation of Non-Market Goods

The third problem related to application of welfare economic theory involves estimation of changes in net social benefit which result from changes in allocation of resources to commodities which are not exchanged in a market (unpriced goods). This issue is particularly relevant in the area of public land use allocation, since multiple use allocation is required by law (see next chapter), and uses such as recreation and wildlife habitat involve "goods" which are unpriced.

Although demand for and supply of unpriced goods obviously exists, direct price-quantity relationships do not. Since analysis of aggregate economic surplus requires estimates of willingness-to-pay, either a hypothetical price-quantity relationship must be developed, some proxy for price must be used, or else demand must be

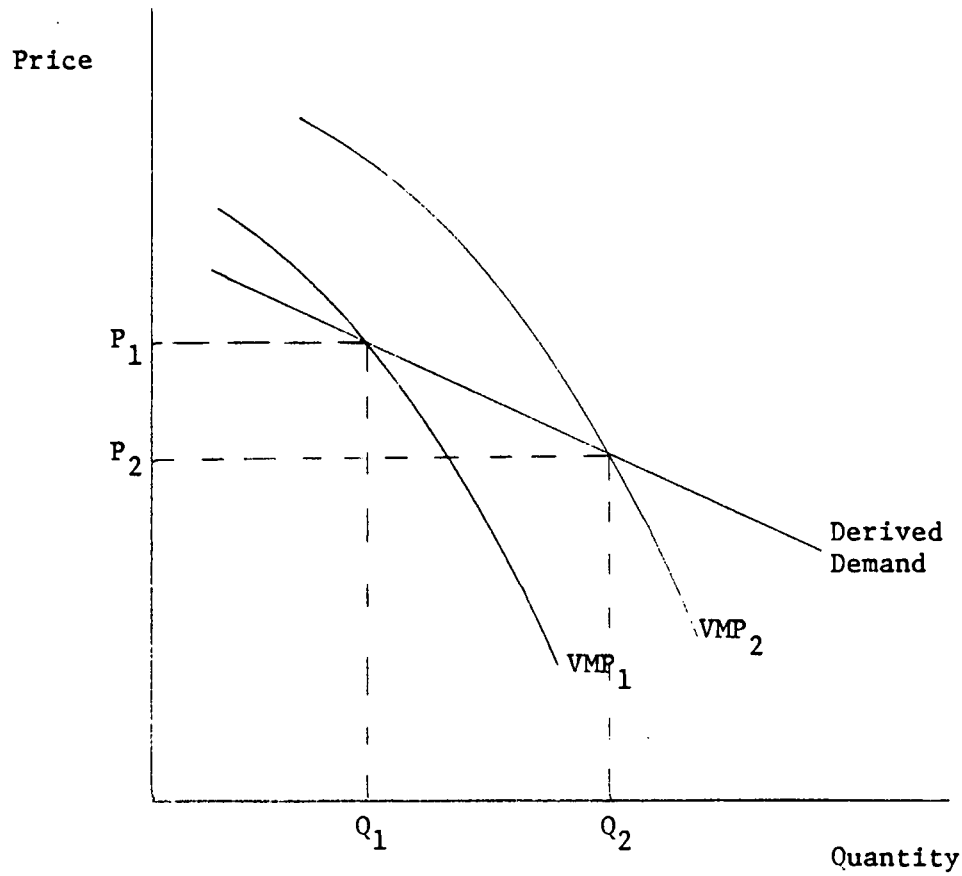
considered perfectly elastic (which implies that price is not a function of quantity). An estimate of supply is also required, and perfectly inelastic supply curve often is used to represent the actual quantity of the good which is available. For example, if the commodity in question is forage on public land, supply may be thought of as function of biological and political factors. In the short run, the biological potential is estimated and government agencies determine how much will be provided. Supply thus appears as a vertical line at some fixed quantity in price-quantity space. This fixed quantity is then allocated among uses; a set fee is charged to ranchers who wish to graze their livestock on public land, and no fee is set for wildlife or other uses of the forage. Long run supply may be affected by political decisions (allocation of more land to forage production), or by investment decisions (such as range improvements).

Estimation of demand for unpriced goods requires specification of a set of conditions of prices of other goods, tastes and preferences, etc. Just as for market goods, these conditions are assumed to remain constant for the duration of the analysis. Willingness-to-pay for the unpriced good is then estimated through surveys which determine a hypothetical price-quantity relationship by asking carefully designed questions, by using travel costs and/or other expenses as a proxy for price, or by other methods. The travel cost method and the survey method are the two most commonly used methods, and are accepted by the land management agencies for use in valuing unpriced amenities provided from public lands. These

methods and more recently developed alternative methods are described in Chapter IV.

If the unpriced good is an input in the production of a market good (as is the case for livestock forage), it is theoretically possible to estimate a derived demand curve for the input. The derived demand is equal to the value of the marginal product of the input factor if the input is the only factor of production. When there are several variable factors of production, however, the value of the marginal product (VMP) is dependent on the amounts of other inputs used. The derived demand for the input is the intersection of price levels (assuming a competitive market, which gives perfectly elastic supply of inputs at a given price) with VMP curves, as shown in Figure 2.

The need to assume a perfectly elastic input supply renders application of this method to public land grazing privileges virtually impossible, since livestock producers face an inelastic supply of publicly owned grazing. Unless a production function approach is taken in the empirical estimation of "profit", or utility derived from wildlife, the VMP method is totally inapplicable to estimation of the value of wildlife habitat as well. However, VMP can be approximated by estimating the average contribution to total revenue of public grazing. Also, linear programming models can provide a point estimate of VMP, and levels of other inputs can then be varied in the model to provide a set of point estimates. This method of estimation of VMP is also discussed further in Chapter IV.



Source: Gould and Ferguson, 1980, p. 357

Figure 2: Deriving Demand From Changes in Value of Marginal Product

Assumptions vs. Reality

Pareto's concepts provide answers to two questions which economists (and others) normally ask in the initial steps of seeking a method by which scarce resources could be efficiently allocated among members of society. An idealized model of an efficient society is described, and a criterion which defines an unquestionable improvement in current conditions is given. Society as a whole is better off if at least one person's conditions are improved and no one is made wore off by some change in resource allocation. A society in which all resources are efficiently allocated would theoretically arise if all the requirements (perfect markets, utility and profit maximizers who face diminishing marginal returns, and perfectly specified property rights) are fulfilled.

None of these conditions are completely satisfied in our society. Using the land management agencys' allocation of grazing and habitat among wildlife and livestock as a case in point it can be shown that each condition is violated in at least one way:

1) The federal government exerts market control by virture of the fact that it controls large land holdings and has the power to set prices, both in the case of wildlife habitat, which is unpriced, and in the case of grazing on public land, for which a fee is set and exchange is restricted.
2) Wildlife "consumers", hunters and recreationists, among others, may be utility maximizers, but they are certainly not fully informed about the hidden costs, such as

expenditure of federal funds, which they bear in exchange for wildlife.

3) Estimation of values for wildlife habitat involves the use of a monetary estimate of a utility which is never translated to dollar terms through profit maximization, although habitat/forage is used to "produce" wildlife.

4) Livestock producers who lease grazing land are known to have other goals, such as keeping their deeded land, which may take precedence over profit maximization [Martin and Jeffries, 1966].

5) Property rights are not perfectly specified and enforced: Some ranchers are thought to have purchased or sold rights to permitted grazing, which in fact belong to the government [Jeffries, 1964].

The theory of second-best indicates that, given these violations, theoretically correct efficiency analysis of the problem is virtually impossible. Regardless of whether or not this particular decision can be considered separately from other economic decisions, the conditions under which Pareto's efficiency conditions might apply do not exist in this "market". Furthermore, real world decisions rarely offer a choice in which no one is made worse off.

Given that Pareto's model does not provide usable criteria upon which to base allocative decisions, modification of the model or of the criteria, or both, is the next logical step. Kaldor and Hicks proposed a modified criterion which allows measurement of value

in dollars, by assuming that all individuals have equal marginal utility of income, and either disregarding distributional changes, assuming that they are negligible, or assuming that they can be dealt with in a separate analysis. The compensation criterion thus allows analysis of problems which are outside the realm of the original model, and provides an empirically applicable measure of changes in social welfare.

Revising the criteria and not the model, using assumptions which essentially allow violation of the conditions of the original model, implies that the margin of uncertainty in the final estimate of social value is considerably expanded. In fact, as Just, Hueth and Schmitz emphasize [1982, p. 76], "even though a money measure is unique, it does not necessarily follow that it measures a utility change." Allocative changes, ipso facto, change the distribution of the benefits among members of society, and efficient prices or quantities which are based on conditions before a change which affects distribution occurs may actually be invalid after the change. Furthermore, an implicit bias toward profit producing resources may result from the decision to measure utility in dollars, since not all benefits resulting from non-market goods are estimated-aesthetic value, for example, is not measured.

Cost-benefit analysis provides a method by which mathematical evaluation of allocative changes can proceed, assuming that value can be measured in dollars, and that an additional dollar has the same value for all people, and disregarding the imperfection of the market in question. If, in using this type of analysis, a "ceteris

paribus" assumption is invoked, changes in the rest of the economy are also assumed away, further expanding the disparity between the value which would ideally be measured and the estimated value. Relaxation of the ceteris paribus condition implies that the value estimate is not unique. If projected changes in gross national product (national income level), tastes, or technology are used to modify an estimate of value, the degree of uncertainty and accuracy of these predictions must also be considered. If estimated values based on the ceteris paribus assumption are assumed to continue into the future, obviously the projections are erroneous to some degree. If any future values are discounted using some politically determined choice of discount rate, further ambiguity may be introduced. The range in value due to the discount rate choice is relatively easy to quantify, however, by simply providing computations using both low and high discount rates. The other sources of error in measuring social welfare changes mentioned are difficult or impossible to quantify because they involve future, unknown changes, theoretically unanswerable problems, or unmeasurable differences between the value which ought to be measured and the estimate of that value which economists are capable of providing.

CHAPTER III

REVIEW OF LEGISLATION AND POLICY

Relationship of Law and Economic Analysis

The process of making decisions regarding the allocation of public land resources is described in Chapter I as having several aspects: economy efficiency, equity, and politics. These interrelated aspects determine how the "problem" is considered by society, and how the various partial solutions provided by user group lobbies, national economic efficiency analysis, regional economic analysis, environmental impact analysis, etc. are weighted in the final decision. The relative importance of these partial solutions has changed over time, and that change has been reflected in the legislation and policy which defines the decision making process. This chapter provides a brief review of these changes over time, particularly as they relate to the economic aspects of the problem of public land allocation. Changes in the relative emphasis on national economic efficiency, political conflicts over ownership of wildlife, the history of grazing fees, and changing philosophies on wildlife habitat provision are reviewed in this chapter, and policies concerning how value is to be measured in the RPA Program are outlined.

Legislative Background

Land Management Legislation

Public land policy can be loosely categorized into three periods based on predominant goals of government actions: disposition, reservation, and management [Dana and Fairfax, 1980]. The period during which Congress disposed of the public domain lasted approximately from 1776 until 1891. A brief period of reservation of land for specific purposes, or withdrawal of land from availability to homesteaders lasted from 1891 until 1905 [ibid., p. 10]. The Forest Reserve Act of 1891 authorized the President to establish Forest Reserves (National Forests), and subsequent legislation (the Organic Act of 1897) placed these reserves under the management of the United States Department of Agriculture's Forest Service. With the birth the of Forest Service and assertion of the federal government's rights of ownership (the right to sell timber resources from publicly owned land), the period of public land management began.

The Taylor Grazing Act of 1934 provided for management of public rangeland by the United States Department of the Interior Bureau of Land Management (BLM). The Secretary of the Interior was given the power to charge fees for permitted grazing on public rangeland. Federal agencies were instructed to explicitly favor local landowners in issuing permits for grazing. The stabilization of the "livestock industry dependent on the public range" was mentioned as a purpose of the Taylor Grazing Act. The Sustained Yield Forest

Management Act of 1944 also emphasized protection of local economic interests; the goal of the Act is to "promote the stability of forest industries, of employment, of communities, and of taxable forest wealth, through continuous supplies of timber" (Sec.1). Both Acts also implicitly recognized the rights of future generations by providing for continued supply of forage and timber.

More recent acts of Congress have neglected the former emphasis on community and industry stability, while reinforcing the protection of the rights of future generations. The Multiple Use - Sustained Yield Act of 1960 emphasizes the interest of the American people (the national perspective), and of future generations by stressing continued productivity and availability of the land for all uses; "outdoor recreation, range, timber, watershed, and wildlife and fish . . .". As defined in this Act [Sec. 4]:

> (a) "Multiple use" means: The management of all the various renewable surface resources of the national forests so that they best meet the needs of the American people; making the most judicious use of the land for some or all of these resources or related services over areas large enough to provide sufficient latitude for periodic adjustments in use to conform to changing needs and conditions; that some land will be used for less than all of the resources; and harmonious and coordinated management of the various resources, each with the other, without impairment of the productivity of the land, with consideration being given to the relative values of the various resources, and not necessarily the combination of uses that will give the greatest dollar return or the greatest unit output.
> (b) "Sustained yield of several products and services" means the achievement and maintenance in perpetuity of a high-level annual or regular periodic output of the various renewable resources of the national forests without impairment of the productivity of the land.

Clearly, the national interest in non-market products of the land is recognized, although no provision is made for estimation of the

social value of products which don't yield the "greatest dollar return". Agency policy, which is reviewed in a later section, does provide for non-market value estimates.

Passage of the Forest and Rangeland Renewable Resources Planning Act of 1974 (RPA) completed the transition in orientation from local to national interest. In Sec. 2, Congress found that:

> "to serve the national interest, the renewable resource program must be based on a comprehensive assessment of present and anticipated uses, demand for, and supply of renewable resources from the Nation's public and private forests and rangelands, through analysis of environmental and economic impacts, coordination of multiple use and sustained yield opportunities...".

Further mention is made [Sec. 2, part 6] of maintaining "a natural resource conservation posture that will meet the needs of our people in perpetuity".

The change in legislative emphasis from local and industry interests toward national interests has not gone entirely unprotested. Obermiller [1982] has pointed out that concern over the distributive consequences of the emphasis on national economic efficiency has contributed to (or caused) the "Sagebrush Rebellion", an attempt by western states to obtain control over federal land. Hyde [1976] laments the absence of regional disaggregation of goals in the RPA program.

Wildlife Management Legislation

The legal history of wildlife management is much less straightforward than that of public land management. Conflict over state

versus federal control over wildlife began in the late 1800's, and continued until 1941. Initially, state "ownership" of wildlife was established by statutory decisions made by the Supreme Court, notably Geer v. Connecticut, 1896, in which the majority opinion concluded that the states had the "right to control and regulate the common property in game" [Environmental Law Institute, 1977, p. 18]. The Lacey Act of 1900 bolstered state regulatory power over wildlife by giving strength to the enforcement of state fish and game laws, while also authorizing the Secretary of Agriculture to adopt measures to protect wild game birds, subject to state laws. In 1906, the federal government asserted its power to prohibit hunting on federal wildlife refuges [Act of June 28, 1906]. In 1934, the Forest Service issued a regulation by which it attempted to retain authority to regulate hunting and fishing seasons and bag limits, but this was replaced in 1941 with a regulation calling for cooperative agreements between the Forest Service and the states, under which state law would govern the taking of all game [Environmental Law Institute, 1977].[3/] This regulation is still in effect, and the state's Departments of Fish and Wildlife issue hunting and fishing licenses, and regulate length of season and bag limits, thereby controlling game populations, while the BLM and the Forest Service

---

3/ Conflicts between federal and state wildlife management still flare periodically. For example, the wild Horses and Burros Protection Act was passed in 1971 to protect unbranded and unclaimed horses and burros, and was struck down in 1975 on the basis that the federal government's rights extended only to protecting the land from damage, and not to protecting animals, other than endangered species.

manage the land resources, providing habitat for wildlife under the principles of the Multiple Use - Sustained Yield Act. Thus the federal agencies collect no return for their "production" of wildlife.

Policy Review

History of Grazing Fee Policy

The first fees for grazing of livestock on federal land were implemented by the Forest Service in 1906, and ranged from $0.20 to $0.35 per head of cattle per grazing season, or from $0.35 to $0.50 per head per year [Berglund and Amdues, 1977]. The current Forest Service (and BLM) fee rate is $1.37. Early Forest Service fee rates were based on comparison to private rental values. In 1933, the Secretary of Agriculture directed that the fee per head per month be adjusted for fluctuations in livestock prices [ibid., p. 2-27].

No fees were charged for grazing on public lands administered by the BLM until 1936. At that time, the predecessor of the BLM, the Grazing Service, set a fee of $0.05 per animal unit month (AUM). In 1946, the Grazing Service merged with the General Land Office to form the Bureau of Land Management, and in 1947 the grazing fee was raised to $0.08/AUM. From 1951-1957 the fee was based on "costs of administration". In 1958, a new formula was introduced which set the fee at an average of the previous years' prices per pound of beef and lamb. The per animal unit month (AUM) fee was raised to 150 percent of the average beef and lamb price in 1963. In 1968 this practice was discontinued, and the "fair market value" (FMV) idea was

adopted.

Initially, the FMV base fee was set at $1.23 per AUM, and the increase in fees to FMV was to be phased in over a period of ten years. This phase in only lasted one year, however; in 1970 a moratorium on fee increases was put into effect pending recommendations of the Public Land Law Review Commission. Between 1971 and 1975, various adjustments were made to the $0.51 base-year (before FMV) fee, but the phase in to FMV was essentially abandoned. In 1975, revised annual increments were calculated, and an additional increment of $0.71 to maintain comparability with private land grazing lease rates was added [ibid., pp. 2-1-2-32]. The current fee formula, as statutorily enacted by the Public Rangelands Improvement Act of 1978, is as follows:

$$FMV = \$1.23 \times \frac{FVI + (BCPI - PPI)}{100}$$

Where:
FMV = "Fair Market Value" per AUM
$1.23 = The difference in costs of operating on Federal vs. private grazing lands, as estimated in 1966.
FVI = Forage Value Index representing the previous year's average monthly rate for pasturing cattle, in dollars per AUM 1964-1968=100.
BCPI = Beef Cattle Price Index; prior year's market price, 1964-1968=100.
PPI = Prices Paid Index; current year's average index of prices paid for various production items, 1964-1968=100.

Obermiller [1984] points out that it is important to note the legal definitions of "to whom should the grazing fee be fair?". Although the Taylor Grazing Act only required that a reasonable fee be charged, a later amendment to the Act, the "Barrett Amendment"

of 1947 extended welfare concerns to the public land dependent communities. The Federal Land Policy and Management Act of 1976 explicitly stated that the United States should receive fair market value for the use of the public lands and their resources, and that the fee charged for grazing should be equitable to both the United states and to the holders of grazing permits. Obermiller comments that while guidance is given as to what constitutes fairness to the permittee, "much less guidance is provided in defining what is fair to the United States." Concern for fairness to public land dependent communities is implicitly recognized in the distribution of the fees received for grazing; a large proportion of fees collected by the Forest Service and the BLM are returned to the local area in the form of road and school subsidies or investments in range improvements. Proceeds from grazing fees are distributed among the federal treasury, rangeland maintenance and improvement funds, and county roads and schools funds as follows: for the Forest Service, 25%, 50%, and 25%, respectively, and for the BLM, 37.5%, 50%, and 12.5% respectively [Radtke and Brokken, 1984, p. 6].

Although fees charged for grazing are based on the "fair market value" of public land, the public land management agencies do not use the fee rate in estimating the benefits received from public land allocated to livestock grazing. Methods of estimating the costs and benefits of alternative allocations of public land are specified by agency policy. In some cases, the methods specified are somewhat inconsistent with economic theory. Concepts and methods specified for the Forest Service's RPA Programs are outlined in the following

sections. The discussion is devoted primarily to the two land use values selected for review in this paper.

Theoretical Inconsistencies of RPA Program Values

The 1985 Draft RPA Program description of valuation concepts acknowledges that:

> "consumers' willingness to pay for a resource is the conceptual basis for valuing benefits, which consist of expenditures or market price times quantity of output, plus consumers' surplus. The use of willingness-to-pay as the value of total gross benefit to society is well established in the literature." [ibid., p. F-2]

Net benefits to society, under this definition, are estimated by aggregate economic surplus, as described in Chapter III. For goods which are produced (or provided) by the government, such as livestock forage and wildlife habitat on public lands, the market supply curve could theoretically be described by the marginal costs of providing various quantities of these goods. Producer's surplus would then be estimated by calculating the area below the price line and to the left of the supply line, above fixed costs (Refer to Figure 2). Net benefit, therefore, can be estimated as total gross benefits, as defined above, less total costs (Figure 3).

Having given due recognition to the theoretically correct benefit estimator, the RPA documentation notes that:

> "Consumers' surplus is not included in the Forest Service value estimates because in most cases it is very difficult to estimate the total demand curve; and because the assumption of a horizontal (or nearly so) demand curve for most resources means consumers' surplus is slight or does not exist at all. Therefore,

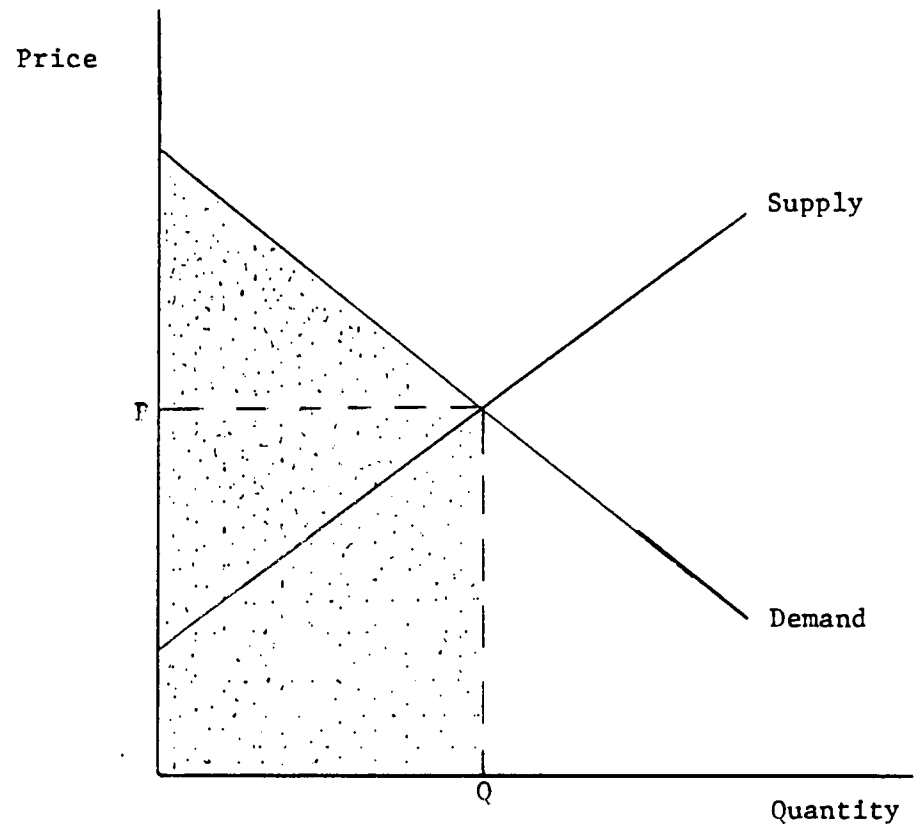
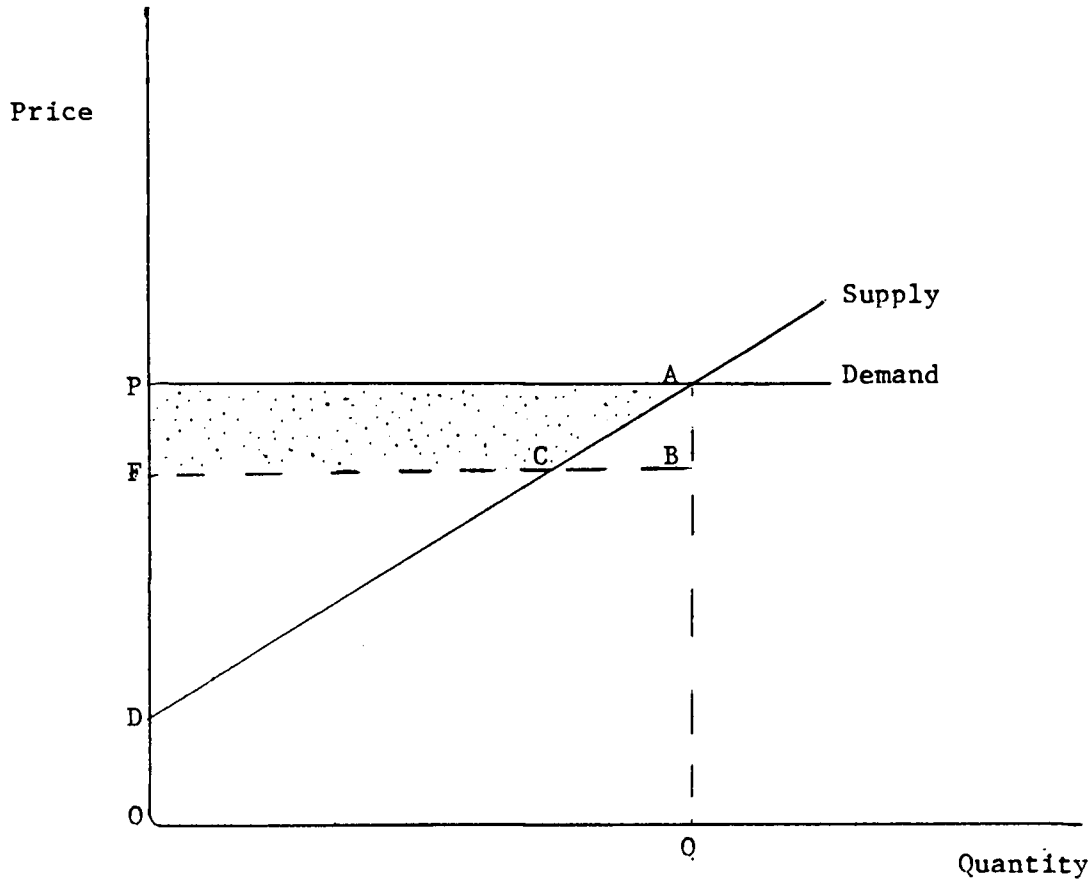


Figure 3: Total Willingness-To-Pay



P = Estimated value of marginal product, which is assumed to represent a nearly horizontal regional demand curve.

F = Fee level (assuming actual fee falls below the estimated competitive market price or value of marginal product).

▨ = Consumers' benefit.

Figure 4: Draft 1985 RPA Program Definition of Consumers' Benefit

> the value of marginal product is used for program values rather than total willingness to pay. The difference between the market price or estimated market price of an output and the actual fee that is being collected for the output is defined as consumer benefit." [USDA Forest Service, 1984; p. F-3]

The reference to the assumption of horizontal demand curves is explained in a footnote, which cites a study by Dwyer, Kelly and Bowes, [1977]. This description is shown graphically in Figure 4. Comparison of Figures 3 and 4 indicates that if, contrary to assumption, a downward sloping demand curve exists, the error in estimating benefits to consumers may be large.

The authors state that:

> "market value is an acceptable measure of contribution to national economic development provided the demand curve can be considered nearly horizontal and the market price correctly measures value in exchange." [p. 173]

Factors limiting the usefulness of market price as a measure of value were noted; these include: "monopoly and monopsony elements, subsidies, externalities, unacceptable distribution of income, price controls, and other government regulation." Also, it is noted that in assuming the market demand schedule to be horizontal, it must be assumed that changes in output of the good in question will be small enough not to affect price in the relevant region. This assumption is noted in the 1985 Draft RPA Program, and simulated market price (including fee) is used as a value estimator for both range use (livestock grazing) and wildlife related uses, including big game hunting on public lands. In the case of wildlife use valuation, value is expressed in terms of dollars per wildlife and fish user

days (WFUD's). The relationship between wildlife or fish numbers and user days is not described in the RPA Program documentation. The assumption that no regional price changes result from the allocative changes proposed in the RPA implies that the changes in AUM's or WFUD's will be small relative to total regional supply. No research demonstrating the accuracy (or lack thereof) of this assumption is presented.

Costs vs. Producers' Surplus

Although producers' surplus is not specifically mentioned in connection with RPA estimates of value, the inclusion of fees charged for grazing or recreation use of land in the value estimates somewhat compenstates for this omission. Reference to Figure 4 shows that the area FBQO (gross fee revenue) includes producers surplus. Subtraction of costs, area DAO, leaves an estimate of any existing producers' surplus. Of course, if area ABC is greater than area FCD, producers' surplus does not exist. The federal government does not attempt to profit from various land allocations, or even to cover costs in many cases, so producers' surplus may in fact be nonexistent. The costs to society of various land allocations take the form of expenditures by the federal government, since taxpayers fund the government.

Additional potential uncertainty in net value estimates is introduced by the fact that complementarity or competition among uses apparently is not addressed, although management alternatives which

show a high rate of a particular use, such as livestock grazing, normally show lower use levels for competing uses. Biologists indicate that livestock and game may complement each other over certain ranges, while competing at more intensive use levels [Thomas, 1982].

Costs which must be deducted to give net benefit (or cost) estimates for alternative land allocations are divided into several categories in the RPA Program: direct costs, resource coordination costs, and support costs. Investment and operation and maintenance are referred to as "activities", and each of these activities has associated costs in each category [Appendix F, 1985-2030 Draft RPA Program]. Presumably the costs are partitioned appropriately among the associated benefits (i.e. costs associated with livestock grazing administration are separated and assigned properly).

Dwyer, Kelly and Bowes [1977], among others, argue that the correct cost figure to use in benefit-cost analysis of alternative land allocations is the opportunity cost; i.e. the benefits foregone as a result of selecting the land use in question. In the RPA Program analysis, however, various alternative allocations are being compared using present net value (discounted benefit-cost) analysis. Inclusion of opportunity costs, in this case, would involve including the highest alternative benefit estimate as a cost, or replacing the actual cost estimates with opportunity cost. It seems more reasonable for the government to continue the practice of implicitly considering opportunity cost by comparing alternatives, while using actual, measurable cost estimates in the computation of benefit-cost relationships.

Grazing Value Policy

A "hay price formula" was chosen as the method of estimating grazing values for the 1980 RPA Program. This method is reviewed further in Chapter IV, but it should be noted that, as with the selection of the method used to estimate wildlife use values for the 1980 RPA Program, consistency with economic theory and concern for accuracy apparently played little part in the policy decision. The primary justification given for selecting the hay price formula method of estimation over other, more theoretically accurate methods is ease of computation. The decision to switch to a more theoretically justifiable method which uses a linear programming model of ranch budgets to estimate grazing values indicates a recent trend toward more reliance on economic analysis.

There appears to be some inconsistency between grazing value estimates and wildlife value estimates. Grazing value estimates are defined to include the Forest Service grazing fee [USDA Forest Service, 1984]. Wildlife use values computed by Loomis and Sorg [1983], and adjusted for the 1985 RPA Program values do not include recreational user's fees. It is unclear whether this would affect the big game hunting values, however, since the federal government does not receive fees charged for hunting. Trips for the primary purpose of hunting may have included stays at Forest Service campgrounds, which do charge fees.

Wildlife and Fish Recreation Use Value Policy

Until the development of the 1980 RPA Program, value was assigned to unpriced uses of public land by means of the "interim unit day value" (UDV) approach. Most federal agencies based their procedures on the "Principles and Standards" published by the United States Water Resources Council [1973, 1979], and on the forerunner to the Principles and Standards, Senate Document 97, Supplement No. 1 [1964]. According to the Principals and Standards, the unit day value approach is designed to serve "in the interim, while recreation methodology is being further developed. . .". The method represents a policy decision regarding values, rather than an application of economic analysis. Values for use in management planning are selected from ranges of acceptable values, which are specified for two categories; general and specialized recreation uses. Big game hunting is considered specialized recreation, which is defined as:

> "A recreation day involving primarily those activities for which opportunities in general are limited, intensity of use is low, and which may also involve a large personal expense by the user. Included are activities less often associated with water projects, such as big game hunting and salmon fishing." [United States Water Resources Council, 1973; Dwyer, Kelly and Bowes, 1977, p. 22]

Selection of values within a given range is essentially a judgement call on the part of the analyst, although some agencies (including the Forest Service) provide point systems which evaluate such factors as the quality of the aesthetic experience, the existence of alternative recreation opportunities, and the degree of development of the

facilities [ibid., p. 30]. Value estimates for big game use developed using the unit day value method (as presented in a study of proposed 1980 RPA values) are described in more detail in Chapter IV.

A later version of the Principles and Standards [1979] indicates that methods which estimate users' willingness-to-pay for the land use in question are preferable to the earlier "interim" approach. Two methods of estimation are listed in addition to the unit-day value method: the travel cost method (TCM) and the survey or contingent valuation method (CVM). The TCM is the preferred choice. The 1980 RPA Program uses the unit day value approach, while the 1985 Program uses TCM and CVM to develop estimates of recreation values. These methods are described in Chapter IV, and the 1980 and 1985 values for big game hunting are listed. Other non-commercial categories of wildlife and fish related recreation uses which are evaluated in the RPA Programs but not reviewed in this thesis include: nongame use, anadromous fish use, resident fish use, and other game use. The 1985 Program also lists two quality categories of general wildlife and fish use; standard and less than standard.

Several relevant inconsistencies appear in the 1985 Draft RPA Program wildlife value policy decisions. Value estimates provided by Loomis and Sorg [1983] are adjusted downward to give the 1985 RPA values because:

> "-The travel cost method represents a total willingness-to-pay. Other resource values in the RPA evaluation represent market price or value of the marginal product. Consequently, the willingness-to-pay values were adjusted in an effort to make the recreation values more compatible with values used for other resource outputs.

> -The travel cost method estimates values on a site-by-site basis. The method does not address the question of whether regionally or nationally a given quantity of RVD's will, in fact, be consumed if that price were changed.
>
> -It is believed that travel cost studies are typically done at higher quality sites, do not take into account substitutes to individual sites, and do not accurately measure trip length; consequently, values from these studies may be on the high side when applied to average situations on a region-wide basis." [USDA Forest Service, 1984, pp. F-11 - F-12]

The policy adopted in response to the first two concerns is described as follows:

> "It is estimated that nationally, roughly a 5 percent increase in price will result in a 1 percent decrease in quantity demanded. It is also estimated that in 1982 the Forest Service provided 7.5 percent of all outdoor recreation. Consequently, it is roughly estimated that there will be a 5 percent decrease in price for each percent of the 7.5 percent Forest Service market share or a total decrease in price of 37.5 percent for clearing the market. The values in Table F.4 were reduced by 37.5 percent to obtain the value used for a standard RVD." [ibid., p. F-12] (Table F.4 contains Loomis and Sorg's RVD value estimates)

The standard and less than standard quality levels mentioned above were introduced in response to the concern about travel cost models bring biased toward higher quality sites or not accounting for substitutes. Loomis and Sorg [1983, p. 2] explicitly note that:

> "Since a majority of the empirical studies estimated the net value of a certain recreation activity at a specific site given or adjusting for the availability of existing or substitute sites, the values reported represent marginal values for an additional recreation site, herd unit, stream, or wilderness area."

The 37 percent downward adjustment of the RPA values thus appears to overcompensate, since several of the reasons for the adjustment

(as quoted above) do not exist: Loomis and Sorg's values already represent marginal values, already include existing sites (presumably Forest Service recreation sites as well), and already account for substitute sites. Also, Loomis and Sorg's review devotes a great deal of attention to adjustment of study values for neglected variables and other errors. Presumably, if trip lengths were measured inaccurately in individual studies they would have corrected for it. Adjustment for this inaccuracy by an RPA program panel after Loomis and Sorg's work was completed seems unjustified.

The TCM and CVM values listed by Loomis and Sorg (after adjustments), and the 1985 Draft RPA values are given in Table 4, Chapter IV of this thesis. The UDV value estimates from a 1980 Draft report, and the final 1980 RPA value estimates are also given, and are updated to 1982 values for comparative analysis. Further description of the alternative empirical methods of estimating wildlife use and grazing values is also given in Chapter IV. The remainder of this chapter is devoted to a discussion of the implications of relevant legislation and policy.

Implications of Legislation and Policy

Brief review of major legislative acts serves to illustrate several points which are relevant to economic analysis. The Multiple Use-Sustained Yield Act clearly indicates that distinction between value and dollar returns should be made. Efficient allocation in the true sense - maximization of utility rather than dollar value, is the implied goal. This goal is constrained by the legislative re-

quirement that no product or service provided by public lands may be completely eliminated, regardless of whether an efficient solution (should one be found) calls for such action. The Resources Planning Act implies that environmental impact assessment and coordination of future and present multiple use opportunities, as well as economic analysis are important to the national interest. Distributive consequences of allocative changes are also recognized as an important factor, although the "national interest" takes precedence.

The political restrictions on the final decisions concerning resource allocations in a sense serve to mitigate the effects of decision making based on dollar value maximization as opposed to the unattainable ideal, utility maximization. Environmental impacts may have little or no effect on dollar values, although presumably they result in gains or losses of social welfare. The effects of changes in income distribution, while disregarded in efficiency analysis, must also be accounted for and considered in the political process.

The fact that actual wildlife numbers and bag limits are controlled by the states, rather than the federal government, is particularly relevant to the issue under consideration in this thesis. Economic analysis of social benefits resulting from wildlife use on federal lands should recognize the cooperative relationship between state and federal government with regard to provision of wildlife, which is the consumption good valued by consumers. A relationship between habitat and/or forage provision, animal numbers, and number of hunter-recreationists may be assumed, but it should, in the interest of accuracy, be recognized as an assumption since

the federal government does not exert direct control over the relationship. This discrepancy between the goods which are provided by the government; wildlife habitat/forage and hunter's access to the land and wildlife is not accounted for in currect policy and legislation, or in economic analysis of the allocative choices.

Inconsistency with economic theory is revealed in the review of policy decisions concerning what values are to be estimated and what methods are to be used in developing the estimates. Changes in consumer's surplus are not estimated. This implies that contrary to legislation and to economic theory, the estimates presented in the RPA Programs are not theoretically accurate estimates of social benefit, unless regional demand curves are horizontal over the relevant range of quantity, or unless changes in output are small enough that price is not affected. This policy is justified on the basis of empirical difficulty in estimating demand curves which implies an acknowledgement of the functional inability of economic analysis to supply unambiguous estimates of changes in social benfits. Estimates of aggregate economic surplus require estimates of aggregate demand and supply. If these estimates cannot be provided, then economists are incapable of applying their theory.

Further acknowledgement of the inability of economic analysis to provide value estimates is indicated by the policy of using relatively arbitrary formulas to estimate values for the 1980 RPA Program, and by the incorrect adjustments made to 1985 wildlife use values. The use of judgement calls to adjust general estimates of value provided by economic analysis presumably reflects the opinion

of RPA Program policy-makers regarding the correct use of economic analysis - establishment of an overall range rather than estimation of exact values.

CHAPTER IV

VALUE ESTIMATES

In Chapter II, the general method of benefit valuation used in the RPA process was described; simulated market prices are used in developing estimates of the value to society of alternative land allocation. While this choice of valuation method can be justified on the basis of certain assumptions, other methods, (and assumptions) may give different (and possibly more theoretically correct) estimates of the benefits to society resulting from certain resource allocations.

In this chapter, some of the alternative methods of estimating values for each of the two selected land uses, livestock grazing and big game use are briefly reviewed. The actual and proposed value estimates computed for the Draft and Final 1980 RPA Program, and for the 1985 Draft RPA Program provision are described, in an effort to illustrate the sensitivity of the estimates to the method chosen in developing them. As noted in Chapter I, the various alternative management plans presented in the RPA Program are not discussed. Also, relatively little emphasis is placed on the estimates of the costs of providing grazing and wildlife (game) habitat/forage, and hunting access since these costs are estimated from government accounting records, rather than by application of economic theory. Presumably there are alternative methods of accounting for these costs which might yield different cost estimates (as is the case for the benefit value estimates), but since the policy decision to

use accounting costs has to some extent removed the issue from the realm of economic analysis, it is considered to be beyond the scope of this thesis, which emphasizes alternative empirical applications of economic theory in the following sections.

Alternative Methods of Estimating Range Forage Values

In a draft paper for the 1980 RPA Program, Bartlett and Ralphs [1978] addressed the topic of method selection for grazing valuation. Four methods using various estimator values were described:

1) Market price of alternative forage sources (hay price method)
2) Price paid by users of similar private forage sources (private rental rate method)
3) Change in net income of users with and without federal grazing (derived demand or value of marginal product method)
4) Value of grazing permit (ranch value method)

A fifth valuation method, which is used in the 1985 Draft RPA program, is the ranch budget, or "income approach". This method describes the value of forage to the user as estimated from linear programming models incorporating ranch budgets [USDA Forest Service, 1984].

Each of the above methods has advantages and disadvantages, and all but the fourth method have been applied to most of the National Forest Regions listed in the RPA Program. [Bartlett and Ralphs, 1978; USDA Forest Service, 1980] The regional value

estimates given by the other four methods are listed in Table 1, and these are updated to 1982 dollars, using a GNP implicit price deflator index, in Table 2. The advantages and disadvantages of each method are briefly outlined below.

Hay Price Method

The hay price method is used in the 1980 RPA Program. Advantages of the method are listed: it is simple to calculate, the market for hay is well established throughout the United States, normalized hay prices are calculated by state each year for use by the Water Resources Council (i.e. a consistent data set is readily available), and the method provides consistent results [USDA Forest Service, 1979, Appendex C]. Bartlett and Ralphs [1978, p. 40] recommend against the use of this method because "alternative forage sources such as hay, supplements and pasture have little similarity to the grazing offered by the Forest Service". They also note that ranches which use these other forage sources "have little in common with a range livestock operation". Index formulas have a further disadvantage when compared to statistical value estimates -- no standard erros can be calculated.

The hay price formula used in the 1980 RPA program included an adjustment factor which relates the quality of the range pasture to the feed quality of hay, as follows:

Formula = Weight x Hay Price x Factor = Rate

Weight = average animal weight (assumed to be 1000 lb.)

Hay Price = average price per ton of hay (normalized 1978 price by state)
Factor = Quality factor of pasture
Lush, green high protein pasture. . . . 0.22
Excellent tall grass pasture. 0.20
Fair to good native pasture, predominantly shortgrass. 0.15
Poor short grasses or considerable weed growth. 0.12
Rate = Total value of grazing per animal per month

The formula provides an estimate of the market value of grazing.

The 1980 RPA Program also lists indexes which describe the projected rise in real values of grazed roughage for ten year periods from 1978-2025. The projected real grazing values for 1985 (adjusted to 1982 dollars) are listed in Table 2.

Private Rental Rate Method

The prices paid by users of similar private forage sources, (private rental rate method) has several advantages; regional price averages can be developed, similar range quality rental rates can be selected, and the private forage market has more (but not all) the characteristics of a competitive market. This method estimates market value for grazing, rather than total WTP. Disadvantages arise if the pasture quality and/or the services provided with private land rental differ from those provided with public range use.

Annual estimates of average private grazing lease rates are provided by the Statistical Reporting Service. The 1979 values are listed in Table 1, and the 1982 values are listed in Table 2. Since state averages are provided, a range of values over states within

the Forest Service regions is given. Bartlett and Ralphs [1978, P. 40] note a lack of general acceptance of private rental values as estimates of the value of public grazing, because no quantity or quality variables for federal grazing have been developed, "non-fee costs of using federal range (are) assumed to increase at a constant rate", and "the fair market value of private grazing may not have been estimated correctly."

Value of Marginal Product Method

The value of marginal product method of estimating demand, or willingness-to-pay, for public land grazing privileges was favored by Bartlett and Ralphs in their 1978 paper. However, as noted in Chapter II of this thesis, development of a derived demand curve estimate from this method is extremely data intensive. Bartlett and Ralphs advocated the use of the difference between one level of VMP and the corresponding marginal cost (non-fee costs of using public range) as an estimator for total WTP. Although this estimator would be biased if other variable inputs are held constant, it does provide an estimate of consumers' surplus, which simple market price estimates do not. Also, this method provides a variation in value depending on the quantity of grazing supplied, which is consistent with economic theory, but may be inconsistent with the assumption of horizontal regional demand curves. Bartlett and Ralphs listed gross benefit, or total WTP, and competitive market estimates of grazing values using estimates of VMP, for each alternative level proposed in the 1980 RPA Program. (They also listed but did not

recommend an estimate of consumers' surplus, which is not reproduced here). The range of these values for each region is shown in Table 1, and adjusted for 1982 dollars in Table 2. The targeted range of AUM supply for each region is given in a footnote.

It is important to note that Bartlett and Ralphs did not conduct surveys to develop their VMP "derived demand" schedules; they adjusted the values estimated in fifteen studies done by various authors, who used various methods which were not described in detail, but included linear programming methods and permit value estimates. Where more than one study was done in a region, values were pooled. All studies were adjusted to 1978 values using an index of prices received by farmers for meat animals. The studies included Qualey and Leistritz, 1976; Lewis and Taylor, 1977; Olson and Jackson, 1976; Stevens and Godfrey, 1972; Pearson, 1971; Pearson and Whitaker, 1973; Anderson and Hipp, 1971. The inconsistency in methodology and time periods among these studies implies that Bartlett and Ralphs' values may suffer from serious inaccuracies. They are listed here for the sake of comparison, although one could easily argue that they do not technically represent an example of the application of the VMP method of deriving demand estimates.

Value of Grazing Permit Method

The estimation of the sale value of federal grazing permits requires information on the sale value of ranches which have grazing permits and comparable ranches which do not have permits associated with the sale. Many variables determine the sale value of a ranch;

pasture quality, number and age of buildings, proximity to a population center, distance between pastures, water developments, number and type of animals sold with the property, etc. The large number of other possible variables and the lack of data due to relatively small numbers of ranch sales in any given region and time period are obvious disadvantages of this method. Also, the method provides an estimate of the marginal capitalized value of a permit, not an annual per-AUM value. Thus further computation is needed to arrive at the desired estimate of annual per-AUM value, and further error or bias may be introduced by the choice of discount rate.

Martin and Jeffries [1966, p. 237] used multiple regression analysis to develop equations which describe ranch sale prices as a function of several variables, as follows:

$$P = f(D,F,B,S,A,t)$$

where:

P is the total sale price of a ranch in dollars,
D is the amount of deeded land in acres,
F is the number of forest permits in animal units,
B is the number of BLM permits in animal units,
S is the number of state permits in animal units,
A is the number of breeding animals, one and two-year-old steers, and stocker heifers sold with the ranch, and
t is the year in which the ranch was sold.

Other variables, including cattle prices, value of improvements, population-distance indices, frontage of deeded land, and ranch elevation were tested and found to be nonsignificant. Capitalized values of $22.98 per AUM for Forest Service permits, $12.90 per AUM for BLM permits, and $25.20 per AUM for state permits were estimated (these are average values in Arizona for the time period 1957-1963).

In a more recent study of New Mexico ranch sales, Fowler and Gray [1980] estimated an average 1979 capitalized value of $82.08/AUM for Forest Service permits, and $71.42/AUM for BLM grazing permits. Using a consumer price index given by Fowler and Gray to update Martin and Jeffries' values to 1979 yields values for comparison: $40.67/AUM and $22.83/AUM for Forest Service and BLM permits, respectively. Fowler and Gray found that overall ranch condition, current value of improvements on ranches, and location of public lands on ranches were the most significant variables affecting appraisal values of grazing permits.

Since these estimates all represent capitalized values, and since estimates are not available for any Forest Service Regions, these values are not included in the comparisons of value estimates given in Tables 1 and 2.

Ranch Budget (Linear Programming) Method

The ranch budget approach to estimating grazing permit value is somewhat comparable to the derived demand or VMP methods. Linear programming provides an estimate of a "shadow price", or mariginal value of the last unit of a given input obtained through maximization of the objective function (usually a profit function) of the linear programming (LP) model. Since LP models maximize the objective function subject to a system of equations which set limits on the amounts of other inputs used in production, using a shadow price for a value estimate implicitly assumes that the average rancher has used a certain, optimum combination of other inputs to satisy a

specific objective. A derived demand curve can be estimated by varying the constraints.

The distinction between VMP and shadow price is that shadow prices are dependent on the quantity of output and on the constrained availability of all other resources, whereas VMP describes the increase in profit (marginal value) as a function of quantity of a given input, ceteris paribus.

The 1985 Draft RPA Program uses shadow price estimates derived from a linear programming model developed by the United States Department of Agriculture's Economic Research Service. Apparently derived demand curves are not estimated. The shadow price estimate is cited as an "estimate of maximum potential market value; i.e., economic value to the permitee under current conditions" [USDA Forest Service, 1984, P. F-14]. Forage values given represent average regional values; each regional average was computed by "multiplying the AUM's of permited use for each National Forest by its forage value, and dividing by the regional total AUMs" [ibid., p. F-14]. These regional average values are listed in Table 2.

The linear programming technique has the advantages of being easier and less expensive to use than other methods, once the ranch budget model is constructed. It allows the researcher more latitude in testing various prices and conditions. An estimate of willingness-to-pay that is at least as theoretically justifiable as the VMP method could potentially be developed, if resolution of the conflict between policy and theory were desired.

Table 1: Livestock Grazing Values in 1978 ($/AUM)

Methods \ Regions[a]	1	2	3	4	5	6	8	9	10
Hay Price Formula[a]	5.57	5.88	5.51	4.96	6.00	5.90	3.76	4.41	3.00
Private Rental Rate[b]	5.56- 7.79	7.26- 10.23	3.42- 5.94	4.10- 6.43	8.07	6.64- 6.67	4.27- 5.67		
VMP Method[d]	5.39- 6.13	4.76- 6.30	4.60- 5.40	5.98- 7.02	5.09- 7.33	4.54- 5.41	0- 5.63	5.20- 6.00	
Competitive Market Value[e/f]	3.10- 4.50	2.42- 3.80	2.20- 3.72	2.68- 4.75	2.64- 4.26	2.00- 3.73	0- 3.95	2.80- 4.29	

[a] There is no Region 7.

[b] Source: USDA Forest Service, 1980, p. c-3. These are the values used in the 1980 RPA Program.

[c] Source: Statistical Reporting Service, USDA. Source lists values by state; range of values over states in Forest Service region is given. No values are given for regions 9 and 10. Values are not given for all states in all regions.

[d] Source: Bartlett and Ralphs, 1978. Source lists values for RPA Alternatives; range over alternatives is given. No value is given for region 10. These values are not actually derived by the VMP methods; they estimate VMP from studies which use various methods.

[e] Source: Bartlett and Ralphs, 1978. Source lists values for RPA Alternatives; range over alternatives is given. No value is given for region 10.

[f] The targeted range of AUM's to be supplied under the various alternatives for each region is as follows (Bartlett and Ralphs, 1978, p. 47):

Regions:	1	2	3	4	5	6	8	9	10
Millions of AUM's	1.35- 2.10	2.50- 3.63	2.87- 4.17	2.26- 3.29	.54- .78	.82- 1.19	.60- .88	.07- .10	0 0

Table 2: Livestock Grazing Values in 1982 ($/AUM)

Methods \ Regions	1	2	3	4	5	6	8	9	10	Range Across Regions
Hay Price Formula	7.49	7.91	7.41	6.67	8.07	7.94	5.06	5.93	4.04	4.04-8.07
Private Rental Rate[b/]	7.48-10.48	9.76-13.76	4.60-7.99	5.51-8.65	10.85	8.93-8.97	5.74-7.63			4.60-10.85 7.63-13.76
VMP Method	7.23-8.24	6.40-8.47	6.19-7.26	8.04-9.44	6.85-9.86	6.11-7.28	0.00-7.57	6.99-8.07		0-8.04 7.26-9.86
Competitive Market Value	4.17-6.05	3.25-5.11	2.96-5.00	3.60-6.39	3.55-5.73	2.69-5.02	0.00-3.95	3.77-5.77		0-4.17 3.95-6.39
Linear Programming Method[c/]	11.15	10.50	8.74	11.00	10.40	10.50	6.10	6.00		6.00-11.15
1980 RPA Program Projected for 1982[d/]	7.79	8.23	7.71	6.94	8.39	8.25	5.26	6.17	4.12	4.12-8.39

[a/] All values except the Linear Programming Method Values are updated from 1978 dollars to 1982 dollars using the GNP implicit price deflator, (factor of 1.345), as used by Loomis and Borg (1983) for updating wildlife values.

[b/] Standard errors of the state average private grazing rental rates for 1982 ranged as follows:

Region:	1	2	3	4	5	6	8
	.213-.308	.304-.651	.456-.490	.351-1.24	.322	.323-.574	.648-1.01

[c/] Source: USDA, Forest Service, 1985; p. F-7. No value is listed for Region 10.

[d/] Source: USDA, Forest Service, 1980, p. L-9. The value increased (in 1978 dollars) is estimated as 104%. Updated to 1982 dollars gives 139.9%. Hay Price Formula values are multiplied by 1.399 to give projected values.

Comparison of Various Estimates of Grazing Value

The value ranges listed in Table 2 represent estimates of three values of federal grazing: the hay price method, the private rental rate method, and the estimate of competitive market value all represent estimates of market value (marginal willingness to pay). The linear programming method gives an upper bound estimate of market value. The VMP method estimates "the total benefit to the users"; or total willingness-to-pay [Bartlett and Ralphs, 1978, P. 46].

Several interesting observations can be made drawn from the information given in Table 2:

1) The VMP estimates do not appear to be significantly greater than the hay price and private rental rate estimates, although they estimate total WTP.
2) The linear programming (LP) estimates fall outside (above) the ranges given by the other methods in Regions 1, 3, 4, and 6. In the remaining Regions, the LP estimates fall within the upper bound of the ranges of either the private rental rate method or the VMP method estimates.
3) The hay price method, which may be the least consistent with economic theory, does not appear to supply unreasonable values, as compared with other estimates.
4) The competitive market value estimates are consistently lower than all other estimates.
5) The ranges across regions are, in general, greater than the ranges within regions.

6) The values which were projected for 1985 in the 1980 RPA Program appear to be relatively consistent with the private rental rate values and the hay price values.

It is difficult to draw any definitive conclusions from these observations, but possible implications of each observation are worth noting:

1) The first observation could imply either that there is little or no difference between total and marginal WTP (i.e. the regional demand curves are indeed nearly horizontal, as assumed in the 1985 Draft RPA Program) or that Bartlett and Ralphs did not adequately distinguish between marginal and total WTP estimation.
2) The second observation implies that the use of LP estimates (maximum WTP estimates) could lead to higher grazing value estimates.
3) The third observation implies that it is unclear whether the more elaborate methods of economic analysis provide better value estimates than the less expensive formula method.
4) The fourth observation, in combination with the first observation, indicates that following Bartlett and Ralphs' proposed methods of estimation may tend to give lower estimates of either total or marginal WTP.
5) The fifth observation indicates that the regional disaggregation of value estimation may provide "more accurate" estimates -- estimates which vary over a narrower range

than the use of national averages would provide.

6) The last observation could be taken as an indication that the projections of future grazing values given in the 1980 program were fairly consistent with more recent estimates.

A discussion of the question of whether these value estimates are unambiguous enough to provide valuable input to the process of allocative decision making is addressed in the section on "Use of Value Estimates in the RPA Program" which follows the discussion of big game use value estimation.

Alternate Methods of Estimating Big Game Use Values

As noted in the policy review section of Chapter III, three methods of estimating the value of recreation-related uses of public land are accepted by most federal agancies, in the following order of preference: the travel cost method (TCM), the contingent valuation or survey method (CVM), and the unit day value method (UDV method) [U.S. Water Resources Council, 1979].

Unit Day Value Method

According to the final version of the 1980 RPA Program, the UDV approach "was used to estimate Forest Service regional recreation, wilderness, and wildlife and fish program benefits" [USDA Forest Service, 1980]. However, the value estimates given in Appendix C of the RPA Program are listed in recreation visitor day (RVD) units, which are different from UDV values - UDV gives a value

for the average number of hours the particular activity is pursued, while RVD values are on a twelve hour basis [Wildlife and Fish Values Task Force, 1980]. Proposals for recommended values to be used in the 1980 program are found in two sources, which conflict in their value estimates. The "Report of a Wildlife and Fish Values Task Force Established by Director, RPA" [1980, p. 2], gives UDV values, which are converted to RVD's using the following formula:

$$\frac{\text{12 hours}}{\text{avg. hrs. in one UD}} \times \text{UDV value range} = \text{RVD value range}$$

The average time spent in each day of big game hunting is given in the Task Force Report as 6.9 hours (average of estimates which ranged from 4.0-9.7 hours/day for different regions). Application of the RVD adjustment formula yields a national average RVD site rent value range of \$17.05-\$22.39. Ranges of site rent values (in 1978 and 1982 dollars) for the nine Forest Service regions are given in Table 3. These ranges were developed by applying a point system specified by the Forest Service to a pre-determined acceptable range of value for specialized hunting and fishing. The acceptable range was found to be \$7.50 to \$12.87 per user day. Application of the point system yielded a range of 60 percent to 100 percent of the maximum value, or \$9.80-\$12.87, (which then converts to the RVD site rent value range mentioned above). Points were assigned for five ranks of quality (poor to exceptional), and for five criteria (recreation experience, alternative opportunities outside of planning area, level of development, accessibility, and environmental quality).

The RVD value for big game use which is actually listed in the 1980 RPA Program is apparently based on an earlier proposal submitted by Brown [1978]. A value of $10.50 is used for all the regions. This represents the average of a recommended range of $7.50-$13.50. The range of value is based on an estimate of willingness-to-pay developed from a survey of hunting-related costs. A regression model of hunting demand in Oregon (a travel cost model) provided estimates of hunting value from which the range of RVD values was developed.

The major disadvantage of the UDV method is the arbitrary nature of the value estimates. Estimates based on judgement calls are not consistent with economic theory, and quantitative estimates of the accuracy of such estimates are difficult to develop. An advantage of the method is that it does not require data intensive analysis.

Contingent Value (Survey) Method

Personal interviews or questionnaires are used in this method of estimating values of recreation experiences. Respondents are asked a series of carefully designed questions concerning their willingness-to-pay for the experience in question. Dwyer, Kelly and Bowes [1977, P. 55] comment that:

> "The method has significant advantages over the travel cost method in situations that involve: (1) considering the value of small changes in quality at existing sites which would not be expected to affect the travel costs of visitors nor their number of visits, particularly if these changes have implications for recreation experiences at a number of sites; (2) estimating the value of a site or area that is one of many destinations visited on a trip; and (3) considering the effects of congestion (crowd ing) on site benefits."

The data intensive nature of the method constitutes a disadvantage; two surveys are normally required to estimate the value of a given area or activity. One survey of users is taken to develop value estimates and collect data on variables which are expected to explain individual differences in variation. An equation which can predict any other user's valuation is then developed, using linear regression. WTP is explained as a function of variables such as user's income, length of stay, and number of years of experience in the area. A second survey of a larger sample of users then estimates the values of the selected explanatory variables for the entire user population [ibid., p. 56].

A second disadvantage of this method involves the potential for biased answers to the survey questions. Users may feel that giving a lower or higher value answer could serve their personal interest. Variability in wording and order of questions can also affect results. It is assumed that proper construction of the questions can eliminate most of this bias, and that consumers are able to accurately estimate the dollar value of their recreation experience [ibid, p. 57; Bishop and Heberlein, 1979].

Loomis and Sorg [1983] provide a thorough literature review of regional studies which estimate recreation values for the various categories of recreation use value given in the RPA Programs, including big game hunting values. Both TCM and CVM studies are included in the review, and various adjustments are used to standardize the values. All values are adjusted to 1982 dollars using the GNP implicit price deflator, and study values are converted to

a standard 12 hour RVD. CVM studies are adjusted if a "protest mechanism" (question designed to allow interviewees to register complaint about the study by a means other than selecting zero WTP) is not employed. Lack of a protest mechanism produces lower value estimates, and Loomis and Sorg use a 15 percent upward revision (decided by an advisory panel) to make the adjustment. A national average CVM big game hunting value is listed as $27.32. CVM based regional values (after adjustments by Loomis and Sorg) are listed in Table 3.

Travel Cost Method

The travel cost method differs from the contingent value method in that it provides a model which can be used for predicting site use (or big game hunting use). CVM value estimates, on the other hand, require an estimate of total use; individuals' WTP is dependent on total use estimates. The use of TCM therefore provides more appropriate estimates of marginal changes in WTP resulting from land management changes.

Like the survey models, travel cost models normally use linear regression. They estimate the number of trips from a population source to a recreation site, as a function of trip costs, population at source, the proximity of users to the area, and the attractiveness of the area. Dwyer, Kelly and Bowes [1977] provide a review of the history of TCM, and a description of the procedure for developing a demand curve from the model, by varying the assumed travel costs.

Three major assumptions required by the method are listed [ibid., p. 82]:

> "1) Entry fees: It is assumed that an individual would react to an increase in entry fees in the same manner as to an increase in travel costs.
>
> 2) Specification: The assumption is made that all relevant and statistically significant variables which affect trip-making are properly specified in the travel cost model. Under this assumption, unbiased estimates of the slope of the site demand curve may be found.
>
> 3) Capacity Constraints: It is assumed that observed data points used to estimate the original model are true demand points. That is, there is no unobserved demand that is unsatisfied due to capacity restrictions."

A further implicit assumption is explained as follows [p. 83]:

> "The travel cost method provides a demand curve for the complete trip including travel to and from the site. . . for the travel cost method to provide an accurate estimate of site benefits, it is required that the consumer's benefits from travel be offset by the amount paid for travel."

Thus it is implicitly assumed that no surplus of value is received from traveling.

A major disadvantage of applying TCM involves the decision of how to adjust for time spent traveling - bias may be introduced if time costs are ignored completely, and the selection of a particular time value is somewhat arbitrary. Other disadvantages arise if the users of an area do not have enough variation in travel costs to indicate a demand relationship, or if the trip includes several destinations.

Loomis and Sorg [1983] list several adjustments (determined

by panel decisions) made to TCM values in correcting for methodological inconsistencies among regional studies:

1) Omission of travel time is compensated for by an upward adjustment of 30 percent.
2) The use of individual observations instead of zone aggregates is preferred, since zone averages tend to overestimate demand (see Loomis and Sorg [1983] for a more detailed explanation). Studies using zone averages are adjusted downward by 0-30 per cent, depending on whether the recreation use in question was more or less specialized.
3) If the TCM study surveyed only instate users, values were adjusted upward by 15-20 percent.

In addition to these changes, value estimates are converted to 1982 dollars using the GNP implicit price deflator. They are also converted to 12 hour RVD units. TCM value estimates for big game hunting (after adjustments) are listed in Table 3.

As noted in the policy review section of Chapter III, Loomis and Sorg's final values are adjusted downward by 37.5 percent to produce the RVD values used in the 1985 RPA Program. Loomis and Sorgs' final value estimates, which are selected from the ranges indicated by CVM and TCM studies, are listed in Table 3. The 1985 RPA values are also listed for comparison.

Comparison of Various Estimates of Big Game Use Values

The values listed in Table 3 are all estimates of the market

Table 3: Big Game Use Values ($/RVD)

Methods \ Regions	1	2	3	4	5	6	8	9	10	Range over Regions
UDV Method (1978 dollars)[a/]	29.40-38.61	23.52-30.89	15.09-19.82	18.62-24.45	19.60-25.74	19.60-25.74	16.76-22.01	12.15-15.96	12.94-16.99	12.15 - 29.40 15.96 - 38.61
1980 RPA Values (1978 dollars)[b/]	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	10.50	-----
UDV Method (1982 dollars)[c/]	39.54-51.93	31.62-41.56	20.30-26.66	25.04-32.89	26.36-34.62	26.36-34.62	22.54-29.60	16.34-21.47	17.40-22.85	16.34 - 39.54 21.47 - 51.93
1980 RPA Values (1982 dollars)	14.12	14.12	14.12	14.12	14.12	14.12	14.12	14.12	14.12	-----
CUM Values (1982 dollars)[d/]		18.40		33.03 36.37						18.40 - 36.37
TCM Values (1982 dollars)		131.80	47.05-51.31	30.81		25.86-75.78	30.51	128.59	---	25.86 -131.80
Loomis & Sorg's Regional Values (1982 dollars)[e/]	50.00	65.00	48.00	50.00	48.00	48.00	40.00	60.00	---	40.00 - 65.00
1985 Oraft RPA Regional Values (1982 dollars)	31.00	41.00	30.00	31.00	30.00	30.00	25.00	38.00	30.00	25.00 - 41.00

[a/] Source: Wildlife and Fish Values Task Force, 1980, p. 18.

[b/] Source: USOA Forest Service, 1979, p. C-5.

[c/] The UOV method values and the 1980 RPA Program Values were updated to 1982 using the GNP implicit price deflator (134.5). This index was chosen in order to be consistent with Loomis and Sorg.

[d/] Source for CUM, TCM and Loomis and Sorg's regional values: Loomis and Sorg, 1983, p. 36. Only deer and elk values are listed for CUM and TCM, although Loomis and Sorg listed antelope values for regions 3 and 4, and included antelope in their weighted regional averages.

[e/] Values from within the range of estimates were selected by a panel for regions with studies; the panel also selected values to use for regions without studies. Studies cited by Loomis and Sorg included: Fisher [1982]; Miller [1980]; Martin, Gum and Smith [1974]; Loomis [1982]; Hansen [1977]; Wennergren, Fullerton and Wrigley [1973]; 8rown and Plummer [1979]; 8rown [1978]; 8ell [1981]; and U.S. Fish and Wildlife Service [1980].

value (marginal WTP) of big game hunting. As with the livestock grazing values, it is difficult to draw any decisive conclusions regarding the actual value of big game hunting. However, it is useful to make a few observations and to speculate on their possible implications.

1) The updated 1980 RPA values are considerably lower than all 1982 value estimates. Three possible implications can be drawn: either the market value of big game hunting increased markedly between 1978 and 1982, the 1980 RPA values are low estimates, or all other value estimates are high relative to the actual, unmeasurable social value.
2) The range of CVM value estimates is somewhat lower than that of TCM value estimates. However, there are very few CVM studies so no implication may be drawn.
3) The updated UDV method values in general agree fairly well with the 1985 Draft RPA Program values. This could imply that the judgement call method may give values which are nearly as close to the true, unmeasurable value as are values developed by adjusting economic estimates.
4) Loomis and Sorg's regional averages are higher than the UDV value estimates, which implies that either the actual market values are higher than the estimates given by the UDV method, or simply that the unadjusted economic methods of estimation give higher estimates than the "interim UDV method".

Due to the relatively arbitrary nature of all of the value estimates (including Loomis and Sorg's values, which were adjusted on the basis of committee recommendations), it is impossible to develop more mathematically specific conclusions about the margin of error of the empirical estimates of big game hunting values. Howver, it is worth re-emphasizing that other values of game use (such as observation or simple existence or aesthetic value) may or may not be accounted for in the RPA Program. There is a separate category of wildlife value for non-game use values, and the relationship between values given in this category and big game hunting values is not examined in this study.

Use of Value Estimates in the RPA Program

In this section, several previously mentioned concerns about the use of the livestock grazing value estimates and the big game hunting value estimates in the context of the economic analysis of RPA Program alternatives are reiterated. The 1985 Draft RPA Program procedures are emphasized, as they represent the current application of the estimates of benefit values. It is not within the scope of this thesis to review the entire procedure presently used in developing estimates of the net present values of each alternative management plan, so the following provides only a brief, general discussion of the overall procedure of economic analysis of land management alternatives.

The 1985 Draft RPA Program includes nine alternative plans for managing the National Forest System. Projected outputs and

costs are listed for each alternative plan for each forest region. The alternatives are defined on the basis of their general output goals, as follows [USDA Forest Service, 1984, pp. 4-5]:

Alternative 1: manage for constant outputs
Alternative 2: place emphasis on market outputs
Alternative 3: place emphasis on non-market outputs
Alternative 4: place emphasis on achieving high levels of all outputs
Alternative 5: manage for reduction of outputs
Alternative 6: implement program levels preferred in the individual National Forest plans
Alternative 7: manage for high present net value
Alternative 8: implement recommended program from 1980
Alternative 9: manage for high productivity of market outputs with emphasis on timber production.

Demand is projected to increase, relative to supply, for range grazing and for all types of outdoor recreation. Range grazing demand is projected to grow 46 percent by the year 2030. Exact projections of recreation and wilderness use demand increases are not given [ibid, p. 1-8]. It is unclear how much real market values are expected to increase as a result of the projected increases in demand. Projected total costs are listed for the years 1986, 1990 and 2030, for each alternative. These costs include all Forest management and investment costs [ibid., Appendix H].

Present net value (PNV) is defined to be "the difference between the discounted value of all priced outputs and the discounted value of all Forest Service management and investment over the analysis period" [ibid., p. 2-83]. Three different PNV estimates are calculated: PNV total, which includes both non-market and market benefits; PNV market, which includes only marketable resource benefits,

and PNV receipts, which considers only actual treasury receipts on the benefit side.

None of the PNV estimates can be said to correctly represent estimates of changes in net social benefits. Many potential sources of uncertainty (in addition to the inaccuracies inherent in the estimates of the market value of various benefits) exist in the PNV calculations. For example, a discount rate of four percent is used [Hasseldahl, 1984]; and the theoretical "correctness" of this discount rate is impossible to determine. In the 1980 RPA Program, some effort was made to mitigate this problem: PNV's were computed for four percent, seven and one-eighth percent, and ten percent discount rates. This practice is discontinued in the 1985 Draft RPA Program, and the four percent rate is not given in the text.

Other potential sources of ambiguity include the projections of future demand, supply, benefits and costs. These projections, like any predictions of the future, are based on information about past value trends and current values. Earlier sections of this chapter illustrated the difficulty of measuring current values. Projections of the future trends of these values must have a wider margin of error than the original estimates, and the original range of accuracy is unknown at least for the two cases examined in this thesis.

In summary, the analysis of empirical estimates of land use value, and of the subsequent use of these values in the RPA Program leads to the following conclusions:

1) It is difficult or impossible to estimate the accuracy of

of the calculated livestock grazing values and big game hunting values because they do not represent application of statistical procedures, and because the estimates may not include all benefits resulting from the two land uses.

2) The cost estimates given in the 1985 Draft RPA Program may or may not be theoretically and empirically correct. In any case the predicted future costs must be somewhat uncertain or inaccurate, and the degree of the resulting margin of error is impossible to document.

3) The ambiguity of projected benefits is similarly impossible to document, although comparison of values estimated by different methods gives some indication of the range within which the estimates may fall.

4) The PNV estimates may not be unambiguous enough to provide an economic ranking of land management alternatives.

CHAPTER V

SUMMARY AND CONCLUSIONS

The introductory chapter of this paper describes the management of public lands as a many faceted problem having three major aspects; political, economic, and environmental. Analysis of the economics of public land allocation is influenced by politics through legislation and policy, and by environmental analysis, which provides estimates of the existing and potential physical productivity of the natural resource base. Economic analysis in turn contributes to the political process of allocative decision-making. Estimates of the economic value of publicly owned land in each of its alternative uses are developed through application of economic theory and methods. A review of this process, and of the aforementioned factors influencing the use of value estimates of public land management, is presented in this thesis. In this chapter, conclusions are developed, based on both the implications of legislative and policy constraints and the theoretical and empirical limitations of economic analysis.

Summary

The fundamental goal of public land allocation is established by legislation, which implicitly states that public land is to be managed in such a way as to maximize social welfare. The legislation

documented in this study illustrates that through the years Congress has provided some indication of how social welfare may be served: first, some land should be allocated to each potential use; and secondly, the allocative decision should not be entirely dependent on economic analysis. The legislation also specifies that national interests should take precedence over local and regional interests, which implies that the primary focus of economic analysis should be national level efficiency analysis.

The review of theoretical and applied economics demonstrates certain limitations of economic efficiency analysis. The foundation of efficiency analysis is a theoretical model that describes how social welfare might be maximized. The model, which defines economic efficiency, is based on individuals' utility functions. Application of the theoretical model requires that dollar values be used to estimate utility. All individuals must be assumed to derive the same marginal utility from a dollar. Changes in income distribution which result from allocative decisions must essentially be disregarded; although they may in fact have some effect on social welfare.

Further disparity between ideal efficiency analysis and actual applied efficiency analysis results from the use of aggregate demand and supply estimates. In order to develop unique estimates of changes in aggregate economic surplus, demand and supply curves are estimated "ceteris paribus"; with the exception of price, all variables influencing aggregate demand and supply are treated as constants. In effect, a partial derivative is used to maximize the estimate of net social welfare change given by net change in

aggregate economic surplus.

These required approximations and limitations, along with others described in chapter II, imply the existence of a major quandary. The question of whether national level economic efficiency analysis does in fact provide an indication of which allocative alternative will lead to the greatest gain in social welfare is unanswerable. Economists disagree over whether the use of efficiency analysis can be certain to lead to unambiguous increases in social welfare.

Review of the methods used and value estimates chosen for each of the two example RPA values suggests further sources of consistency in the economic analysis of public land allocations. Estimates of competitive market price are used to approximate marginal net social benefits. The products of estimated market price times the alternative changes in quantity of the resource in question under different management plans gives theoretically correct estimates of social benefits only if the regional demand for the resource in question can be considered perfectly elastic (horizontal) at the estimated market price. If the derived demand for the commodity in question (livestock producers' derived demand for grazing on public land, or big game hunters' derived demand for wildlife habitat/forage) is downward-sloping, the use of market values to measure marginal social benefits is consistent with economic theory. Many empirical studies describe or assume downward sloping demand curves: For example, Bartlett and Ralph's [1978] methods of estimating livestock grazing values use downward sloping regional or site-specific demand curves.

With the exception of the private land rental method of estimat-

ing livestock grazing values, no statistical estimates of accuracy (such as variance or standard error) may be developed for any of the value estimates described in this thesis, because in every other case the value estimates were based to some extent on judgement calls or committee decisions, which introduce statistically unmeasurable error. Even if it were possible to estimate a confidence interval, or range of accuracy for the empirical estimates, it is important to recognize that the selected empirical methods can only be assumed to measure the relevant value -- the social benefits resulting from the land use in question. Unless this assumption is made, qualifications regarding empirical accuracy, and descriptions of factors which reduce the empirical accuracy of value estimates become irrelevant.

The presentation of the results of economic efficiency analysis in the RPA Programs introduces further confusion. Projections of future values of each land resource use are combined with projected furture costs to give estimates of net benefits over time. These values are then discounted to develop present net value estimates of the various land management alternatives. The present net value estimates represent the final product of the economic analysis, and are the value estimates actually used in the decision-making process.

Conclusions

Many of the problems and inconsistencies documented in this thesis may be insurmountable. Economists are incapable of directly

measuring utility. Dollar value estimates, with all their inherent inaccuracy, are considered the best alternative, since they can sometimes be observed in the marketplace. Economic models which define efficient allocation of resources for a situation as complex as that faced by public land management agencies have not been developed. Unique estimates of changes in social welfare cannot be produced without a set of rigid assumptions which bear little relationship to the situation faced by the land management agencies. The hypothesis that the estimates of social benefits derived from the alternative land uses do not actually measure changes in social welfare cannot be rejected . Yet it must be assumed that applied economic analysis does measure welfare changes if the entire process is to be considered valid.

Assuming that the theoretical uncertainty mentioned above does not render the estimates of the social value of various land allocations invalid, the comparisons of value estimates presented in the study indicates that there is no clear difference between estimates of value developed using economic methods and estimates which are based more or less on expert opinion. A potential advantage of the use of economic methods -- the availability of statistical estimates of value ranges -- is negated by averaging findings from many studies, by adjusting them on the basis of committee recommendations, or by the selection of methods which do not provide statistical estimates, such as linear programming.

The present net value estimates used in the final economic analysis of RPA Program alternatives further compounds the problems

with empirical inaccuracy by combining estimates of current market values with discounted long term projections of future values. Projected changes in future benefits and cots, and the rate used in discounting, are neither clearly displayed nor explained. Since projections of the future are less accurate than estimates of current conditions, it seems that the practice of combining current estimates of value with future estimates, and emphasizing the resulting present net value figures as "the primary criterion used to measure the economic worth of the National Forest land and resources under alternative programs for the valued outputs" provides decision-makers with extremely vague information [USDA Forest Service, 1984, p. 2-83].

Recommendations

In light of the above conclusions, several recommendations seem logical:

1) Further research on the cost-effectiveness of using economic methods to estimate values of alternative land uses should be conducted. If it is concluded that economic estimates are worth their costs (as compared to less expensive "judgement estimates"), greater consistency in methodology could reduce the need for adjustments such as Loomis and Sorg [1983] have made, thereby allowing standard errors or other statistical estimates of accuracy to be presented.
2) Predicted trends in demand and supply (econometric fore-

casts) should be clearly presented, along with estimates of the accuracy of these forecasts.

3) If present net value estimates are developed, the sensitivity of the estimates to variations in the discount rate should be displayed.

4) In addition to totalling the benefit and cost estimates of each alternative management plan, it seems logical to present information on the direct relationship of social benefit to the quantity of the resource allocated to a given use.

These recommendations all relate to a central, general suggestion: the format of the contribution to land management decision-making presented in the economic analysis of the RPA Programs should be disaggregated. Readers should be able to distinguish between numbers which have resulted from judgements made by other decision-makers. If a choice must be made between presenting fewer numbers which are so aggregated that they are nearly meaningless, or more numbers which give the decision-makers some understanding of the limitations of economic analysis, then the latter choice is recommended. Economists may find it difficult to defend, on scientific grounds, the quality of their contribution when value estimates are adjusted on the basis of committee decisions, and the inherent inaccuracies of resulting estimates and predictions are not acknowledged.

BIBLIOGRAPHY

Act of June 28, 1906, Public Law 59-314, 59th Congress.

Anderson, C.L. and T.S. Hipp. Requirements and Returns for 1,000 Cow Beef Herds on Flatwoods Soils in Florida. University of Florida Experiment Station Circular 385 [1971, update 1976].

Arrow, K.J. Social Choice and Individual Values. New York: John Wiley and Sons, Inc., 1951.

Arrow, K.J. and R.C. Lind. "Uncertainty and the Evaluation of Public Investment Decisions," American Economic Review, 60 [1970], pp. 364-378.

Bartlett, E.T. and M. Ralphs. "Estimation of Grazing Values for the 1980 RPA Program," in 1980 RPA Values, USDA Forest Service, 1978.

Bell, F. "Recreational Benefits for the Atchafolaya River Basin," Contract report number 14-16-009-80-009, for U.S. Fish and Wildlife Service by Department of Economics, Florida State University, 1981.

Bergland, B. and C.D. Andrus. Study of Fees for Grazing Livestock on Federal Lands, Washington, D.C.: U.S. Government Printing Office, October 21, 1977.

Bishop, R.C. and T. Heberlein. "Measuring Values of Extramarket Goods: Are Indirect Measures Biased?" American Journal of Agricultural Economics 61 [1979], pp. 926-930.

Brown, G. and M. Plummer. "Recreation Valuation", Appendix A6 of "An Economic Analysis of Nontimber Uses of Forestland in the Pacific Northwest", Forest Policy Project, Washington State University, 1979.

Brown, W.G. Proposed 1980 Program RPA Values for Wildlife and Fish. Report presented May 8, 1978, to RPA Workshop, U.S. Forest Service, Washington, D.C.

Brown, W.G., F. Nawas, and J. Stevens. "The Oregon Big Game Resource: An Economic Evaluation", Special Report 379, Agricultural Experiment Station, Oregon State University, Corvallis, OR, 1973.

Clawson, M. "Methods of Measuring the Demand for and Value of Outdoor Recreation". Resources for the Future, Reprint No. 10, Washington, D.C., 1959.

Currie, J.M., J.A. Murphy, and A. Schmitz. "The Concept of Economic Surplus and Its Use in Economic Analysis", The Economic Journal 81 [1971], pp. 741-799.

Dana, S.T. and S.I. Fairfax. Forest and Range Policy. New York: McGraw-Hill, Inc., 1980.

Davis, R.K. "The Value of Outdoor Recreation: An Economic Study of the Maine Woods", Ph.D. dissertation, Harvard University, 1963.

Davis, O.A. and A.B. Whinston. "Welfare Economics and the Theory of the Second Best", Review of Economic Studies 32 [1965], pp. 1-14.

Dwyer, J., J. Kelly, and H. Bowes. "Improved Procedures for Valuation of the Contribution of Recreation to National Economic Development", Water Resources Center Report No. 128, University of Illinois at Urbana, Champaign, Illinois, 1977.

Environmental Law Institute. The Evolution of National Wildlife Law. Council on Environmental Policy, 1977.

Federal Land Policy and Management Act, Public Law 94-579, 94th Congress, October 21, 1976.

Federal Register. "Principles and Standards for Planning Water and Related Land Resources". Water Resources Council, Washington, D.C., May 24, 1979 and September 10, 1973.

Fisher, W. "Travel Cost and Contingent Value Estimates Explored", Eastern Economics Association, May 1, 1982.

Forest and Rangeland Renewable Resources Planning Act, Public Law 93-378, 93rd Congress, August 17, 1974.

Freeman, A.M. "Approaches to Measuring Public Goods Demands". American Journal of Agricultural Economics 61 [1979], pp. 915-920.

Fowler, J.H. and J.R. Gray. "Grazing Land Values in New Mexico", Agricultural Experiment Station Research Report 456, New Mexico State University, 1981.

Georgescu-Roegen, N. "Choice and Revealed Preference", Southern Economic Journal, 21 [1954], pp. 119-130.

Gordon, I.M. and J.L. Knetsch. "Consumer's Surplus Measures and the Evaluation of Resources", Land Economics 55 [1979], pp. 1-10.

Gould, J.P. and C.E. Ferguson. Microeconomic Theory. Homewood, Ill: Richard D. Irwin, Inc., 1980.

Gum, R.L. and W.E. Martin. "Problems and Solutions in Estimating the Demand for and Value of Rural Outdoor Recreation", American Journal of Agricultural Economics 57 [1975], pp. 539-566.

Hansen, C. "A Report on the Value of Wildlife", Intermountain Region, U.S. Forest Service, Ogden, Utah, 1977.

Hasseldahl, N. Public Information Officer, Suislaw National Forest. Private Communication, April 13, 1984.

Helfrich, M.A.P. "Towards Estimating the Optimum Combination of Cattle and elk on the Apache-Sitgreaves National Forest of Arizona". Unpublished M.S. thesis, University of Arizona, 1981.

Hicks, J.R. "The Foundations of Welfare Economics", Economic Journal 49 [December 1939], pp. 696-712.

Hicks, J.R. "The Four Consumers' Surpluses". Review of Economic Studies 11 [1943], pp. 31-41.

Hicks, J.R. A Revision of Demand Theory. Oxford, England: Clarendon Press, 1956.

Howe, C.W. Benefit-Cost Analysis for Water System Planning. American Geophysical Union, Water Resources Monograph 2, 1971.

Hyde, W.F. "Resources Planning Act: Critique and Alternative Approach", Journal of Forestry 79 [1976], pp. 282-284.

Jeffries, G.L. "The Marginal Value of Public Grazing Permits to Arizona Ranchers", Unpublished M.S. thesis, University of Arizona, 1964.

Just, R.E., D.L. Hueth, and A. Schmitz. Applied Welfare Economics and Public Policy. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1982.

Kaldor, N. "Welfare Propositions of Economics and Interpersonal Comparisons of Utility", Economic Journal 49 [1939], pp. 549-552.

Krutilla, J.V. and A.C. Fisher. The Economics of Natural Environments. Baltimore: The Johns Hopkins University Press for Resources for the Future, 1975.

Lacey Act of 1900, 56th Congress, Session 1, Chapter 479, May 17, 1900.

Lewis, E.P. and D.T. Taylor. "Impacts of Public Lands Policies on the Livestock Industry and Adjacent Communities", Wyoming Agricultural Experiment Station Research Bulletin 116, 1977.

Lipsey, R.G. and K. Lancaster. "The General Theory of Second Best", Review of Economic Studies, 63 [1956], pp. 11-32.

Little, I.M.D. A Critique of Welfare Economics. Oxford: Claredon Press, 1950.

Loomis, J. and C. Sorg. A Critical Summary of Empirical Estimates of the Value of Wildlife, Wilderness, and General Recreation Related to National Forest Regions. Fort Collins, Colorado, 1983.

Loomis, J.B. "Use of Travel Cost Models for Evaluating Lottery Rationed Recreation: Application to Big Game Hunting", Journal of Leisure Research 14 [1982], pp. 117-125.

Marglin, S.A. "The Social Rate of Discount and the Optimal Rate of Investment", Quarterly Journal of Economics 77 [1963], pp. 95-111.

Martin, W.E. G.L. Jefferies. "Relating Ranch Prices and Grazing Permit Values to Ranch Productivity", Journal of Farm Economics 48 [1966], pp. 233-242.

Martin, W.E. and R. Gum. "Economic Value of Hunting and Fishing and General Rural Outdoor Recreation", Wildlife Society Bulletin, 1978.

Martin, W.E. and A. Smith. "The Demand for and Value of Hunting, Fishing, and General Rural Outdoor Recreation in Arizona", Technical Bulletin 211, Agricultural Experiment Station, University of Arizona, Tucson, Arizona, 1974.

Martin, W.E., J.C. Tinney, and R.L. Gum. "Comparing "Estimates of Market and Nonmarket Values for Products of a Given Land Base", Natural Resource Economics Division Discussion Paper No. 44, U.S.D.A., Washington, D.C., March 1978.

Miller, R. "The Demand for the Colorado Deer Hunting Experience", Unpublished Ph.D. dissertation, Colorado State University, Fort Collins, Colorado, 1980.

Mishan, E.J. "A Survey of Welfare Economics, 1939-1959", Economic Journal 70 [1960], pp. 197-265.

Mishan, E.J. "Welfare Criteria: Resolution of a Paradox", Economic Journal 83 [1973], pp. 747-767.

Mishan, E.J. Cost Benefit Analysis. London, England: George Allen and Unwin, 1982.

Multiple Use Sustained Yield Act of 1960, Public Law 86-517, 86th Congress, June 12, 1960.

National Forest Management Act of 1976, Public Law 94-588, 94th Congress, October 22, 1976.

Obermiller, F.W. "Economic Efficiency vs. Distributive Equity: The 'Sagebrush Revellion'", Western Journal of Agricultural Economics 7 [1982], pp. 253-263.

Obermiller, F.W. and L.E. Wear. "National Economic Efficiency Versus Local Community Stability Goals in Public Land Management: A Review of Relevant Literature", unpublished manuscript, 1982.

Obermiller, F.W. "Economic Perspectives on the Valuation of Public Land Livestock Force". Paper presented at the Symposium on "Grazing Fees: What is Fair Market Value"? National Cattlemen's Association Annual Convention, New Orleans, January 23, 1984.

Olson, C.E. and J.W. Jackson. "Impact of Change in Federal Grazing Policies on South-Central Wyoming Mountain Valley Cattle Ranches", Wyoming Agricultural Experiment Station Research Bulletin 96, 1975.

Organic Administration Act of 1897, 55th Congress, Session 1, Chapter 2, June 4, 1897.

Pareto, V. Cours d' Economic Politique. Vol. 2, Laus Anne, 1896.

Pearson, H.A. and L.B. Whitaker. "Returns from Southern Forest Grazing, Journal of Range Management 25 [1973], pp. 85-87.

Peryam, J.S. and C.E. Olson. "Impact of Potential Changes in BLM Grazing Policies on West-Central Wyoming Cattle Ranches", Wyoming Agricultural Experiment Station Research Bulletin 87, 1975.

Pigou, A.C. The Economics of Welfare [4th edition], London: Macmillan, 1932.

President's Water Resources Council. "Policies, Standards and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources", Senate Document No. 97, 87th Congress, 2nd Session, May 1962.

Public Land Law Review Commission. One-Third of the Nation's Land, Washington, D.C.: U.S. Government Printing Office, June 1970.

Public Rangelands Improvement Act of 1978, Public Law 95-514, 95th Congress, October 25, 1978.

Qualey, N.J. and L.F. Leistritz. "An Economic Analysis of Pasture Management Alternatives for Southeastern North Dakota", North Dakota Agricultural Experiment Station Agricultural Economics Report No. 106, 1975.

Radtke, H. and R. Brokken. "IMPLAN vs. Primary Data Input/Output Models: A Comparison of Impact Estimates for Hypothestical Changes in the Federal Grazing Fee", unpublished manuscript, 1984.

Randall, A. Resource Economics: An Economic Approach to Natural Resource and Environmental Policy. Columbia, Ohio: Grid Publishing, Inc., 1981.

Schuster, E.G. and J.G. Jones. "Extramarket Valuation for Resource Allocation: A Critique", in F.J. Wagstaff (compiler), Proceedings -- Range Economics symposium and Workshop, General Technical Report INT-149, Intermountain Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, July 1983, pp. 63-73.

Scitovsky, R. "A Note on Welfare Propositions in Economics", Review of Economic Studies 9 [1941], pp. 77-88.

Stevens, J.E. and E.B. Godfrey. "Use Rates, Resource Flows and Efficiency of Public Investment in Range Improvements", American Journal of Agricultural Economics 54 [1972], part i, pp. 511-621.

Statistical Reporting Service. U.S.D.A., L. Duane Sewell, private communication to R. Brokken, 1984.

Sustained Yield Forest Management Act of 1944, Public Law 78-273, 78th Congress, March 19, 1944.

Sutherland, R. "A Regional Recreation Demand and Benefits Model", Corvallis Environmental Research Laboratory, U.S. Environmental Protection Agency, Corvallis, Oregon, 1980.

Taylor Grazing Act of 1934, Public Law-73-482, 73rd Congress, June 28, 1934.

Taylor Grazing Act Amendment (or Barrett Amendment), Public Law 80-376, 80th Congress, August 5, 1947.

Thomas, J.W. Elk of North America. Harrisburg, Pennsylvania: Stackpole Books, 1982.

Tullock, G. "The General Irrelevance of the General Impossibility Theorem", Quarterly Journal of Economics 81 [1959], pp. 256-270.

United States Department of Agriculture, U.S. Forest Service. A Recommended Renewable Resources Program - 1980 Update. F.S. 346, Washington, D.C.: Government Printing, September 1980.

United States Department of Agriculture, U.S. Forest Service. Draft Environmental Impact Statement, 1985-2030 Resources Planning Act Program, 1984.

United States Fish and Wildlife Service. National survey of fishing hunting and wildlife associated recreation. Received from Dr. M. Hay, Division of Program Plans. 1980.

VanKooten, G.C. "The Integration of Efficiency and Equity in Public Decision Making: Theoretical Issues and Applications", Unpublished Ph.D. dissertation, Oregon State University, 1982.

Weisbrod, B.A. "Income Redistribution Effects and Benefit-Cost Analysis" in S.B. Chase [ed.] Problems in Public Expenditure Analysis. Washington, D.C.: The Brookings Institution, 1968, pp. 177-209.

Wild and Free Roaming Horses and Burros Protection Act of 1971, Public law 92-195, 92nd Congress, December 15, 1971.

Wildlife and Fish Values Task Force. Defining Recreational Values Dependent on Wildlife and Fish to be Used in Regional and Forest Land and Resource Management Planning, U.S. Government document, July 18, 1980.

Willig, R.D. "Consumers' Surplus Without Apology", American Economic Review 66 [1976], pp. 587-597.

Wennengren, B., H. Fullerton, and J. Wrigley. "Estimation of Quality and Location Values for Resident Deer Hunting in Utah", Bulletin 448, Utah Agricultural Experiment Station, Utah State University, Logan, Utah, 1973.