

## CHAPTER II

### DECISION-MAKING AND RESOURCES MANAGEMENT

Against the background of national flood policy and a sequence of geographical research which includes study of the choice available to occupants of flood plains, it is useful to examine decision theory and decision-making schema. How relevant are they to resource management study in general, and flood plains in particular? Do they assist in arriving at more refined understanding of why people do or do not occupy flood hazard areas?

#### Some Underlying Assumptions of Decision-Making Schema

Decision-making, in a broad sense, is the selection of alternate courses of human behavior, and decision-making schema are descriptions or prescriptions of this process. The study of decision-making is a burgeoning, inter-disciplinary, and somewhat confusing, area of research.<sup>1</sup>

Decision-making schema hold an intrinsic attraction for students of resources management. The concept of the multiple purpose use of resources, the variability of the perception of resources from culture to culture, the differences in resulting choices in similar environments, all offer grist for the mills of decision theory.

The writer has found it helpful to identify four of the underlying assumptions found in almost all decision-making schema and in their applications to resource problems. These are: (1) the underlying view of man's rationality; (2) the types of decision

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<sup>1</sup>In a recent review article, John W. Dyckman, "Planning and Decision Theory," Journal of the American Institute of Planners, XXVII (November, 1961), 335-345, are listed 110 works dealing with decision-making including works by economists, statisticians, operations researchers, psychologists, political scientists, planners, and sociologists. Ward Edwards' review article, "The Theory of Decision-Making," Psychological Bulletin, V (1954), 380-417 lists some 218 items. Paul Wasserman and Fred S. Silander in Decision Making: An Annotated Bibliography (Ithaca, N.Y.: Cornell University, Graduate School of Business and Public Administration, 1958) annotated over 400 references. The bibliography contains a topical listing of decision studies found to be useful as an introduction to this vast literature. Only studies actually cited in this chapter appear in footnotes.

processes involved; (3) the conditions of knowledge under which choice is made; (4) the criteria that are used to guide such choice.

### Man's Rationality

The underlying view of man's rationality.--Rationality may be used to simply describe that ability to choose clearly and consistently those alternate courses of human behavior that are most appropriate towards attaining some end or goal. Among the difficulties in comparing inter-disciplinary research in decision-making are the conflicting assumptions as to man's rationality. These have been sharply defined by Simon in the following manner:

The social sciences suffer from an acute case of schizophrenia in their treatment of rationality. At one extreme we have the economists, who attribute to economic man a preposterously omniscient rationality. Economic man has a complete and consistent system of preferences that allows him always to choose among the alternatives open to him; he is always completely aware of what the alternatives are; there are no limits to the complexity of the computations he can perform in order to determine which alternatives are best; probability calculations are neither frightening or mysterious to him. Within the past decade, in its extension to competitive game situations, and to decision-making under uncertainty, this body of theory has reached a state of Thomistic refinement that possesses considerable normative interest, but little discernible relation to the actual or possible behavior of flesh-and-blood human beings.

At the other extreme, we have had tendencies in social psychology traceable to Freud that try to reduce all cognition to affect. Thus, we show that coins look larger to poor children than to rich (Bruner and Postman), that the pressure of a social group can persuade a man to see spots that aren't there (Asch), that the process of group problem solving involves the accumulation and discharge of tensions (Bales), and so on. The past generation of behavioral scientists have been busy, following Freud, showing that people aren't nearly as rational as they thought themselves to be. Perhaps the next generation is going to have to show that they are far more rational than we now describe them as being--but with a rationality less grandiose than that proclaimed by economics.<sup>1</sup>

Simon goes on to offer his own alternative:

The alternative approach . . . is based on what I shall call the principle of bounded rationality:

The capacity of the human mind for formulating and solving complex problems is very small compared with the size of the problems whose solution is required for objectively rational behavior in the real world--or even for a reasonable approximation to such objective rationality.

If the principle is correct, then the goal of classical economic theory--to predict the behavior of rational man without

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<sup>1</sup>H. A. Simon, Administrative Behavior (2d ed.; New York: Macmillan, 1957), p. xxiii.

making an empirical investigation of his psychological properties--is unattainable. For the first consequence of the principle of bounded rationality is that the intended rationality of an actor requires him to construct a simplified model of the real situation in order to deal with it. He behaves rationally with respect to this model, and such behavior is not even approximately optimal with respect to the real world. To predict his behavior we must understand the way in which this simplified model is constructed, and its construction will certainly be related to his psychological properties as a perceiving, thinking, and learning animal.<sup>1</sup>

Thus does Simon construct a trichotomy, fraught with perils of over-simplification. By utilizing the extremes of economic or psychological man, some scholars may insist that Simon has caricaturized the mainstreams of economic or psychological thought. Be this as it may, the writer in his review of the decision-making literature of the social sciences has found few exceptions to Simon's description of the prevalent underlying assumptions of rationality. If one acknowledges the descriptive aptness of Simon's trichotomy, what of its prescriptive value? Restated in another way: granted that decision-making analysts, consciously or unconsciously, formulate an underlying assumption as to man's rationality, is there one of these assumptions that is more useful for formulating decision-making schema?

To the writer, the stance, or assumptions as to man's rationality, from which the decision-making analyst prepares to discuss the process of decision-making has utility only in terms of the analyst's objectives and study matter.

One such objective is the intent of the analyst in terms of the normative-behavioral dichotomy or, as the writer prefers, those models of man that aspire to describe and predict his behavior as opposed to those that aspire to prescribe what his behavior ought to be. If the intention of the analyst is to describe correctly human behavior in decision-making situations and to predict future behavior, then it is clear to the writer that an assumption of omniscient rationality for economic man is at variance with both the potential and actual behavior of men.

It must be recognized that there are many who have wearied of the failure of behavioral theory to provide generalized descriptions of human action. Stimulated by computer technology, they are constructing a closer approximation of the rational economic man by prescribing rules and routines to help men become more nearly rational. These research workers appear ready to leap-frog the question: How does man perceive choice and act upon

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<sup>1</sup>H. A. Simon, Models of Man: Social and Rational (New York: John Wiley & Sons, 1957), p. 198.

it? and replace it with the question: How can he make his choices and choice mechanisms better? For some the horizon is endless and their ultimate goal might well be the following:

We assert that it is possible to describe analytically any human function which can be reasonably defined in objective terms--and we specifically include in such functions "thinking" insofar as the term is definable. If by "thinking" one means being able to do arithmetic, or play a good game of chess, or learn from experience, or make optimal decisions in exceedingly complex situations, then we assert that thinking can be described analytically, and there are two important corollaries: if it can be described analytically, it can be simulated; and if it can be simulated, it can be performed mechanically.<sup>1</sup>

Omniscient, rational economic man, is a viable model for describing the behavior of a select group of human beings, though this group may be limited to the very proponents of the model. With an objective of prescribing rules for making better choices, surely one cannot argue that men ought not aspire to the very heights of rationality. What makes this view so vulnerable to Simon's attack is that its proponents do not restrict themselves to a prescriptive role, and often take the either/or position of Marschak that:

The theory of rational behavior is a set of propositions that can be regarded either as an idealized approximation of the actual behavior of men or as a recommendation to be followed.<sup>2</sup>

The writer would suggest Marschak's set of propositions are indeed recommendations to be followed, but at best could be an idealized approximation of the actions of very few, if any, men.

If the intention of the analyst is to devise descriptive-predictive models of human behavior, his attention might be directed to either Simon's stance of bounded rationality or that of psychological man dominated by affect.<sup>3</sup> The choice between these

<sup>1</sup>R. E. Machol (ed.), Information and Decision Processes (New York: McGraw Hill, 1960), pp. viii-ix.

<sup>2</sup>Jacob Marschak, "Rational Behavior, Uncertain Prospects, and Measurable Utility," Econometrica, XVIII (1950), 111.

<sup>3</sup>John Krutilla and Leslie Curry have pointed out, quite correctly, that many useful studies of a descriptive-predictive nature have been carried out within the framework of traditional economic man or more commonly, a rational man subject to a variety of constraints including the costs of obtaining additional information, human fallibility and lack of clairvoyance, chance, and the like.

The more constraints placed on the omniscience of the rational man, the closer such a model moves to that of bounded

two assumptions as to man's rationality is influenced by the subject matter under study. In the writer's view, bounded rationality appears most appropriate for those situations in which one can hypothesize substantial conscious choices and an underlying view of psychological man lends itself to areas of decision in which there is evidence that less conscious, or instinctive choice processes are involved.

A model of man's rationality for resource managers.--Resources by definition are culturally determined, that is, a resource is a thing that becomes a resource when perceived as useful to man. To understand, describe, and predict from the varieties of ways that men manage resources implies a certain model of man. In this model, men bounded by inherent computational disabilities, products of their time and place, seek to wrest from their environment those elements that might make a more satisfactory life for themselves and their fellows. Simon's concept of bounded rationality is a suitable framework for such a model.

On the other hand, there is the same pressure in resource management as well as in other avenues of human affairs to leapfrog the need for patient understanding of complex activities and prescribe efficient resource allocation systems. As has been previously stated, the assumption of the maximum rationality on the part of man cum computer is almost inescapable in this field of research.

In explaining man's behavior in the face of an urban flood hazard the underlying assumption of man's rationality will be that of bounded rationality and a prime purpose will be the consideration of what the specific bounds might be.

#### Types of Choice Processes

Conscious decision-making provides but a fraction of the welter of decisions that men make every day. The existential concept of free and conscious choice is not only a "dreadful freedom" but time-consuming as well. The bulk of man's daily decisions are either habitual or so trivial as to take on a random aspect; men thus protect themselves from the burden of consciously choosing amidst the minutiae of life. The important decisions in life,

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rationality until such time as the difference might be more semantic than real.

Essentially a matter of focus, the espousal of bounded rationality found in this volume, is not intended as a denial of the utility of other formulations but rather to assert the utility of focusing on the limitations in decision-making rather than on an ideal from which men deviate.

while relatively few in number, do involve conscious elements in choice and often tend to be unique. In general three types of choice processes might be distinguished:

The conscious choice process.--There is a general acceptance that conscious choice processes involve some reflection on the part of the chooser, a consideration of ends, and alternative means of securing those ends. Churchman would distinguish between free choice or how one would choose on the basis of their own values; and a more restricted choice; the choices men make when their own values are bound up with extraneous or irrelevant external factors.<sup>1</sup> Existential philosophers would deny for the most part the distinction claiming that, in the last analysis, all men are free to choose among some alternatives.<sup>2</sup> The more psychologically oriented analyst might emphasize the impact of the unconscious on even the apparently conscious choice.<sup>3</sup> In any event, many of the important unique decisions men make involve considerable amounts of reflection.

The habitual choice process.--Habitual choice, or the recourse to traditional or repetitive behavior, has a profound influence on the ordering of men's activities. Geographers are quick to note how many responses to man's environment take on aspects of habitual choice. The writer would suggest that most habitual actions, be they trivial or important, result originally from more or less conscious decisions, made by some individuals singly or collectively interacting with society. Certain analysts like Firey, think that long-term habitual response systems like open-field farming represent not a habitual response to the environment as such, but "willing conformity" implying even in long-established traditional systems some conscious choice.<sup>4</sup>

Unconscious and trivial choice.--A detailed discussion of unconscious choice is beyond the ken, training, or inclination of the writer. Most readers might confirm that choices of love, marriage, and the like, are poorly suited for description by a rational conscious choice process. Fortunately, resources

<sup>1</sup>C. West Churchman, Prediction and Optimal Decision: Philosophical Issues of a Science of Values (Englewood Cliffs, N.J.: Prentice Hall, 1961), p. 18.

<sup>2</sup>Jean-Paul Sartre, Existentialism (New York: Philosophical Library, 1947), pp. 38-40.

<sup>3</sup>Gardner Lindzey (ed.), The Assessment of Human Motives (New York: Grove Press, 1960), p. 19.

<sup>4</sup>Walter Firey, Man, Mind & Land: A Theory of Resource Use (Glencoe: The Free Press, 1960), pp. 111-130.

management appears to involve little unconscious choice, that is, choice governed by ends and means that are perceived dimly, if at all, by the chooser. On the other hand, certain questions like the propensity to gamble with nature, be it drought, flood, or a home on Fire Island, might conceivably be described by unconscious choice processes. This theme will be returned to in later sections.<sup>1</sup>

Another type of choice recognized by the writer (but denied by certain schools of psychology) is that of trivial choice. Many unique choices (non-habitual) are so trivial (either unimportant or the chooser is indifferent) that the choice takes on a random aspect. Indifference curves attempt to identify a point at which a choice between alternatives may be trivial, even though the alternatives themselves may have considerable significance.

The process of choice in resources management.--Elements of all three choice processes enter into the decisions made in the management of resources, but conscious elements appear to dominate. A mine is opened because there is a need for metal; a hillside site is selected for a home because it overlooks the ocean; water is added to a field because it has not rained. In others, one finds habitual response as well; stockpiling or purchasing silver persists after the original need has been filled; a house designed for a level lot is placed on a hillside; fields in an arid area are watered on schedule whether it rains or not. Some decisions perplex the analyst and one tends to ascribe to them unconscious or random influence. The shrewd small-town merchant is enticed into investing in a fraudulent mining stock; a particular hillside development takes place because the developer once had a flat tire there; irrigation is encouraged because a people raised in a humid climate associate green fields and flowing water with the good, fertile, and beautiful as opposed to a perceived ugliness of arid grass lands or desert.

In a broad over view, choice in resource management is primarily conscious choice and habitual choice which has been routinized after a series of initial conscious choices. What are

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<sup>1</sup>L. Wundheiler, a psychologist friend, suggests that the distinction between unconscious and conscious decision processes is best made not as a function of some class of activity, but rather as a function of the amount of desire or motivation for a certain goal. As such desire or motivation increases, so would irrational behavior regardless of type of activity.

Nevertheless, the writer would maintain that there are classes of human activity in which most, but not all, behavior can be explained in a rational, conscious framework, and others in which such explanation appears much weaker.

the bounds of such conscious choices? Firey likes to consider them as choices coming from three sets; a set of physically possible alternatives, a set of culturally adoptable alternatives, and a set of economically gainful alternatives.<sup>1</sup> White orders his thinking by defining a set of theoretical choices and a set of practical choices. These practical choices are controlled by two principal factors of awareness and restraint.<sup>2</sup> This study will attempt to identify empirically a range of choice of flood reduction measures as individually perceived. This discussion will be found in the fifth chapter.

### Conditions of Knowledge

Risk and uncertainty.--Choice, however it is made, is made under a variety of conditions of knowledge as to alternatives and outcomes. The best available information may only suggest a range of outcomes, some with a known probability distribution and others with an uncertain one. The first case, outcomes with a known probability distribution, has been distinguished as risk, the second case as uncertainty.<sup>3</sup>

Dispersion of knowledge.--In the complex world, seldom is the best knowledge ever able to be completely brought together, or when this is done, assimilated. There is wide dispersion of such knowledge in any community of men. Thus, a descriptive theory of choice must deal with the well-informed and the poorly-informed and the choices that men make under certainty, risk or uncertainty. To complicate the matter further, such a theory must deal with the eventuality that not only do the conditions of knowledge vary, but the personal perception of the same information differs. Thus, for an objective standard of knowledge there may be a substantially different subjective interpretation of the same.

The conditions of knowledge under which resource decisions are made.--Natural resource management involves a great deal of uncertainty. It is first of all an economic activity, with uncertainty similar to other economic activities. Secondly, it is a field of human endeavor particularly sensitive to the great natural

<sup>1</sup>Firey, p. 37.

<sup>2</sup>White, Natural Resource Journal, pp. 26-27.

<sup>3</sup>Since F. H. Knight in 1921 (Risk, Uncertainty & Profit [Boston: Houghton Mifflin, 1921], p. 233) coined these distinctions, numerous writers have suggested that the division between risk and uncertainty is at best hazy, a view concurred in by the writer. However, while the division may be hazy, the distinction between the extreme cases of certainty, risk, and uncertainty is useful.



uncertainties of drought and flood, fire and disease, and the like. Thirdly, uncertainty increases rapidly with time. Resource managers frequently plan for far longer periods (50-100 years) than the managers of other economic activities. Lastly, its technology is not only subject to the uncertainty of premature obsolescence, but of uncertain disbenefits, frequently of a serious nature. There are few experts, either here or in the Soviet Union, prepared to forecast with assurance the disbenefits of the proposed shift from grassland rotation to intensive farming in the Soviet Union, or for that matter even the long-term benefits. How do resource managers deal with such uncertainty? Ciriacy-Wantrup describes a series of measures for dealing with risk and uncertainty primarily economic devices of discounts, hedging, pooling, shifting risk, or greater flexibility in the management of resources. He then suggests that in the face of great uncertainty, managers abandon a calculative approach and fall back on custom or tradition as "habit patterns."<sup>1</sup>

The dispersion of knowledge in a community of resource managers is related both to variation in the quality and completeness of the available knowledge and to differences in its perception and interpretation.

One might distinguish between the common knowledge distributed more or less normally among a community of resource users and a distribution of technical knowledge. Common knowledge among Illinois corn farmers would have a smaller variance than a less homogenous group, for example, the world-wide community of mining investors. The technical knowledge of corn farming is diffused among a complex of individuals who range from experts on hybrid seed corn to the entomology of the corn borer.

Given these dispersions of knowledge or in White's terms, its awareness,<sup>2</sup> the subjective interpretation varies considerably: Two farmers read the directions on a fertilizer bag, then apply it differently. Two motorists drive the Logan Canyon road in Utah; for one the sinuous curves following the river are a pleasurable drive, for the other accident-prone obstacles interfering with his desired speed.

A recent series of studies of the Iowa Agricultural and

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<sup>1</sup>S. V. Ciriacy-Wantrup, Resource Conservation: Economics & Policies (Berkeley: University of California Press, 1952), pp. 111-128.

<sup>2</sup>White, Natural Resource Journal, p. 27.

Home Economics Station are relevant.<sup>1</sup> One hundred and forty-four farms in western Iowa were studied since 1949 for their progress in reaching a public goal of soil conservation measured by a maximum of five tons of soil loss per acre annually. This goal was decided on by Soil Conservation Service technicians who prepared individual farm plans for each farm, designed to attain the goal but without regard to economic analysis. In Firey's construct these practices designed to effect such a goal are the set of the physically possible.

The actual soil loss was measured several times and the results for 1949 and 1957 are shown in Figure 1. Farmers were interviewed at the same time as to those practices that they thought were desirable to install. If such practices were installed the Iowa study estimated that the soil loss distribution would appear as shown by the two other curves on Figure 1. Thus the curves of actual soil loss can be taken to represent two levels of adjustment to the soil resource; the curves of desirable practices represent two levels of rising aspiration; and the technicians' goal represents an arbitrary and economically unrelated set of physically possible adjustments. In this limited sense, the curves contrast one type of technical knowledge, and the distribution of perceived common or average knowledge at two states of time.

A consideration of the conditions of knowledge under which flood-plain decisions are made comprises much of what follows, occupying the greater portions of Chapters Four and Five.

#### Evaluation Criteria

Given men with certain powers, these being ascribed to them by the assumption made by the analyst as to their rationality, and given a choice process functioning under certain conditions of knowledge, how do or should men go about making decisions?

For certain choice processes or assumptions as to man's rationality the criteria used to evaluate choice are inextricably bound up with the process. In habitual choice the criterion is

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<sup>1</sup>John C. Frey, Some Obstacles to Soil Erosion Control in Western Iowa (Ames: Iowa State College Agricultural Experiment Station Research Bulletin No. 391, 1952); R. Burnell Held and John F. Timmons, Soil Erosion Control in Process in Western Iowa (Ames: Iowa State College Agricultural and Home Economics Experiment Station Research Bulletin No. 460, 1958); Melvin G. Blase and John F. Timmons, "Soil Erosion Control--Problems and Progress," Journal of Soil and Water Conservation, XVI (July-August, 1961), 157-162.

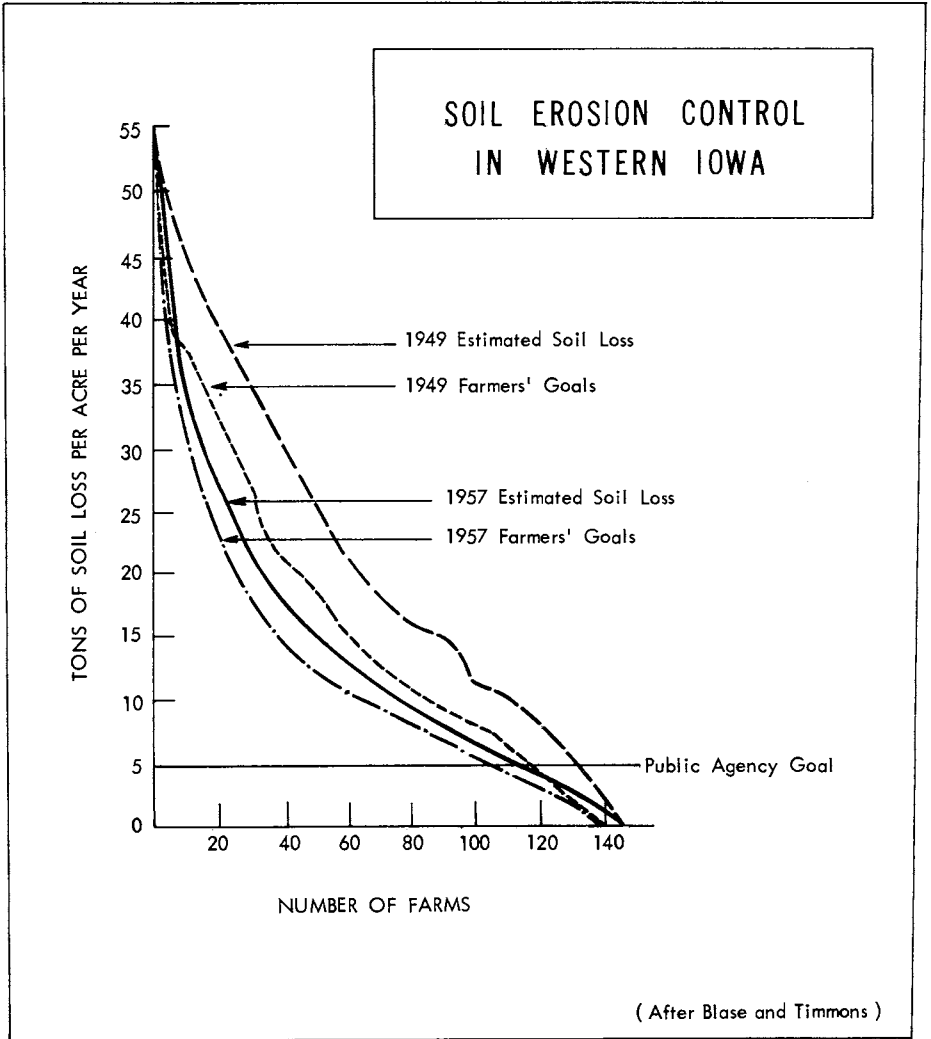


Fig. 1

to do as one did formerly in a similar situation. The criteria for psychological man dominated by affect would presumably be such affect. It is for the conscious process of choice that one might inquire as to criteria for decision making.

Prescriptive criteria.--The prescriptive studies flower in this effort. To those who desire them, simple and complex rules are available to guide choices, to advise when to secure more information, to include hunches, and the like.<sup>1</sup> The writer finds himself tempted to summarize the rules as: the optimists' rules, those designed to maximize good fortune (money, best expectation, utility, or satisfaction); the pessimists' rules designed to minimize ill-fortune (worst expectation, regret, irreversible trends); and the neutralist rule of when uncertain assume equal probability for all outcomes.

Descriptive criteria.--Most decision-making studies are either prescriptive or theoretical, few being based on observations of group or individual behavior. To these studies, one might add the growing literature of experimental choice situations developed mainly by psychologists and sociologists.

Taken overall, such studies seem inconclusive. They yield mainly negative insights by suggesting that decision makers do not adhere to many of the assumptions made in prescriptive or theoretical works.<sup>2</sup>

Among other things, there is some evidence that certain probability distributions are intrinsically valued in excess of their mathematical expectation. Disturbing for game theory constructs is the finding that some men play not to win but because they like the game or they ignore outcomes that appear threatening to them.

Many analysts adhere to "maximizing" rules, not only as prescriptive criteria but as approximations of behavior. They assert that despite their descriptive imperfections such rules best approximate and explain many types of behavior.

Seeking a descriptive rule, Simon suggests that human behavior frequently satisfies a rule that he calls "satisficing."<sup>3</sup> In this construct individuals simplify the choice of outcomes into two or three classes: satisfactory or unsatisfactory; win,

<sup>1</sup>See bibliography.

<sup>2</sup>Edwards, pp. 409-411; Herbert Simon, "Theories of Decision-Making in Economics and Behavioral Science," American Economic Review, XLIX (June, 1959), 253-274.

<sup>3</sup>Simon, Models of Man, pp. 241-260.

lose, or draw, and the like. Given such outcomes, Simon has people seeking or evaluating alternatives until they find one matching a broad class of satisfactory outcomes. In general, such an alternative is not the optimal one in the sense that it maximizes some esteemed objective. Simon also introduces a dynamic quality to the construct: if alternative solutions are not easily found, then the boundary between what is satisfactory or not might shift downward, and conversely, if a minimum solution is found with ease, the boundary might shift upward in a fashion analogous to the psychological concept of levels of aspiration.

Evaluation criteria for resource managers.--Resource management contains a body of evaluation criteria, many of which conflict. First there are the economic criteria of the market; markets that frequently conform closer to the ideal competitive situation than the oligopolistic markets of industrial society. These are followed by a host of legislative prescriptions, such as "that the benefits . . . shall be in excess of the costs" or to manage for "multiple use" or "first in time, first in right," and the like.<sup>1</sup> Overlaying this structure are the profound problems of measuring intangible or opposed values: scenic vistas vs. water skiing, salmon fishing vs. power generation, sand dune recreation vs. steel mills, and the like.

A study by the University of Tennessee Agricultural Experiment Station into the organizational problems of small watersheds, attempted to explore the criteria used by farmers in three sites of proposed P.L. 566 watershed protection projects, in accepting or rejecting such programs. They found that:

The results indicated that landowners did not consider monetary costs and benefits alone when forming opinions about the watershed program. A landowner's attitude towards the program frequently was based on one or more of the following considerations:

1. Degree of confidence in the individuals or agencies supporting the program.
2. A belief that the program would cause a personal monetary loss . . . that the money they would have to pay into the program could be invested more profitably in other uses.
3. A fear that individual rights might be infringed upon. . . .
4. A fear that some friends and neighbors would be adversely affected by the program. . . .

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<sup>1</sup>A neo-classic view of the conflict between criteria is the subject of a number of studies at the University of Chicago including: Richard S. Ablin, "Misallocation of Electric Power in the Pacific Northwest" (Unpublished Ph.D. dissertation, Department of Economics, University of Chicago, 1960); B. Delworth Gardner, "Misallocation of Resources of Federal Range Land" (Unpublished Ph.D. dissertation, Department of Economics, University of Chicago, 1960).

Many landowners had formed attitudes for or against the program on the basis of incomplete or inaccurate information about it.<sup>1</sup>

Crane, in a recent study of the replacement of small private dams breached in the 1955 flood in Massachusetts found primarily non-monetary benefit criteria used to decide on replacement.<sup>2</sup> The decisions were influenced by the rigidity of the state laws on dams and respect, or lack of respect, for their enforcement. Where partial ponds survived the breaching, these proved satisfactory, a finding relevant to the use of satisficing criteria.

To the writer, some form of satisficing best describes the variety of evaluation criteria used in reaching resource-management decisions. However, this is at best a weak observation. Evaluation criteria range from complex computer routines to the "off-the-cuff" decision and considerably more studies of an empirical nature will have to be made before reaching more useful generalizations.

Unfortunately this study does not contribute greatly to that task. Its substantive findings, discussed briefly in Chapters Five and Six, are inconclusive on this point and subject to differences of interpretation.

Decision Studies in Resources Management:  
A Comparative Table of Underlying  
Assumptions

To illustrate the use of decision-making schema in resources management and the variety of underlying assumptions found in such studies, Table 3 has been prepared. Six works have been chosen, representing that of a political scientist, a sociologist, two economists, and two geographers. Chronologically by publication date,<sup>3</sup> these are: S. V. Ciriacy-Wantrup's Resource Conservation, a pioneer study of the economics of conservation; J. Blaut's study of micro-economic geography, entitled "The Economic Geography of a One Acre Farm on Singapore Island"; Lee's Optimum Water Resources Development, which tentatively sets forth a methodology for optimal water development in

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<sup>1</sup>David W. Brown and Joseph E. Winsett, Organizational Problems of Small Watersheds (Knoxville: University of Tennessee Agricultural Experiment Station Bulletin No. 310, 1960), pp. 2-3.

<sup>2</sup>Donald Crane, "Small Dam Replacement in South-Central Massachusetts" (Unpublished Master's thesis, Department of Geography, University of Chicago, 1962), pp. 47-48.

<sup>3</sup>See bibliography for complete description of publication.

TABLE 3

## COMPARISON OF DECISION-MAKING STUDIES IN RESOURCES MANAGEMENT

Study (1)	Intent of Study (2)	Decision Area (3)	Examples or Empirical Studies (4)	Rationality Assumption (5)
S.V. Giriacy- Wantrup  <u>Resource Conservation</u>	Descriptive- predictive  Prescriptive	Flow resources	Diverse and minor	Bounded rationality
J. Blaut  "The Economic Geography of a One-Acre Farm on Singapore Island"	Descriptive- predictive	Land use	Vegetable farming in Singapore	Bounded rationality with emphasis on motivation
I. Lee  <u>Optimum Water Resources Development</u>	Prescriptive	Water resources in California	Water use in California	Economic rational man
E. Banfield  <u>The Moral Basis of a Backward Society</u>	Descriptive- predictive	Social and economic activity	Village in Southern Italy	Bounded rationality
W. Firey  <u>Man, Mind and Land</u>	Descriptive- predictive	Resources	Folk, feudal and industrial societies	Bounded rationality with strong unconscious psychological undercurrents
G.F. White  "The Choice of Use in Resource Management"	Descriptive- predictive	Resource use	Flood plains	Bounded rationality

Choice Process  (6)	Conditions of Knowledge  (7)	Evaluation Criteria  (8)
Conscious and habitual	"Best knowledge" available in given social group at a given time. This knowledge operates under risk and uncertainty grouped together	Satisficing; A safe minimum standard of conservation by preventing irreversibility of depletion
Conscious	Good knowledge of resource, inputs, etc. No distinction between risk and uncertainty. Short-term uncertainties estimated and allowed for and secular trends and long-term uncertainties ignored because of inability to deal with them	Maximize net family income subject to non-economic value constraints
Conscious	Requires data as to physical relations and time trends not yet available. Suggests devices for dealing with risk and uncertainty	Maximize dollar measures of net economic product forthcoming from alternative lines of water development
Primarily conscious with habitual and unconscious elements	A shared knowledge common to the socio-economic group within the village. A clear preference for certainty and short-term horizons, risk and uncertainty is equated with calamity: a state that cannot be planned for or dealt with but only feared	"Maximize the material, short-run advantage of the nuclear family, assume that others will do likewise." Those whose behavior is consistent with this rule are called amoral familists
Conscious, habitual, unconscious	A spectrum of knowledge but concentrated in some culturally determined norm. Uncertainty dealt with in part by "likelihood" estimate	Satisficing; meeting criteria of possible, adoptable, gainful, and likely to be done by others
Conscious, habitual, unconscious	A broad spectrum of knowledge ranging from the best scientific to almost total ignorance. Risk with discrete probabilities described as sensitivity points	Some maximizing of net present value of gains over losses but ranging from "intuitive acceptance to highly sophisticated computations"



California; E. Banfield's study of a southern Italian village, The Moral Basis of a Backward Society; W. Firey's Man, Mind and Land, an overall theory of resource use; and G. F. White's "The Choice of Use in Resource Management" which accounts for some of the elements in decision-making as applied to resource use.

For each study certain key features are shown in tabular form. These, in most cases, were deduced by the writer as a judgment of the work in question and may vary considerably from the authors' own intentions, conceptions, and methods.

The features shown in the Table are: (column 1) a judgment as to the intent of the study, that is, whether it was intended to be descriptive-predictive or prescriptive; (column 2) the area of human activity in which the decisions under consideration are made; (column 3) whether examples or empirical findings are included; (columns 4-7) the four underlying assumptions; man's rationality, type of decision processes being discussed, the conditions of knowledge under which the decisions are made, and finally the evaluation criteria used to decide choice.

The six studies were chosen, not to convey their substantive findings for Table 3 ill-serves such a purpose, but to illustrate the richness and variety of authorship, intent and assumptions found in resource management decision studies.

The intent of this volume is narrower in scope and purpose. Although it comments on various aspects of the decision process, its focus is on the conditions of knowledge under which flood plain resource decisions are made. What is the nature of flood hazard information available to flood-plain occupants? What kind of choices of adjustment do flood-plain users perceive? What is the relationship between the perception of hazard and the choice of action to reduce flood damage?