IDENTIFICATION OF THE MISSOURI PUBLIC'S PERCEPTION OF NATURAL RESOURCE PROBLEMS

A Dissertation
Presented to
the Faculty of the Graduate School
University of Missouri

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

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by
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March, 1974

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ACKNOWLEDGMENTS

The author wishes to express sincere appreciation to his advisor and committee chairman, Dr. Durward Brewer, for guidance and counsel during preparation of the dissertation. Two other committee members, Dr. J. C. Headley and Dr. Herbert Lionberger, were frequently consulted on a specific aspect of the study, and their advice was deeply appreciated.

Sincere thanks are extended to the Economic Research Service and the University of Missouri personnel who were instrumental in providing the opportunity for me to further my education. Special appreciation is extended to Dr. Neil Cook for his help in providing this opportunity.

Finally, appreciation is also extended to my wife, Phyllis, for laboring over several drafts and the entire family for their continuous encouragement, patience, and understanding throughout my graduate studies.

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CHAPTER I

INTRODUCTION

> Up to now, the decisions that have destroyed our environment have been made in the board-rooms of giant corporations, in the thousands of government agency offices protected from public scrutiny by layer on layer of bureaucracy, and even in the frequently closed committee rooms of Congress, all by the consent of a lethargic Public.
>
> --Senator Gaylord Nelson

The question of how resources are allocated is basic to the type of economic system a country chooses. In our mixed economy we have chosen to rely on market allocation while substituting other approaches only in cases of explicit market failure. In such cases, the general approach has been that of government provision of public goods and services. Theoretically, the avenue for initiating or controlling the quantity and quality of public goods and services has been through the political process.

No explicit market exists for allocating resources when collective action is needed. The consumer of publicly produced goods neither directly bids for a given supply nor determines what quantity he is willing to purchase at some price. Government agencies generally determine the quantity and quality of public goods and services to be supplied. This determination is based on an array of factors including

agencies' budgets and Executive or Legislative Branch preferences. The public's preferences can be conveyed by politicians to the Executive Branch or they can be interpreted independently by department heads or program administrators in the Executive Branch.

Planning in the public sector is a counterpart to the market place in the private sector. In the planning process, the felt need on the part of the public for collective provision of public goods and services should be appraised, and efficient allocation of resources toward production of the desired public good or service should be proposed. In this context, the planning process serves as the mechanism which determines what production possibilities are considered and how resources are combined in production. The final decision of whether or not to produce is made in the political arena by allocating or failing to allocate funds to implement a proposal.

Actions by special-interest groups concerning the Trans-Alaskan pipeline, Hell's Canyon reservoir on the Snake River, Florida barge canal, and clear cutting on National Forest lands suggest that some natural resource use and development decisions evolving from the planning process may not be in the public's best interest.[1] In the State of Missouri several reservoirs planned and funded for initial construction are being contested, giving rise to

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[1]Resources for the Future, Resources--Some Highlights of 1971 (Washington, No. 93, January, 1972).

the same question.

A review of economic literature on natural resource planning reveals considerable criticism of the planning process. Continued legal action against development, even after construction begins, and professional criticism both point to an omission in the consideration of potential public goods and services. This is not to suggest that past economic research is irrelevant but that the economic problems may be broader than what has been included in past economic models. Once it is recognized that "what" to consider for public production is not automatically guided by some "invisible hand" through the workings of the political process, then some form of corrective therapy is an appropriate economic endeavor. Just as "workable competition" has become a normative economic concept in the private sector, so could "workable consumer sovereignty" be developed as a normative concept in the public sector.

Problem Statement

The gross national product of the nation is increasing, and the public sector is becoming a more important segment of the total volume of goods and services being produced. Growth of the public sector in both absolute and relative terms emphasizes the need for making more economic decisions. It, further, reflects the growing importance of efficient resource allocation decisions in the public sector to aggregate social welfare.

The process of determining what public goods and services should be produced is being increasingly scrutinized by economists and noneconomists alike. Public and technical criticism of the allocation of public funds for specific natural resource development functions is becoming more pronounced. The general concensus is that the political mechanism for making these decisions is not operating effectively. Furthermore, modification of public decision-making models, such as cost-benefit analysis, is not expected to correct this ineffectiveness.

Economic analysis in comprehensive resource use and development planning has concentrated on developing a criterion for choosing between projects and establishing the optimum scale of selected proposals. The inability to foresee the future and adequately appraise the present in a dynamic world relates to only part of the shortcomings of economic analysis within the public sector.

The basic economic question of what public goods and services should be considered for production has been essentially ignored. It has been assumed that necessary public goods and services were identified through the political process. The problem is that such information has not been adequately conveyed in this manner. The planning institution has functioned in this capacity by default, and its actions have been biased toward specific alternatives and against change. Use of elaborate economic models to guide in the selection of an alternative for efficient

production of a bundle of goods and services makes little economic sense if the appropriate alternative has not been included in the analysis.

In the past, time and funds have constrained the type of activities employed in developing natural resource use and development plans. These constraints do not generally allow intensive sampling through personal interview techniques to identify public preferences. Omission of information about public preferences has resulted in the loss of much semblance of consumer sovereignty in the production of public goods from natural resources. In this respect, the planning framework should be reappraised and alternative approaches examined.

Objectives

The fundamental objective of the study was to develop a procedure for collecting data on public preferences which would be applicable to federal, state, and local natural resource planning activities. Cognizance of the funding and timing constraints confronted by planners caused this researcher to pursue a technique which would not require a major increase in costs or time involved. Other techniques should naturally be considered but are not included in the study.

A wide range of information on public preferences could be assembled for use by planners. The scope of the research, however, was limited to information concerning the public's perception of natural resource problems. Specific

attention was directed to water, land, and air resources and their associated attributes.

An understanding of the relationship between public preferences and socio-economic characteristics would be somewhat indicative of the social impact of various natural resource development alternatives. Limited research findings are available in the area. A comprehensive framework was used in the research to analyze the relationship between public perception of salient natural resource problems and selected socio-economic characteristics. The research was directed towards exploring a wide range of potential relationships rather than an in-depth study of the cause and effect of one or two specific associations.

The specific objectives are: (1) to develop a framework for identifying the public's perception of natural resource issues, (2) to determine the Missouri public's general concern for the natural environment, (3) to measure the public's awareness and perception of the seriousness of salient natural resource problems, and (4) to analyze the association between the public's perception of the seriousness of a problem and selected socio-economic characteristics.

A Working Hypothesis

The study was based on the underlying assumption that public decisions on natural resource use and development issues have failed to reflect the interest of society in general. Several economists have taken such a

position, and the literature suggesting this viewpoint is discussed in Chapter II.

A review of natural resource planning identifies some characteristics of the existing institutional framework that may impede the development of comprehensive multi-purpose plans which are in the general public's interest. In both cases the discussion is only of a suggestive nature. No statistical proof is presented to support the underlying assumption of the research. It is accepted, however, as a working hypothesis upon which to operate during the investigation.

Once the working hypothesis is accepted, the problem becomes: How can the economic decision-making process concerning the production of public goods and services from our natural resources be improved? The possibility investigated is to survey the general public's perception of natural resource problems in order to develop data that can be incorporated into the subjective decision-making process.

CHAPTER II

NATURAL RESOURCE PLANNING

Historical Concern for Natural Resources

Conservation and development of natural resources have been public issues for many years. Pigou, in The Economics of Welfare, contended that it was the Government's responsibility to "watch over and if need be, by legislative enactment, to defend, the exhaustible natural resources of the country from rash and reckless spoilation."[1] The present practice of oil depletion allowances which involve a subsidy to encourage oil resource depletion deviates considerably from this concept. We are, however, becoming increasingly conscious of the finiteness of these resources.

Concern for natural resources has been an issue in this country since its development. Three specific periods during which the public and the government focused on the use and development of our natural resources stand out. Fisher refers to these as the Classical Period, the Depression Period, and the Environmental Period.[2]

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[1]A. C. Pigou, The Economics of Welfare (London: MacMillan & Co., Ltd., 1960), pp. 29-30.

[2]Joseph L. Fisher, Conservation as Research, Policy, and Action (Washington, D.C.: Resources for the Future, Inc., Reprint No. 96, October, 1971), pp. 4-8.

The first period was climaxed in 1908 by the establishment of the first Governors' Conference to Consider Resource Problems. Many conservationists were associated with the movement, but two of the more prominent were Gifford Pinchot, a forester who later became Chief of the Forest Service, and W. J. McGee, an ethnologist in charge of the Bureau of American Ethnology.[3] The movement was fueled by concern over the careless and wasteful use of our natural resources during the westward movement plus the recognition of a limit to the western frontier.

The second period followed the 1933-36 depression. Results of improper land use and the drastic need for jobs and personal income for millions of unemployed centered attention on conserving and developing our natural resources. During this period extensive programs were instigated which served to foster soil, grassland, and woodland conservation and promote development of natural areas, while at the same time providing work for the unemployed.

The third period centers around the environmental quality movement of the late 1960's and early 1970's. It is characterized by a more comprehensive concern for man's total environment but is mainly directed at the three basic natural resources--water, land, and air and their associated attributes.

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[3]Henry Jarrett, ed., Perspectives on Conservation (Baltimore: John Hopkins Press, 1958), p. viii; Ernest S. Griffith, "Main Lines of Thought and Action," information corresponding to that given for Jarrett, p. 5.

Several popular books, including Silent Spring and So Human an Animal, preceded the last movement. As the movement progressed, established environmental interest groups, such as the Sierra Club and the Audubon Society, flourished with renewed activity. Relatively new groups, as the Environmental Defense Fund, World Wildlife Fund, the Wilderness Society, and the Nature Conservancy, have sprung up. All of these groups have become influential in the natural resource decision-making process.

During this time the strategies for management and development of natural resources have undergone considerable change. A general shift from project planning to comprehensive planning has taken place. Lately, the emphasis has been multi-objective planning rather than the single objective of economic efficiency.

The existence of social objectives other than economic efficiency has been recognized by governmental planners for many years. The difficulty in quantifying the effects of resource development on these objectives in a comparable manner has hampered their inclusion in an economic evaluation. Legislating the use of multi-objective planning has not solved the comparability problem, but it has forced at least token recognition of other social objectives in the planning process.

Natural Resource Planning in a Democratic Society

The democratic philosophy suggests that comprehensive resource development planning should provide a

framework for determining alternative development strategies void of any form of decision-making. In this context, the public would make all decisions directly or indirectly through elected representatives, and each citizen would have equal voice in the decision. This philosophy was conveyed by Mark Buchanan concerning comprehensive agricultural research planning. He suggested that, "Good planning deals with alternatives, priorities, and choices. It is not decision making but it can be a tremendous aid to the decision making process."[4]

To admit that planning involves decision-making by the planner, who is isolated to a considerable degree from the affected public, would be a blow to Buchanan's philosophy. The existing institutional framework for developing comprehensive natural resource development plans, however, forces the planner to be a decision maker. The planner decides what project elements will be included and at what level, thus establishing the product mix from natural resource development. The more comprehensive the plan, the more the decision-making power is shifted from the affected public to the planner.

The complexity and interdependence of natural resource use and development decisions by the public sector have been used as justification for guiding resource

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[4]Mark T. Buchanan, "Research Planning: Needs and Opportunities," Agricultural Science Review (Washington, D.C.: Cooperative State Research Service, Vol. 9, No. 4, October, 1971), p. 23.

allocation through intermediate and long-term planning. A detailed analysis of the use of program planning and budgeting systems in public sector decision-making was conducted by a subcommittee of the Joint Economic Committee of Congress in 1969. The committee's report "reflects the judgement that the implementation of public expenditure policy can be more effective if guided by the results of sound and quantitative economic analysis of available options."[5] Such guidance implies establishment of governmental planning functions and charges agencies with natural resource use and development decisions.

Decision-making of this type takes place within the governmental structures, and the planner making decisions about the product mix is essentially immune to direct public control or retaliation. The affected public may have essentially lost its "democratic" decision-making power with respect to what and how much is produced. The only decision left in the public's control may be whether or not to produce which can be controlled through the funding channels.

The question of how effectively the public can control planning decisions in the current institutional framework needs to be pursued. If comprehensive planning

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[5]Robert H. Haveman, "The Analysis and Evaluation of Public Expenditures: an Overview," in The Analysis and Evaluation of Public Expenditures: the PPB System to Subcommittee on Economy in Government of the Joint Economic Committee, Congress of the United States (Washington, D.C.: Government Printing Office, 1969), p. 9.

involves decisions on product mix and if trade-offs between alternative plan elements are made in the planning process, then how can "A comprehensive public viewpoint . . . be applied in the evaluation of project effects"?[6] This author suggests the attempt to represent such a viewpoint is beyond the present capabilities of planners. Furthermore, comprehensive planning in the past has been dominated by advocacy planning techniques, using pressure groups, public hearings, and "grass roots" advisory committees as sounding boards for determining the public's interest. Such techniques do not comply with the democratic principle of equal representation for all.

Pressure groups can only be considered representative of aggregate public interest if the basis for formulating such groups is homogeneous and no groups have been given a head start. If certain groups are already established and/or formulation of some groups would have a considerable organizational advantage over others, then such a framework cannot be expected to provide a general public point of view.

The financial support of pressure groups is an important determinant of their influence. The current distribution of income and wealth alone would suggest an unequal representation of the general public in

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[6]Senate Document 97, Policies, Standards and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources (Washington, D.C.: Government Printing Office, 1962), p. 5.

decision-making through pressure groups, even without a heterogeneous organizational base or existence of "forgotten groups."[7]

Comprehensive Versus Project Planning

Planning can be separated into two general categories--project and comprehensive. Project planning is oriented towards a team effort in planning a specific project--school, highway, drainage channel, etc. This form of planning is generally single-purpose in nature, and the decisions on what, when, and where have already been established. Project planning involves an efficient allocation of resources to accomplish a single delineated purpose. Such planning may arise from general public requests or pressure groups representing a subset of the general public. The public at large has the capability, however, to control single-purpose developments of this nature directly by voting on project financing or indirectly by voting for representatives who control such functions and support their point of view.

Comprehensive planning encompasses all single-purpose projects which need to be considered and analyzed concurrently. Achieving comprehensive planning requires that basic objectives be defined, and the general preferences of the affected public, with regards to relevant

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[7]For a discussion of the "forgotten groups" see Mancur Olson, Jr., The Logic of Collective Action: Public Goods and the Theory of Groups (Rev. ed.; New York: Schocken Books, 1971).

alternatives, be known. Senate Document 97 spelled out in great detail the framework for comprehensive planning in the use and development of water and related land resources.[8]

The economic efficiencies to be gained in comprehensive multi-purpose resource development planning preclude single-purpose development proposals in most cases. Eckstein discussed this as it relates to the interdependencies of water use within a river basin.[9] Comprehensive resource development planning requires economic decisions by the planner on what, how, when, where, and for whom certain public goods will be produced.

A product mix is specified in any comprehensive multi-purpose plan. The alternatives available to the public once a plan is presented are to accept or reject the entire package. If the existing institutional framework hampers public influence during development of a plan, then acceptance or support of the proposal by the public can no longer be assumed to indicate an optimum product mix or desirable redistribution of income. Furthermore, rejection of any multi-purpose proposal does not necessarily reflect the undesirability of any particular good or service in the product mix. The procedure used in selecting the product mix of multi-purpose, natural resource development proposals

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[8]Senate Document 97, Policies, Standards, and Procedures, pp. 1-3.

[9]Otto Eckstein, Water Resource Development (Cambridge, Mass.: Harvard University Press, 1971), p. 31.

is of paramount importance, and the problem would be expected to grow as the mix or ingredients of the package increased.

A Different Typology of Planning

Another typology of planning was helpful in considering the planning which has taken place. It divides planning into traditional, advocacy, user-oriented, or incremental categories.[10]

Traditional planning

Traditional planning of resource development prescribes goals, plans, and means. Goals reflect conventional wisdom of appropriate ratios of particular activities; for example, five acres of park per 1,000 urban city dwellers. This type of planning assumes that future needs are functions of the past, and past allocations are appropriate through time.

The use of traditional ratios is a much more acceptable approach when the project elements have been included in plans already developed and the trade-offs have been worked out over time. An example would be the designation of a recreational area for parking, camping, picnicing, playgrounds, etc. To establish ratios or standards for new project elements; such as, water quality and aesthetics, where historic ratios do not represent the true

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[10]Susan S. Fainstein and Norman I. Fainstein, "City Planning and Political Values," Urban Affairs Quarterly, Vol. 6, No. 3 (March, 1971), p. 342.

trade-offs, is questionable. A more basic criticism of the approach is that it leads toward product homogeneity and does not allow for preference changes through time.

Advocacy planning

It is recognized that a multitide of conflicting social interests exist under advocacy planning and that some of these are irreconcilable. The planning unit assumes responsibility for a particular clientele and represents its views and interests rather than attempting to plan for society as a whole. The assumption is that activities of individual planning units, working for the self-interest of individual groups, result in what is best for society as a whole. The fact that group organizations are a necessity to influence planning and existing organizations have excessive influence on plans was ignored.

Special-interest groups are very effective in influencing decisions in the comprehensive planning process. A model suggesting how environmental groups can use their influence to apply considerable pressure at the political and planning level has been developed.[11] Supposedly, these groups can apply pressure disproportionate to their actual representation of the public which emphasizes the questionability of extensive use of this form of planning.

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[11]Timothy O'Riordan, "Public Opinion and Environmental Quality," Environment and Behavior, Vol. 3, No. 2 (June, 1971), p. 202.

Advocacy planning may be an adequate approach in developing single-purpose project plans, but extensive use of advocacy planning in developing comprehensive multi-purpose plans was considered inappropriate. In a single-purpose planning framework, the planning unit's role is to plan the most effective means of providing the resource development desired by advocates of the project. The question of "what" is given, and the planning role only answers the question of "how." No consideration is given to the general public's interests.

Consideration of alternative development activities and the resultant redistribution of income, if any, are ignored under the assumption that these considerations are appropriately expressed through the political process. If a more desirable alternative exists or if the resultant income redistribution is undesirable, it is assumed that appropriate action will be taken and the proposed development will not be funded.

The growing importance of the public sector suggests the impractical of effectively airing all necessary planning decisions in the political arena. The potential for representatively reflecting all public interests through group activity is also considered improbable. These problems hamper application of advocacy techniques in single-purpose planning. The possibility is even less remote that this technique would reflect the general public's interests with comprehensive planning.

User-oriented planning

Planners attempt to discover the desires of all community members in user-oriented planning and then plan in relation to limited available resources. Goals are based on the desires of clients for facilities being planned. The client is the public in general; the rich, the politically powerful, or the members of a pressure group are not considered to be more important than other members of society.

User-oriented planning, in theory, supports the democratic philosophy. In practice, it is severely hampered by the shortcomings of the existing social welfare theory. Decision-making in user-oriented planning depends on the planner's ability to measure and compare the individual community member's benefits from public goods produced by alternative forms of resource development. An objective means of making interpersonal comparisons, however, is not available. A related problem is the inability to identify the preferences of future generations. Unless these problems are overcome, total reliance on a user-oriented planning approach is not possible.

The possibility is not precluded that user-oriented techniques may provide information valuable in decision-making. One user-oriented technique which has good potential for improving the decision-making process is random sampling and analysis of the general public's perception of existing problems and the seriousness of these problems. The public's attitudes, preferences, and

expression of "willingness to pay" for activities which could be included in a multi-purpose resource development plan may not provide an adequate basis for decision-making. They can, nevertheless, provide information that could be useful in a subjective decision-making process.

Incremental planning

Incremental planning involves decision-making on short-run marginal analysis of a limited number of alternatives. No long-run objectives are defined, and no specific end-means considerations are involved. It is suggested that such a process cannot technically be considered as planning.

The four types of planning discussed are not mutually exclusive, and planning in the natural resource field is probably a mixture of all four types. Natural resource development planning, in any case, is heavily skewed towards advocacy planning, with considerable reliance placed on traditional ratios or standards where available. If these ratios are not available, the tendency is to develop a ratio based on what is recognized at the time as very limited knowledge. Water quality and automobile exhaust emission standards are prime examples. These ratios tend to be built into the system and are difficult to change even when additional information becomes available.

Criticism of Existing Institutional Framework

Natural resource development planning has become a legitimate function of government, and expenditures for planning and development are increasing. At the same time public and professional criticism of the product mix of development plans is becoming more evident. Irving Fox, in an article discussing research on water-related problems, reflected some of these criticisms by discussing topics which suggested the following questions: (1) Has the institutional framework for making water resource development decisions tended to cater toward majority preferences and (2) Has the system of subsidies (provision of goods and services at prices below recovery costs) provided the motivation for organization of interest groups which have stronger voices in the decision-making process than those representing society in general who pays the bills?[12]

Fox recognized that the question of resource allocation in the public sector was broader than the conventional economic viewpoint and suggested:

> . . . a major problem in achieving an institutional design that accords with my concept of how the decision-making process should function is that of creating conditions whereby the diffused unorganized interests have an effective voice in deciding what information should be generated (alternatives) and what action should be taken. No system of project and program evaluation, such as benefits-costs analyses,

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[12]Irving K. Fox, "Promising Areas for Research on Institutional Design for Water Resources Management," in Implementation of Regional Research in Water-Related Problems, ed. by Dean T. Massey (University of Wisconsin: 1970), pp. 35-38.

will ever meet this problem.[13]

The apparent failure of our existing institutions in the natural resource area resulted in Schmid proposing an analytical institutional economics approach to environmental quality research. He suggested that "the majority (may not) really want a change in their life style, but if they do . . . it will require a major change in property definition and distribution and careful attention to the details of implementation and administration." Elsewhere he implied that the institutional arrangement for decision-making in the public sector was the critical mechanism "which determines the actual stream quality level (or other environmental attribute) that our cost minimization models are applied to."[14] The way individual preferences are represented through planning and management of our natural resources needs to be revised before plans can reflect the best interests of society.

Another area of criticism suggested that a new breed of nonagricultural demands requiring production of an increasingly different array of outputs from our natural resources was confusing the public decision-making process

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[13] Ibid., p. 39.

[14] A. Allan Schmid, "An Analytical Institutional Economics: Challenging Problems in the Economics of Resources for a New Environment," American Journal of Agricultural Economics, 54, No. 5 (December, 1972), p. 900.

for natural resources.[15] The environmental movement emphasized a growing scarcity of some types of environmental amenities which existed in abundance in the past and were considered to be free commodities at one time. It also suggested that associated with our affluence is a preference for environmental quality improvement. If the bundle of public goods and services is expanding, the quantity of information which needs to flow between producer and consumer should be simultaneously increased. It is doubtful that detailed information of this nature on a wide variety of products can be adequately conveyed through the planning process.

Steiner examined the literature on theoretical views concerning identification of public interest and how public interest was translated through the political process. He concluded that the development of decision models, based on existing knowledge, would be inadequate as techniques for deriving the demand for all public goods and allocating resources accordingly. He did feel, however, that economists could contribute to the decision-making process and suggested that:

> It seems to me of prime importance, however, to distinguish between the present inadequacy of our theories and the presence of a phenomenon . . . . It is less elegant, but not less scientific to take

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[15]Raymond D. Vlasin, "Some Key Issues and Challenges Posed by Nonagricultural Demands for Rural Environments," American Journal of Agricultural Economics, 53, No. 2 (May, 1971), 241; L. T. Wallace, "Future Use of Rural Resources," information corresponding to that given for Vlasin, pp. 244-46.

> as a starting point for evaluating social actions the revealed objectives of society instead of the derived ones.[16]

The determination of the public's awareness of natural resource problems and measurement of the intensity of these problems would be a step in this direction.

Allee took a very critical stand in discussing the current situation and suggested that:

> A (comprehensive) plan is a trial balloon, not a set of decisions. Agencies are not likely to commit themselves to a project selected largely on technical and economic criteria so long as local support is so crucial to the consent-building relations between themselves and the others with whom they share decisions.[17]

There should be a way of determining the public's preferences other than spending thousands of dollars for a comprehensive plan to use as a trial balloon. This author does not agree that comprehensive planning has digressed to this stage, but feels that the question is still relevant. Furthermore, why should a project selected on "sound" economic criteria diverge so radically from local preferences that it does not receive local support?

Criticism of this nature has generated from comprehensive resource development planning procedures used in

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[16]Peter O. Steiner, Public Expenditure Budgeting (Washington, D.C.: The Brookings Institute, November, 1971), p. 41.

[17]David J. Allee, "Management of Natural Resources for Optimum Development--Cutting the Cost of Decision-Making," in Issues in Natural Resource Use and Development, ed. by Dan Bromley and Loyd Fischer (North Central Regional Strategy Committee on Natural Resource Development, October, 1971), p. 37.

the past. New principles and standards for planning water and related land resources, proposed by the Water Resources Council, have been approved.[18] This multi-objective approach will in no way completely alleviate the situation discussed. The new principles and standards may allow some existing pressure groups to have a greater influence on planning and will probably perpetuate the organization of others. This undoubtedly will change the product mix presented in future comprehensive plans. A change in the evaluation framework in favor of one set of pressure groups over another does not necessarily correct an inequity. It may only tip the scale in the opposite direction.

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[18]Federal Register. Water Resources Council Proposed Principles and Standards for Planning Water and Related Land Resources (Washington, D.C.: Government Printing Office, December 21, 1971), Vol. 36, No. 245, Part II.

CHAPTER III

LITERATURE REVIEW

Public Decision Theory

Political theory which dominates the Western World is founded upon a belief in the individual's ability to act rationally in pursuit of his own self-interest and happiness. The theory, which is based squarely on the utilitarian concept, has prospered in spite of the demise of the utility concept as an economic framework for allocating resources.[1]

Several attempts have been made to explain the political process. The attempts generally have been unsuccessful in developing a theoretical framework primarily because they were only partial analyses of the problem. The investigations have been more successful in pointing out the complexity of the process than in explaining it.

Self-interest versus public-interest concepts

The descriptive writings concerning the functional framework of our public decision theory can be broken down into two general areas--the public-interest approach and the

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[1]Edwin T. Haefele, A Utility Theory of Representative Government (Washington, D.C.: Resources for the Future, Inc. Reprint No. 94, July, 1971), p. 350.

self-interest approach.[2] The public-interest approach suggests that public sector decisions do not conform to the preferences of individuals who make up society in general. Accordingly, resource allocation in the public sector should be a different allocation process than one controlled directly by the simulation of individuals' monetary expenditures for public goods or democratic representation of individual preferences through representative government.

Burkhead and Miner suggested that the public-interest theory rejected the objective function of maximizing the welfare of individual citizens per se but left nothing in its place.[3] It was not clear whether the power, prestige, or authority of the bureaucracy or some form of aggregate social welfare should transcend individual welfare. The failure to specify clearly the nature of the objective function was considered to be one of the shortcomings of the theory. The logic of the approach, nevertheless, has considerable appeal. This was expressed by M. D. Little when he suggested:

> "most people who consider the welfare of society do not, I am sure, think of it as a logical construction from the welfares of individuals. They think rather in terms of social or economic groups or in terms of average or representative men."[4]

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[2]Jessee Burkhead and Jerry Miner, Public Expenditure (Chicago: Aldine-Atherton, Inc., 1971), p. 146.

[3]Ibid., pp. 150-51.

[4]I.M.D. Little, A Critique of Welfare Economics (London: Oxford University Press, 1950), p. 49.

One attempt to clarify the social content of individual behavior has been through the concept of merit goods. Discussions and examples of the subject, however, have centered around alteration of individual preferences because of uncertainty, ignorance, or interdependent utilities on the part of the individual. The discussions have not supported a public-interest approach which includes externalities and distributional effects any more than they have suggested an expanded self-interest approach which takes into consideration "extended sympathy" or "altruism" concepts.[5]

In the self-interest approach, public decisions on resource allocation are a direct reflection of individual preferences emerging from the interplay of individual maximizers within a political framework which responds solely to individual preferences. Group or collective preferences do not deviate from preference orderings established by the interplay of individual maximizers.

A basic premise which is imposed on the self-interest approach but not the public-interest approach is the concept of consumer sovereignty. In the welfare function:

$$W = f\ (U_1, U_2 \ldots U_i)$$

where U_i represents the utility of an individual as he views it, consumer sovereignty is implied. Identification

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[5]Burkhead and Miner, Public Expenditure, p. 129.

of the welfare function from the public-interest approach would suggest identification of the U_i's partially or totally by some other sources.

The basic works in welfare economics by Pareto, Barone, Little, Lerner, Buchanan, and Tullock reflected the self-interest approach.[6] They identified consumer sovereignty as a social objective. Conventional theory rests on the value judgment that if one person becomes better off without decreasing the welfare of anyone else, welfare has been increased.[7] The subjective determination of "better off" and "without decreasing" is based upon an evaluation by the affected individual. If the welfare function is not accepted as being based solely on individual preferences, then this value judgment is not acceptable.

Welfare economics has been described as a basis for counseling with governments or communities on appropriate policy actions. Any counsel offered has depended on the value judgments upon which the theory was based, but these value judgments often were not communicated between the involved parties. Even if they were, a complete agreement has not been reached on the value premise on which welfare economics should be based.[8]

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[6] Ibid., p. 146.

[7] D. M. Winch, Analytical Welfare Economics, (Baltimore, Md.: Penguin Books, Inc., 1971), p. 27.

[8] Abram Bergson, Essays in Normative Economics (Cambridge, Mass.: Harvard University Press, 1966), p. 60.

Arrow's general possibility theorem

Kenneth Arrow explored the problem of formulating a criterion of social welfare and suggested that if a rule of collective decision-making could be found which yields a consistent ordering of alternatives, then the criterion could serve for social welfare.[9] He proceeded to construct a criterion based upon specific value judgments, which seemed appropriate, but the criterion he developed may be indeterminate except for the extreme case of consistent orderings across all individuals. If his description of the criterion is accepted, the usefulness of welfare theory becomes questionable.

Discussion of the criterion since Arrow's work has led to discounting the relevance of the theorem for both political decision theory and economic welfare theory. It has been argued that the concern of welfare economics is counseling individual citizens or communities based upon some ethical premises or value judgments and establishment of these premises "has little or no bearing on welfare economics."[10]

Arrow's criterion was constructed in an ordinal utility framework and failed to reflect any strength of individual preferences.[11] The process of representative

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[9]Burkhead and Miner, Public Expenditure, p. 46.

[10]Bergson, Normative Economics, p. 46.

[11]Ibid., p. 45.

government, however, allows these preference intensities to be weighted through vote trading by political representatives.[12] It has also been shown that if a "simple and probable type of interdependence is assumed among the individual's preference functions," the problem is trivial with large numbers of voters.[13]

Rating Scale

One of the basic problems in social sciences is development of valid and reliable measuring instruments. Measurement has been defined as a set of "rules for assigning numbers to objects in such a way as to represent quantities of attributes."[14] Economists have been plagued with unsuccessful attempts to develop an interval measurement of social welfare. The inability to establish a standarized measure of utility, allowing for interpersonal comparisons, has hampered the practical application of welfare theory in public decision-making.

In other social science fields attempts to measure characteristics, such as intelligence, perception, or attitudes, have had somewhat greater success. Summated scales, differential scales, and cumulative scales are

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[12]Haefele, A Utility Theory, p. 352.

[13]Gordon Tullock, "The General Irrelevance of the General Impossibility Theorem," The Quarterly Journal of Economics, LXXXI, No. 2 (May, 1967), p. 256.

[14]Jim C. Nunnally, Jr., Introduction to Psychological Measurement (New York: McGraw-Hill Book Co., 1970), p. 7.

three general types of scales which have been developed.[15]

The summated scale has had a relative degree of success in social science research and is probably used most frequently. In development of such scales the subjects are asked to respond to a series of items or questions. Each response is given a numerical score, and the summation of all scores for an individual is interpreted as representing his position on the measurement scale. No attempt is made to construct the questionnaire so that items are evenly distributed over the entire range of the scale as required by other techniques. This makes the development considerably easier but may limit the attainable level of measurement.

One of the more frequently used summated scales, devised in 1932, was perfected by Likert.[16] The scale, now referred to as the Likert scale, has been widely used in attitudinal studies. It makes possible the ordinal ranking of individuals in terms of the favorableness of their attitudes toward a given object. The scale does not provide a basis for saying how much more favorable one is than another.

Another broad group of scales which may provide interval measurement are referred to as differential scales. L. L. Thurstone has been instrumental in

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[15]Claire Selltiz, Research Methods in Social Relations (New York: Holt, Rinehart, and Winston, Inc., 1962), pp. 357-377.

[16]Ibid., p. 366.

developing the approach, and one method of developing the scale is referred to as the "equal appearing" intervals method.[17] Several hundred items are evaluated by a panel of judges, and the scale value assigned to each item is the median value of these judges. A small number of the items are selected from throughout the scale range to represent equal appearing intervals. By this procedure an interval scale is supposedly developed.

Considerable criticism has been raised against the Thurstone scale, and its ability to provide an interval level of measurement seems questionable. Selltiz analyzed both types of scale and also questioned their validity, but he seemed to be more acceptable to the Likert-type scales.

Two general criteria need to be met when selecting items for inclusion in a rating scale.[18] First, the items must promote responses related to the attribute being measured. Second, the scale must differentiate between people who are at different points along the dimension being measured.

In developing a summated rating scale based upon several items or questions, two assumptions are generally made relating to the weighting of individual items and the weighting of individual responses within an item. The general approach is to weight each item equally and assign

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[17] Ibid., p. 359.

[18] Ibid., pp. 357-58.

weights of 1, 2, 3, etc., corresponding from the lowest to highest individual response within an item. The approach not only assumes an equality between similar responses to all items, but it also assumes that the distance between two adjacent responses for a particular item equals one unit and equals the distance between any other adjacent response for that item.[19]

Some items may have greater importance than others, and an unequal weighting of items may be desired. A basis for making this distinction does not generally exist. A procedure known as the sigma scoring technique has been developed for allowing different weights for identical responses to different items. This approach assumes a normal distribution for the individual responses. The positive and negative deviations of the midpoints of each response category from the mean are converted to positive values called sigma scores and used as weights. The approach is rather laborious and has not proven to change the results appreciably.[20]

Another type of scale used less frequently is the cumulative scale. It is developed by ordering the items according to their intensity. If a respondent agrees with a particular item, he is expected to respond favorably to all prior items. Further, if the individual responds

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[19]William J. Goode and Paul K. Hatt, Methods in Social Research (New York: McGraw-Hill Book Company, Inc., 1952), p. 273.

[20]Ibid., pp. 273-274.

unfavorably to an item, he would be expected to respond unfavorably to all additional items on the scale. An individual's score is computed based on the number of favorable responses.

The Bogardus social-distance scale is an example of a cumulative scale which aggregates scores across individuals rather than across items. The scale represents a continuum from close association to hostility or rejection of some ethnic group. It is the classic technique for measuring the attitudes of different segments of the population toward specific ethnic groups.[21]

A detailed procedure is followed in developing word associations which represent equal appearing intervals over the complete range of the social-distance continuum. This involves analyzing approximately 100 judges' responses to a large number of statements before selecting a few statements which approximate equal appearing intervals.

Public Perception Studies

The use of such scales to measure public preferences and attitudes is a subject area germane to public decision theory but seldom emphasized in economic literature. George Katona and other researchers associated with the Survey Research Center, University of Michigan, have emphasized the economic relevance of the public's attitudes and preferences. They suggested that measurement of the

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[21]Selltiz, Research Methods, pp. 370-371.

public's attitudes toward production of public goods and services was needed as a partial basis for making public decisions. Majority preferences were not regarded as a mandate to decision makers, but it was felt that information of this type should be available and have a bearing on the decisions made.[22]

Public attitude and preference surveys have been conducted in varied subject-matter areas, including the quality of the environment and natural resource use. Some of the procedures and findings of studies in these two areas are reviewed in this section.

In a 1971 study in New York State the problem volunteered most frequently as being the most serious problem facing the community was pollution.[23] In a 1972 nationwide study of metropolitan housewives, "protection of the natural environment" and "preservation of natural resources" ranked fifth and seventh, respectively, as national problems.[24] Other studies conducted by different

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[22]Eva Mueller, "Public Attitudes Toward Fiscal Programs," Quarterly Journal of Economics, Vol. 77, No. 2 (May, 1963), p. 210.

[23]Louis Harris and Associates, Inc., The Public's View of Environmental Problems in the State of New York (May, 1971), p. 11.

[24]National Analysis, Inc., prepared for Environmental Protection Agency, "Metropolitan Housewives' Attitudes Toward Solid Waste Disposal," (June, 1972), p. 16. (Draft copy-mimeographed).

research organizations have reflected similar findings.[25]

Some researchers have focused on specific segments of the environment, such as water quality, air quality, or land use. Here, also, the findings indicated that the public perceived these topics as being nationally important issues.[26]

One hypothesis which was tested in these investigations was that the public's perception of natural resource problems and their willingness to pay for attacking the problems varied by socio-economic characteristics. In a Wisconsin water quality study, regression analysis was used, and perception of water quality was defined as the dependent variable.[27] It was concluded that concern about water pollution was unrelated to income and that women were more likely to feel that pollution was a problem than men. The study also indicated that people in small towns were more likely to consider pollution a problem than people in larger urban areas. The last conclusion was recognized by the

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[25]Rita James Simon, "Public Attitudes Toward Population and Pollution," Public Opinion Quarterly, Vol. 35, No. 1 (Spring, 1971), p. 94; Arvin W. Murch, "Public Concern for Environmental Pollution," information corresponding to that given for Simon, p. 101.

[26]H. George Frederickson and Howard Magnas, "Comparing Attitudes Toward Water Pollution in Syracuse," Water Resources Research, Vol. 4, No. 5 (October, 1968), p. 888; Metropolitan Housewives' Attitudes, p. 5; Elizabeth L. David, "Public Perceptions of Water Quality," Water Resources Research, Vol. 7, No. 3 (June, 1971), p. 454.

[27]David, Water Resources Research, p. 454.

researcher to be contrary to the general degree of pollution in small and large cities.

Another study interested in the extent of public concern for the quality of the environment concluded that the "environmentally concerned individual tends to be more liberal in sociopolitical orientation, younger, and better educated than persons who are less concerned with ecological issues."[28] It was suggested that a pluralistic constituency dedicated to environmental quality improvement may not presently exist. The study used Likert-type scaling techniques to develop five different scales referred to as conservation scale, pollution scale, power plant scale, pollution control scale, and overpopulation scale. These scales were based on thirteen to sixteen independent items.

Economists have recognized the problems associated with asking the public how much they are "willing to pay" for provision of nonmarket goods and services. People cannot be expected to know very accurately how much they would pay for goods and services they are not accustomed to purchasing. If they knew, the "free rider principle" would suggest they would not reveal their preferences accurately.[29]

Another problem is that factors, such as political party affiliation and levels of government providing the goods or services, influence the preferences for public

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[28]Louis N. Tognacci, Russel H. Weigel, et al., "Environmental Quality," Environment and Behavior, Vol. 4 (March, 1972), pp. 83-85.

[29]Burkhead and Miner, Public Expenditure, p. 46.

goods and services. For example, in a study of the Durham, North Carolina, community it was found that the degree of pollution problems as perceived by the public was positively related to willingness to pay for problem alleviation. When specific measures were proposed involving existing institutions and means of financing, however, the relationship did not necessarily hold.[30]

Acknowledging these shortcomings, the willingness to pay concept still has some credibility, and questions of this type have been asked. In a New York State study of the public's view of environmental problems, it was found that 60 percent of the respondents indicated a willingness to accept a $50 increase in family expenses to reduce pollution. When the amount was raised to $200, only 33 percent so indicated.[31]

In the same study, car owners were asked if they would be willing to pay specific additional amounts for a car with a pollution free engine. There were 60 percent who indicated a willingness to pay $200, and 81 percent were willing to pay at least $50 over their present costs. This willingness to pay was found to be positively related to income and negatively related to age.[32]

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[30]Murch, Public Concern for Environment Pollution, p. 105.

[31]Louis Harris, Public's View of Environmental Problems, pp. 128-29.

[32]Ibid., p. 45.

A detailed study of the public's perception of a local problem in Clarkston, Washington, was established for the specific purpose of "determining the nature and extent of air pollution . . . and to assemble data and information needed as a basis for remedial action."[33] This town is near a Kraft pulp mill. Public complaints about reduced visibility, damage to house paint, tarnished silver, and suspected effects on health motivated the U.S. Department of Health, Education, and Welfare to undertake the study of the area. A questionnaire was developed which attempted to measure the public's perception of air pollution along three separate continua--awareness of a problem, personal severity. Then, using Guttman scale analysis these individual indexes were combined to develop a single index of the proportion of the Clarkston population disturbed by air pollution. Twenty percent of the subjects were found to have a zero scale type reflecting essentially no awareness or concern for air pollution in Clarkston. The remaining 80 percent were distributed among the 1 to 4 scale types reflecting a low to high degree of awareness and concern.

In reviewing the literature two interesting points became apparent. The first was that no attempt was found to relate problem awareness to some physical measurement of the existence and severity of a problem. The general approach

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[33]Nahum Z. Medalia, Community Perception of Air Quality: An Opinion Survey of Clarkston, Washington (Cincinnati: Public Health Service No. 999-Ap-10, June, 1965), p. v.

has been to select a problem area and then relate perception of the problem to socio-economic characteristics. The second point was that findings of association between awareness and socio-economic characteristics were not consistent between studies.

CHAPTER IV

METHODOLOGY AND ANALYTICAL PROCEDURE

Limited research has been pursued to establish the public's opinions and preferences on natural resource issues. The project was instigated as an exploratory study in this area. The State of Missouri was selected as the geographical base for the investigation recognizing that research results would be desirable for all areas of the country if they proved valuable in a planning context.

In a democratic society all responsible members should have a voice in public decision-making. In this context, it would have been desirable to define the population of interest for the research as all eligible voters. The population referenced in the study was modified slightly to include all Missouri household heads and their spouses. A quota sampling procedure was used which forced the sample to reflect several socio-economic characteristics of the entire adult population. The perceptions of the omitted segment of the population were not expected to vary significantly from those included. Thus, the results were viewed as reflective of the entire adult population of Missouri.

An underlying assumption of the research was that consumer sovereignty was a desirable social goal which

should be preserved in some "workable" form. The procedure followed the self-interest approach in selecting the individual's perception of a problem and evaluation of its seriousness as a basic unit for decision-making in resource allocation.

Study Area

The 114 Missouri counties were organized into twenty regional planning commissions following passage of State legislation in 1966. The purpose of these commissions was to help solve common problems through state and regional planning. Economic base concepts were employed in establishing the twenty commissions, and community characteristics, such as physical and social compatibility and location of economic growth centers, were considered.

The twenty commissions represented more geographic detail than desired in the study. Therefore, they were combined into six planning regions as delineated in Figure 1. The planning region boundaries followed regional planning commission boundary lines to keep the research as meaningful as possible to the smaller planning entities. The same economic base concepts used in designating the original twenty commissions were employed in combining commissions into six planning regions.

The Northwest Planning Region has 16.7 percent of the state's land area and 6.5 percent of the state's population. St. Joseph is the dominant economic center for

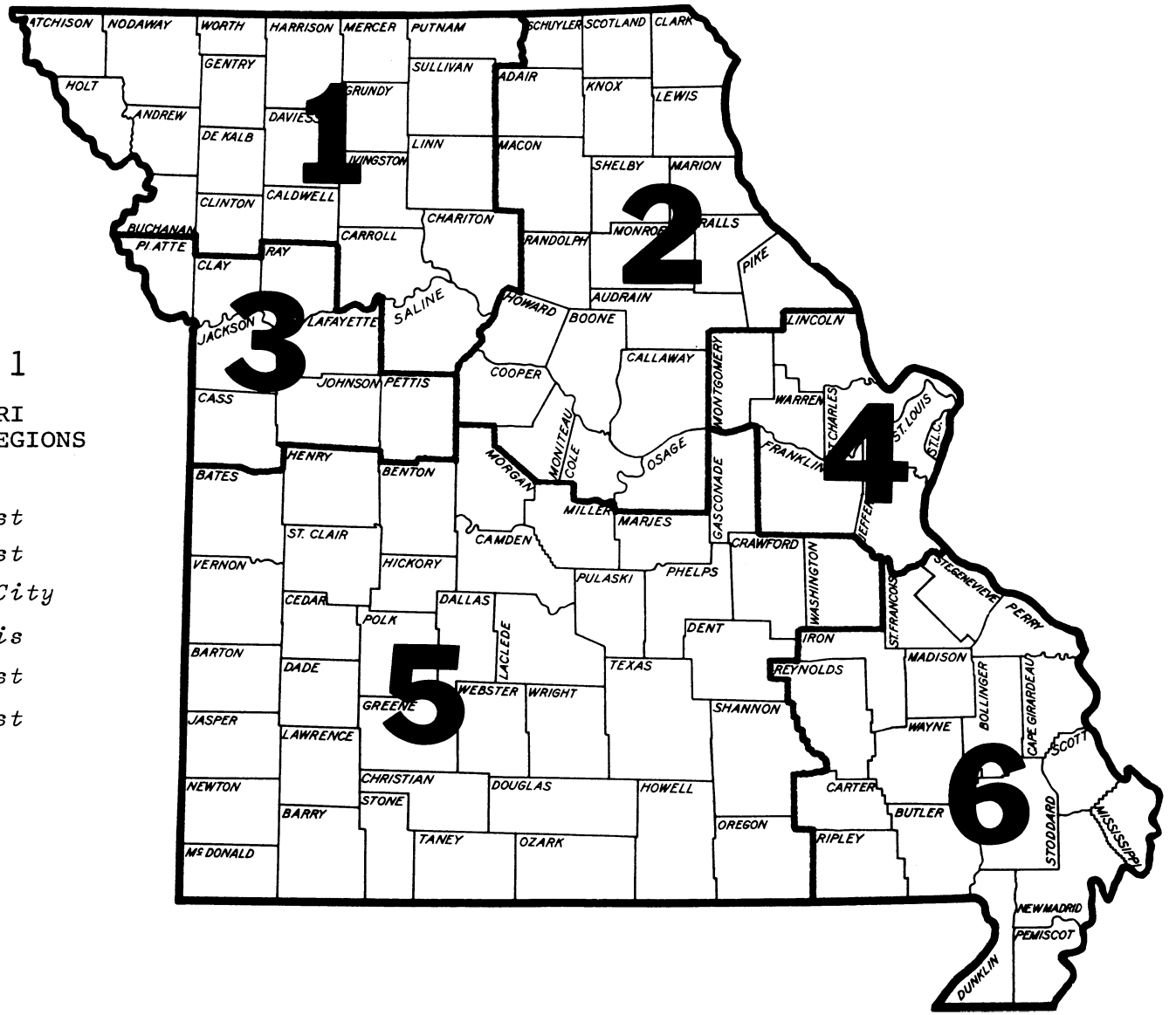

FIGURE 1

MISSOURI
PLANNING REGIONS

1 *Northwest*
2 *Northeast*
3 *Kansas City*
4 *St. Louis*
5 *Southwest*
6 *Southeast*

the region, but Marshall, Maryville, and Chillicothe with over 10,000 inhabitants also serve as smaller centers. Some soils in the region are highly suitable for intensive crop production although most are hindered by erosion and maintained in less intensive agricultural uses. The two primary mineral resources mined in the region are coal and clay.

The Northeast Planning Region has 16.6 percent of the state's land area and 8.4 percent of the population. There are several economic centers in the region, of which Columbia and Jefferson City are the largest. Other cities with a population of 10,000 or more are Hannibal and Kirksville in the northern section and Fulton, Mexico, and Moberly in the southern half of the region. Many of the river bottomlands are intensively cropped despite the existence of flooding and drainage problems. The uplands are generally maintained in grassland and woodland, but some rotational cropping is practiced. Coal is the most important mineral resource of the region.

Kansas City and St. Louis, along with the urban fringe of the two metropolitan areas, are the economic centers for planning regions 3 and 4. The Kansas City Planning Region has 7 percent of the state's land area and the St. Louis Planning Region has 6.2 percent of the land area. The St. Louis region has the largest proportion of the state's population with 39.9 percent, followed by the Kansas City region with 20.6 percent. The agricultural

sector of the two regions is of secondary importance because of the small land area involved and the prevalence of industry.

The Southwest Planning Region is the largest with 38.3 percent of the land area but with only 16.9 percent of the state's population. The economic centers with over 10,000 population include Joplin, Carthage, Springfield, and Rolla. The region is the least suitable area of Missouri for crop production, but it has outstanding scenic value. The top soils are very shallow, and the subsoils are porous allowing fast penetration of rainfall and formation of underground streams and spring outlets.

In the Southeast Planning Region, the economic centers are Cape Girardeau, Poplar Bluff, and Sikeston. The region has 15.2 percent of the state's land area and 7.7 percent of the population. The fertile delta soils are the most intensively cropped in the state. Some of the southeast counties in this region have over 75 percent of their land area under cultivation, but the rate of cultivation declines as one moves north and west. Principal mineral resources in the region are coal and zinc, but some iron and lead are mined.

Missouri ranges from densely populated urban areas with sizeable industrial complexes to sparsely populated regions. The physical terrain ranges from level delta land under intensive agricultural use to mountainous regions which are primarily tourist oriented. In the northern half

of the state the stream flows vary considerably with many of the small tributaries being dry part of the year. During low-flow periods, streams used for disposal of effluents and other wastes have a high concentration of pollutants. In the southern part of the state most of the streams are supplemented by springs and generally have higher low-flows. Stream pollution still results at points near raw sewage inputs. With such a diverse setting, a wide variety of environmental quality and natural resource use problems would be expected.

Data Collection

The development of data collection procedures was guided by the objective of utilizing a technique which would correspond with time and fiscal constraints of various planning groups. Several alternatives were considered, and the possibility of using telephone interviewing techniques or the Amalgam Statewide Survey, conducted by the University of Missouri Public Opinion Survey Unit, was investigated.

The approach selected was to contract data collection with a private research organization, National Family Opinion, Inc., of Toledo, Ohio. It maintains a current panel of households whose family members have expressed a willingness to answer mail questionnaires. A quota sample was drawn from the panel representative of the Missouri adult population on four socio-economic characteristics--age, sex, income, and population density. The sample was drawn from all household heads and their

spouses to simplify the problem of contacting different family members in a mail questionnaire. Two mail questionnaires were developed and are presented in Appendix A. Socio-economic characteristics of the respondents to these questionnaires are presented in Appendix B.

The questionnaires were developed around four basic questions:

1. How concerned is the public about the quality of the natural environment?
2. How does the public view the change that has taken place in the quality of the natural environment in their community over the last ten years?
3. Are people "willing to pay" for improvement of the quality of the water, land, and air?
4. What is the public's view of the salient natural resource problems in their communities?

Structured and unstructured questions were used in a series of two questionnaires in attempting to identify all salient natural resource problems. In the first questionnaire open-ended questions were asked concerning problems associated with the three basic resources--water, land, and air. These resources were broadly defined in an attempt to encompass all natural resource problems. Then, based on the responses to the first questionnaire, a series of structured questions were developed for a followup questionnaire to the initial respondents.

The distribution of responses to open-ended questions may not appropriately reflect the public's perception of community problems. Individuals may not be

adequately informed, may not always recall every serious problem, and may be hesitant to commit themselves because of the sensitivity of the question. Use of such responses, as representative of the public's perception of the problem, would have assumed that the omitted problems were random events. Respondents may be more prone to mentioning conventional-type problems in response to open-ended questions, and the public's perception would be skewed accordingly.

A structured series of questions was expected to minimize some of these inadequacies but would not have allowed for public identification of problems. The series of two questionnaires was expected to result in a better appraisal of the public's perception of natural resource problems than would have been developed from individual use of either questionnaire.

Data Analysis

Some of the data collected were measured in nominal units for which order has no meaning. Geographical region, occupation, and sex are classifications of this type. Other attributes, such as seriousness of a problem, population density, and family income, were measured on an ordinal basis where "equal" or "greater than" distinctions can be made.

Nonparametric statistical techniques were used in the analysis because of the nominal and ordinal level of measurement of the variables involved. The formulas for each of the statistical tests utilized in the study are

presented in Appendix C.

The distribution of all variables was not known to be normal, and some variable classifications were open-ended. It was desirable to use the same measure of central tendency throughout the study, and for this reason the median was selected.

Median values were developed for two variables, concern and seriousness. Median concern for the quality of the natural environment was established at the community and state level. Median seriousness values were developed for general problems and specific natural resource problems.

The procedure for developing median values was the same for each variable. Four adjectives, "not," "slightly," "very," and "extremely," were selected for use to infer continuous intervals on the entire concern and seriousness scales. The detailed process of developing word associations which represent equal appearing intervals was not pursued. Instead, seriousness adjectives which have been evaluated and used in many other studies were selected. These word associations were expected to approximate equal segments on the concern and seriousness continuum under study.

For analysis purposes a weight of 1 through 4 was used, 1 for not concerned or not serious up to 4 for extremely concerned or extremely serious. In the discussion a median value of 2.00 reflected the midpoint of the slightly concerned or serious category. The range of the

very serious or concerned categories was from 2.5 to 3.5. A value of 3.30 represented a point 80 percent of the way across the very serious interval.

Any progressive numbering system would be adequate for establishing median values, and equal appearing intervals are not essential for this part of the analysis. These are critical characteristics, however, for developing a problem importance index, and all median values were based on this framework to be consistent throughout the analysis.

A Chi-square analysis was used to test for independence between two variables. It indicated the likelihood of having a distribution as different from statistical independence as observed by chance alone. It did not, however, measure the degree of association which existed between two variables. The main emphasis of the analysis was to explore for the existence of covariation between socio-economic characteristics and public perception of natural resource problems.

Nonparametric correlation analysis was also used to test for linear association between all variables measured at the ordinal level. A single summary statistic which described the strength of the linear association existing between two variables was an additional output of the correlation analysis. The Kendall technique of nonparametric correlation analysis is preferred when the number of ordinal categories is small, resulting in a large

number of ties, and this procedure was used.[1]

The approach might appear to be a duplication of the analysis for ordinally measured variables. The Chi-square analysis tested for any form of association, either linear or nonlinear. The correlation analysis provided a more powerful test for a linear association but was inappropriate for identifying nonlinear associations. Use of both techniques provided a basis for suggesting the existence of either type of relationship. The employment of only one of the analysis techniques would have meant using a less powerful test than was available for detecting linear relationships or using a technique inappropriate for detecting nonlinear relationships.

Physical condition as a variable

Statistical tests for association do not identify the existence of a cause and effect relationship. A diagrammatic representation of some of the relationships thought to influence the public's perception of natural resource problems is presented in Figure 2. The combined influence of these relationships was believed to more nearly reflect the real world, but this complicates the picture for making inferences from research findings.

The solid line in the figure suggests that the public's perception of natural resource problems is the

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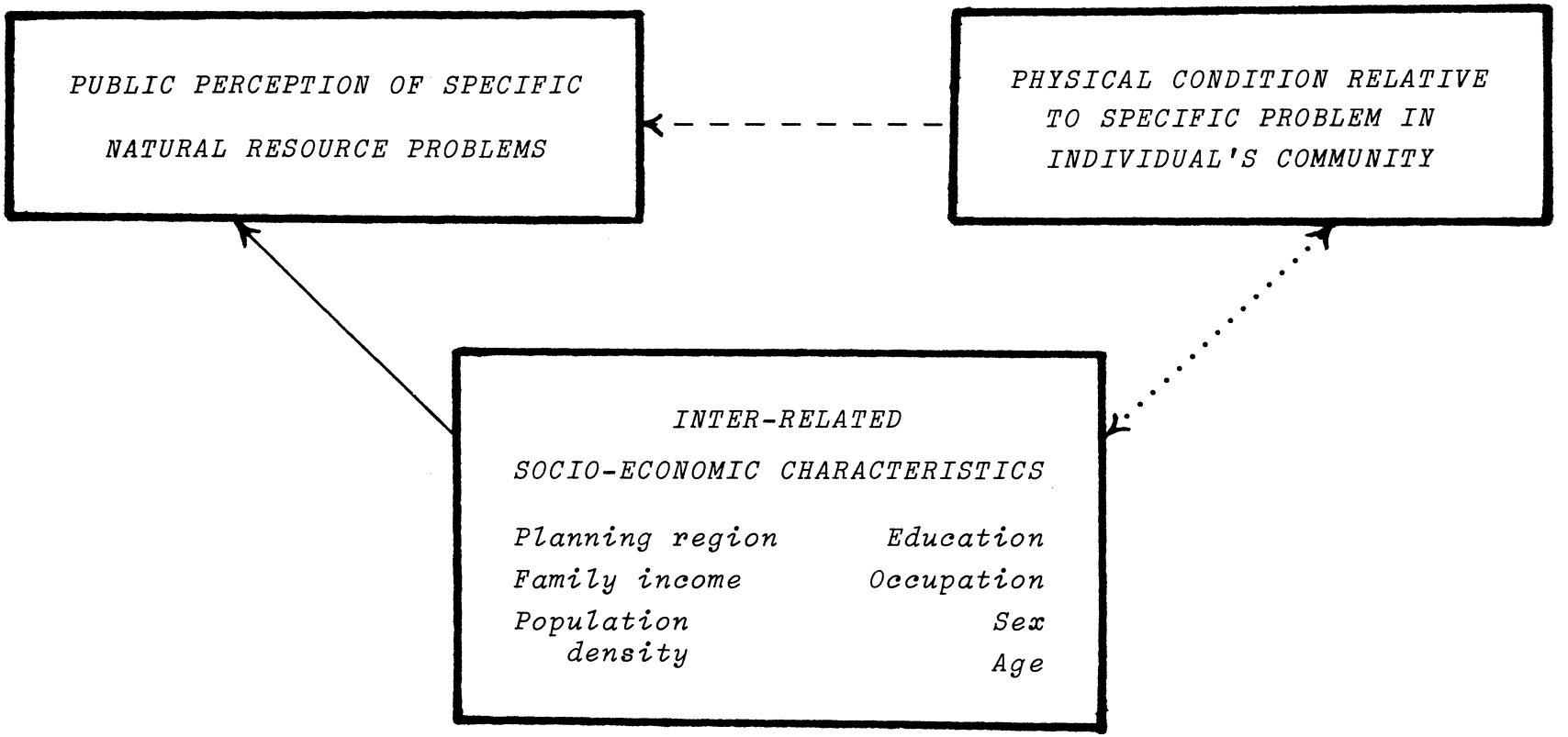
[1]Norman H. Nie, Dale H. Bent, and C. Hadlai Hull, Statistical Package for Social Sciences (New York: McGraw-Hill, 1970), p. 153.

FIGURE 2

DIAGRAMMATIC MODEL OF SOME RELATIONSHIPS WHICH INFLUENCE THE PUBLIC'S PERCEPTION OF NATURAL RESOURCE PROBLEMS



direct result of the individuals' socio-economic characteristics. Public perception studies which have included only information on socio-economic characteristics tended to operate in this framework. The dashed line suggests that the public's perception is the direct result of the physical features of the natural environment in the respondent's community. The dotted line suggests that a relationship exists between the physical condition and the inter-related socio-economic characteristics.

Past research tended to ignore any influence of the physical condition upon public perception. If the existing physical condition influences perception as suggested, studies of large geographic areas which omitted the physical condition as a variable, but had definite physical variations, may have resulted in erroneous conclusions. Studies of small geographic areas could have been based on the assumption of a constant physical environment throughout the study area, but such a justification statement was not found in reviewing past studies.

The physical condition at each sample point in the study was not known, and identification of this type of information would have been very complex. Further study in the area would involve measuring aspects of the environment, such as aesthetic quality, for which no universally accepted standard units of measurement are available. The existence of some of the relationships suggested in Figure 2 cannot be examined until research quantifying these

aspects of the physical environment are conducted.

An attempt was made to quantify the quality of the air in the respondent's community. The Missouri Air Conservation Commission has monitored the quality of the ambient air at various locations throughout the state. Two measures, settleable particles and suspended solids, were used as a basis for development of a high, medium, and low air quality deterioration code for each Missouri county. The county rating was based on the mean value for the six-month period from January 1, 1971, to July 30, 1971.[2]

Counties with no monitoring station were assumed to have the least air quality deterioration and were given a "low" rating. Monitored counties with a mean value of 25 tons or more of settleable particles per square mile or 75 micrograms or more of suspended solids per cubic meter were given a "high" air quality deterioration rating. Monitored counties with mean values below these figures were given a "medium" rating. County air quality deterioration ratings are summarized in Figure 3. Such a delineation was recognized to be merely an approximation of the actual community situation.

The air quality variable was used in a partial non-parametric correlation analysis to further examine the relationship between socio-economic characteristics and public perception of air quality problems. The technique

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[2]Missouri Air Conservation Commission, Missouri Air Quality January-June 1971 (Jefferson City, Mo.).

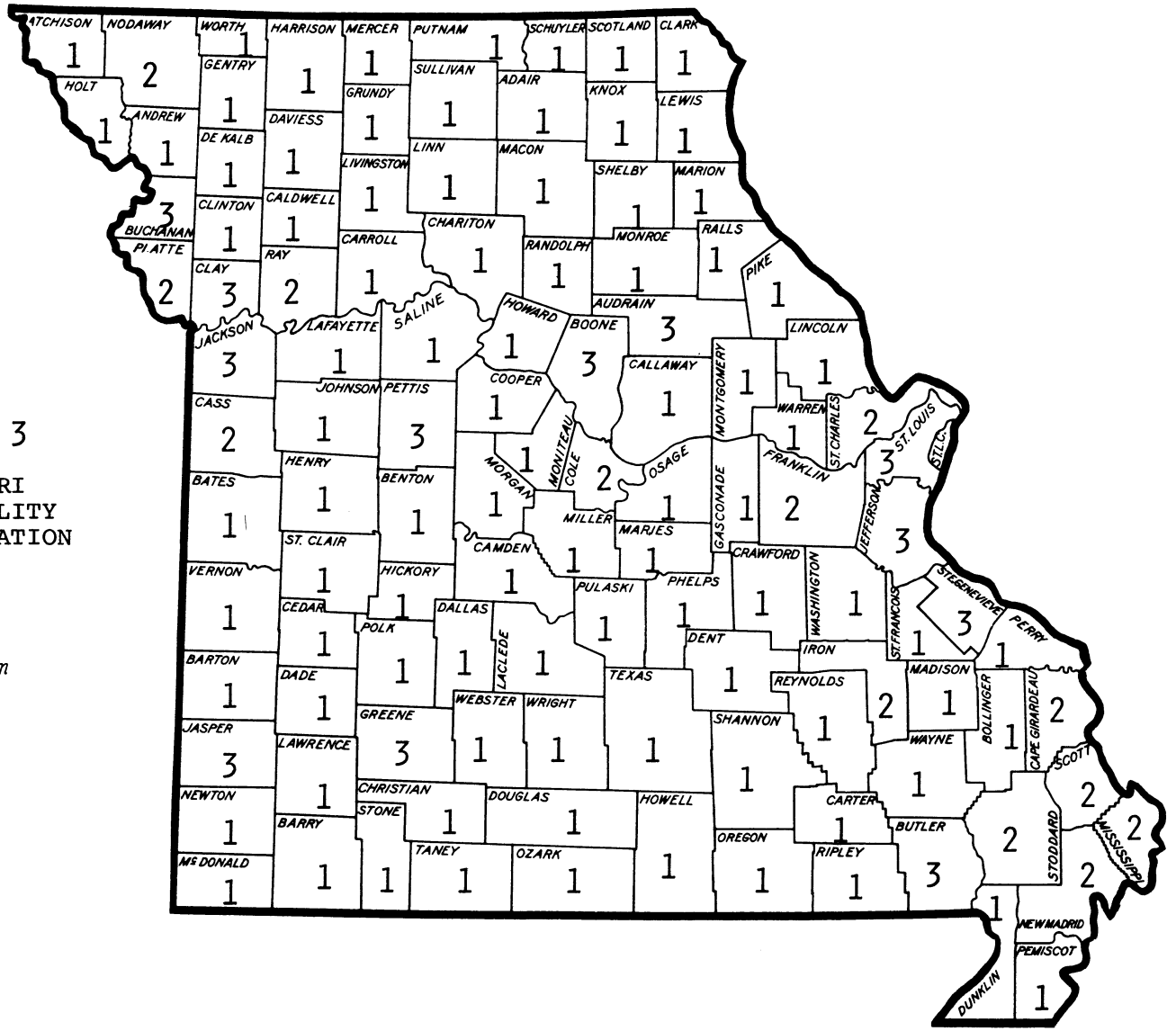

FIGURE 3

MISSOURI
AIR QUALITY
DETERIORATION

1 Low

2 Medium

3 High

was used to suggest spurious relationships and provide an underlying basis for suggesting causal inferences.

Importance index

An absolute measure of the social benefit resulting from the alleviation or reduction in intensity of a specific salient problem would be very useful in planning. Identification of such a measure was beyond the scope of the research. An attempt was made to use the data collected on the public's perception of specific problems as a basis for developing a problem importance index. The basic assumption was that the importance the public attached to a specific natural resource problem was directly related to the improvement in social welfare forthcoming through alleviation of the problem.

The individual utility received from a good or service was recognized to be a function of more than one factor. The individual's consumption level was considered the dominant variable, but others included the means of financing production, the consumption level and general welfare of others, and the individual's capacity for satisfaction.

In the research, the individual's evaluation of the existence and seriousness of natural resource problems was assumed to be highly correlated with the utility the individual would receive from the alleviation or reduction of the intensity of the problem. The importance of a problem was recognized to be a less than perfect surrogate

for utility but was suggested as being indicative of the gross social benefit forthcoming from diminishing or alleviating a natural resource problem.

Some scaling techniques used in other social sciences were employed in developing such an importance index. The index was computed by adding across individuals to scale items rather than aggregating across items to scale individuals as most scales have been developed.

Data were collected on a respondent's awareness and perceived seriousness of forty-seven salient natural resource problems. The importance index was developed by combining the two characteristics, awareness and seriousness, into categories of no problem, a problem which was slightly serious, a problem which was very serious, and a problem which was extremely serious. Each of these classifications were viewed as being an interval on a broad continuum of problem seriousness.

For analytical purposes a weight of 0 to 4 was assigned to each seriousness category--0 being no problem and 4 a problem which was extremely serious. The importance index of each specific problem was developed by summing the seriousness weight associated with that problem for each respondent. There were 578 respondents to the second questionnaire, and the procedure established a scale with a potential range from 0 to 2,312.

The appropriateness of the weights was examined by using the sigma scoring technique to standardize the

responses and develop different weights for each problem. Only minor modifications in the importance index resulted with the sigma scoring technique, and the results are compared in Appendix D.

A problem confronted in developing the index was that different combinations of responses resulted in equal importance indexes. For example, one response of extremely serious was equal to two responses of slightly serious or four responses of not serious. In general, such equal combinations would be expected to reflect social indifference of one action over another. Further investigation would be necessary to determine whether the word associations selected reflected the appropriate combinations. Such an investigation was not undertaken but would be necessary before the use of an importance index concept could be widely used as a tool in comprehensive planning.

In developing the importance index, problem seriousness was assumed to be a continuous variable which all individuals applied consistently across similar types of problems. That is, if an interval seriousness scale existed and the division between not serious and slightly serious for a particular individual was 1.5 units for one problem, it would be the same for all other natural resource problems. Any problem with a scale value of less than 1.5 units would be arbitrarily referred to as not serious.

A more substantive basis for the development of the scale and its economic value needs to be further

investigated. Detailed testing for word associations representing equal appearing intervals and scale validity and reliability are needed. In this respect, the scale can only be viewed as an initial thrust which appears to have considerable potential and needs further exploration.

CHAPTER V

PUBLIC PERCEPTION OF THE QUALITY OF THE NATURAL ENVIRONMENT

Natural resource managers and planners are a dominant force in establishing the quality of the natural environment. Subjective decisions concerning trade-offs between environmental quality and other social objectives are inherent in natural resource use and development plans. The present subjective decision-making process does not attempt to objectively ascertain the general public's preferences. The process could be enhanced through consideration of descriptive data on the general public's perception of their environment.

Primary data were collected and analyzed on the public's perception of general aspects of the natural environment and specific salient natural resource problems. Results of the analysis of the general aspects are reported in this chapter, and results of the specific problem analysis are summarized in the following chapter.

General Concern

The quality of the natural environment has been a major national concern for the past several years. It has received recognition in national political campaigns,

newspapers, and State of the Union messages. National and regional surveys have suggested that the public views environmental quality as a local and a national problem, ranking it as one of the five most important community or national problems.

The concern Missourians have for the quality of the natural environment at the local community level and for the state as a whole was analyzed. Respondents were found to be atypical of national trends. Approximately 61 percent were extremely or very concerned about the quality of the natural environment within their respective communities, as shown in Table 1. A slightly larger percent were concerned about the quality of the natural environment at the state level.

TABLE 1
RESPONDENTS' CONCERN FOR THE QUALITY OF THE NATURAL ENVIRONMENT AT THE COMMUNITY AND THE STATE LEVEL

Degree of Concern	Community Concern		State Concern	
	Number	Percent	Number	Percent
Not concerned	27	3.7	16	2.2
Slightly concerned	237	32.4	214	29.2
Very concerned	326	44.5	344	47.0
Extremely concerned	118	16.1	109	14.9
No response	27	3.3	49	6.7

The quality of specific natural environmental attributes varies widely in the State of Missouri. In such a diverse setting, individuals in different regions were expected to view their local environmental situation differently. They also were expected to have different views

of the local and the statewide situation. A comparison of the median degree of concern at the community and the state level did not reflect this differentiation, Table 2. Most of the regions were more concerned at the state level, but very small differences were found. The median value for the entire study area was 2.78 for community concern and 2.83 for state concern.

TABLE 2
RESPONDENTS' MEDIAN CONCERN FOR THE QUALITY OF THE NATURAL ENVIRONMENT AT THE COMMUNITY AND THE STATE LEVEL BY PLANNING REGION

Planning Region	Median Community Concern	Median State Concern
Northwest	2.70	2.70
Northeast	2.68	2.75
Kansas City	2.79	2.81
St. Louis	2.90	2.90
Southwest	2.49	2.71
Southeast	2.85	3.00
All Regions	2.78	2.83

No wide variation in median community concern between regions was found. The Southwest Planning Region had the lowest value of 2.49, compared to the highest value of 2.90 for the St. Louis Planning Region. Although the intensity of the public's perception of specific problems was expected to vary widely from region to region, it was not reflected in these values. Apparently, each region has a composite environmental situation about which people are substantially concerned even though the specific problems may differ.

The Kansas City, St. Louis, and Southeast Planning Regions appeared to exhibit a higher degree of community and state concern for the quality of the natural environment than the other three regions. The distribution of the varying degrees of community and state concern, by planning regions, was analyzed with a Chi-square test. The null hypothesis of no difference in community concern between planning regions was tested and rejected, Table 3. In a similar null hypothesis test for state concern, the Chi-square value was 21.60 with fifteen degrees of freedom which was not significant, ($.10<P<.20$).

TABLE 3
RESULTS OF A CHI-SQUARE TEST FOR INDEPENDENCE BETWEEN COMMUNITY CONCERN AND SELECTED SOCIO-ECONOMIC CHARACTERISTICS

Socio-economic Characteristics	Computed Chi-square Value	Degrees of Freedom	Significance Level
Planning regions	31.72	15	.01
Population density	30.47	15	.01
Family income	18.74	12	.10
Occupation	74.89	27	.001
Sex	2.27	3	.50
Age	21.09	15	.20
Education	25.13	9	.01

A tendency to place higher weights on more geographically immediate problems would suggest a basis for some regional variation in state concern. Respondents were all from the same state, however, and should have evaluated the same composite situation as a basis for expressing

concern at this level. Less variation at the state level was, therefore, to be expected.

Past research has indicated that the environmental quality movement has been more pronounced among individuals with certain socio-economic characteristics. A Chi-square analysis was used to test the null hypothesis of independence between community concern and several other socio-economic characteristics--income, population density, occupation, education, age, and sex. The analysis suggested that the null hypothesis should be rejected at the 5 percent level of significance for three of these socio-economic characteristics--population density, occupation, and education.

It should be cautioned that interrelationships between the variables may have been the cause of the significant variation rather than the direct influence of the variable itself. For example, the occupational groups with an above average degree of concern for the natural environment were concentrated in the major urban areas. Occupation may have been associated with community concern through an indirect, rather than a direct, relationship with geographic location. This pointed out some of the problems of drawing inferences from the results and emphasized the need for analysis techniques which would permit the influence of some variables to be controlled.

Relative Importance of General Problems

Over 90 percent of the respondents suggested they were concerned about the quality of the natural environment at the community and the state level. To establish the relative importance of this problem, the public's perception was compared with other problems. Information on the awareness and seriousness of several nationally recognized problems, including the quality of the natural environment, was collected and is summarized in Table 4.

TABLE 4
RESPONDENTS' AWARENESS AND PERCEPTION OF SERIOUSNESS OF FOUR NATIONAL PROBLEMS AT THE COMMUNITY LEVEL

Problem	Percent Aware	Median Seriousness
Drug addiction	89	2.64
Crime	93	2.18
Quality of natural environment	84	2.04
Welfare of poor	81	2.08

The quality of the natural environment, as a community problem, was indicated by 84 percent of the respondents. They were more aware of two other problems, drug addiction and crime, but less aware of the problem of welfare of poor. The median seriousness of the quality of the natural environment as a problem in the respondents' communities was 2.04, the lowest value of all four problems. Although the Missouri public apparently did not consider the quality of the natural environment as the most

important problem in the state, the research did establish it as an important problem.

Natural Environmental Quality Change

All members of the public did not feel that every component of the natural environment was deteriorating. In fact, more people viewed the quality of the water and land resource as having improved or not changed than thought it had deteriorated, Table 5. Over 20 percent of the respondents viewed the quality of the water and land resource as having improved over the last ten years. Another 29 to 34 percent felt that the quality of the resource had not changed. Water quality deterioration was thought to exist by 31 percent of the respondents, and 33 percent felt land quality had deteriorated. Only 40 percent of the respondents felt air quality had improved or not changed; whereas 48 percent suggested it had deteriorated.

TABLE 5
RESPONDENTS' PERCEPTION OF CHANGE IN WATER, LAND, AND AIR QUALITY OVER THE LAST TEN YEARS

Degree of Change	Percent of Public Indicating Change		
	Water Quality	Land Quality	Air Quality
Greatly deteriorated	10.0	7.9	21.4
Slightly deteriorated	21.4	25.1	26.8
No change	34.3	28.8	27.0
Slightly improved	13.5	16.0	10.2
Greatly improved	10.0	5.9	3.0
Don't know	9.6	14.5	9.8
Total	100.0	100.0	100.0

Many respondents who thought water, land, and air quality had not deteriorated also expressed a concern for the community environment, indicated that a problem of some degree of seriousness existed, and expressed a willingness to pay for quality improvement in these problem areas. Environmental deterioration is generally considered to be the dominant factor behind the environmental movement. The results suggested that deterioration was not a prerequisite for desiring quality improvement and outward shifts in the demand for environmental quality may also contribute to a disequilibrium condition.

The combination of shifts in the supply and demand for public goods and services will determine the direction and rate of change in the quality of the environment needed in the years ahead. It is important that both functions be better understood before policy instruments for regulating environmental quality through time are finalized. For example, rigid devices, such as quality standards, would be ineffective if major temporal shifts in the demand or supply of environmental quality aspects were anticipated. If such a policy instrument were used, it would be necessary to develop some mechanism for periodic adjustment in the future. Otherwise, the system would tend to be locked in on a particular quality level and not allowed to change as needed.

Water, Land, and Air Quality Problems

Respondents were asked to specify the seriousness of the natural resource problems associated with the water, land, and air components. Those reflecting the view that a problem of some degree of seriousness existed were considered to be aware of a problem for that particular natural resource component. The seriousness of problems related to the three basic components of the environment is summarized in Table 6. Community water quality problems of some degree of seriousness were suggested by 75 percent of the respondents. Land quality problems were perceived to exist by 72 percent of the respondents, and 78 percent were aware of air quality problems.

TABLE 6
RESPONDENTS' PERCEPTION OF THE SERIOUSNESS OF WATER, LAND, AND AIR QUALITY PROBLEMS

Degree of Seriousness	Percent of Respondents Indicating Seriousness		
	Water Quality	Land Quality	Air Quality
Extremely serious	7.4	3.6	10.7
Very serious	17.1	14.8	20.4
Slightly serious	30.3	29.5	26.6
Not serious	20.4	23.9	20.6
No problem	19.3	15.6	15.8
Don't know	4.5	9.8	3.4
No response	1.1	2.9	2.5
Total	100.0	100.0	100.0

The median seriousness of the water, land, and air quality problems was computed on a 4-point scale. The value was 2.07 for water quality and 1.90 for land quality.

Median seriousness for air quality was 2.20, the highest for the three components. The analysis suggested that Missourians, in general, were most aware of air quality problems and considered problems associated with this component of the natural environment to be the most serious.

The distribution of awareness by socio-economic characteristics is summarized in Table 7. Air quality differences between urban and rural areas are one of the more prominent physical divergences in Missouri's natural environment. A similar divergence in the public's perception was illustrated with 53 percent of the rural respondents and 90 percent of the largest urban group expressing an awareness of air quality problems.

Public awareness of water and land quality problems was generally greater for urban groups than rural, but the difference was not as pronounced as for air quality. Further, the positive relationship suggested between urban-size categories and perception of an air quality problem was not apparent for the water and land quality problems.

The awareness of water, land, and air quality problems was greatest for the middle income groups, with 81 percent of the respondents in the $12,000 to $14,999 income group aware of one or more water quality problems. The highest community awareness rate for other problems was represented by the $8,000 to $11,999 income group with 78 percent of the respondents indicating an awareness of land

TABLE 7
RESPONDENTS' AWARENESS OF WATER, LAND, AND AIR QUALITY PROBLEMS, BY SOCIO-ECONOMIC CHARACTERISTICS

Socio-economic Characteristics	Percent of Respondents Aware of Problems		
	Water Quality	Land Quality	Air Quality
Population Density			
Rural	74	64	53
Urban:			
Less than 50,000	70	77	75
50,000-499,999	84	72	84
500,000-1,999,999	75	72	86
2,000,000 and over	77	75	90
Family Income			
Less than $4,000	73	62	67
$4,000-$7,999	70	65	69
$8,000-$11,999	75	78	90
$12,000-$14,999	81	75	83
$15,000 and over	77	74	77
Age			
Less than 25	88	83	75
25-34	75	74	82
35-44	76	81	84
45-54	81	76	81
55-64	73	69	76
Over 64	70	56	69
Planning Regions			
Northwest	73	61	59
Northeast	73	77	71
Kansas City	77	73	85
St. Louis	78	75	90
Southwest	69	65	57
Southeast	78	72	67

quality problems and 90 percent an awareness of air quality problems.

Why middle income groups should be more perceptive of water, land, and air quality problems was not fully understood. One hypothesis for the decline in higher income groups was that these groups can afford to partially circumvent their quality problems through relocation or purchase of environmental resources. If the hypothesis is correct, then higher income groups are generally confronted with less severe circumstances than middle and low income groups. For example, affluence may allow higher income groups to live in more desirable areas, purchase membership to organizations which provide recreational activities and aesthetic amenities, and actually buy a desired environment through a second home or a rural acreage. On the other end of the income scale, the situation may be just reversed. The lower income groups may have other economic problems so severe that they tend to discount or ignore the less-pressing environmental quality problems.

The distribution of awareness by age groups was visually examined. In almost every case the four age groups below fifty-five had an above average awareness of water, land, and air quality problems while the two older age groups were below average in awareness. This suggested the existence of an association between awareness of quality problems associated with the three basic components of the

natural environment and age but no definite linear trend was apparent across all three problems.

Geographical variations in awareness were greatest with respect to air quality problems and ranged from 57 percent in the Southeast Planning Region to 90 percent in the St. Louis Planning Region. Land quality problem awareness varied from 61 percent in the Northwest Planning Region to 77 percent in the Northeast Planning Region. Water quality problem awareness varied from 69 percent in the Southwest Planning Region to 78 percent in the Southeast Planning Region. The variations can generally be rationalized on differences in the physical situation, but other factors may have been involved.

A comparison of the median seriousness of water, land, and air quality problems by socio-economic characteristics was conducted using the 4-point median seriousness scale. The results are summarized in Table 8. The same distributional patterns displayed by awareness were evident in the median seriousness analysis. Rural respondents rated water, land, and air quality problems less serious than urbanites. The most serious problems were perceived by one of the middle income groups. The 45-54 age group viewed water and land quality problems to be the most serious while the 35-44 age group held the most serious perception of air quality problems. From a regional standpoint, the problems were generally perceived to be more

TABLE 8
MEDIAN SERIOUSNESS OF WATER, LAND, AND AIR QUALITY PROBLEMS AS PERCEIVED BY RESPONDENTS, BY SOCIO-ECONOMIC CHARACTERISTICS

Socio-economic Characteristics	Median Seriousness		
	Water Quality	Land Quality	Air Quality
Population Density			
Rural	1.83	1.57	1.33
Urban:			
Less than 50,000	2.02	1.36	1.65
50,000-499,999	2.00	1.83	1.78
500,000-1,999,999	2.25	2.02	2.22
2,000,000 and over	2.17	2.15	2.83
Family Income			
Less than $4,000	2.04	1.78	1.76
$4,000-$7,999	2.02	1.86	2.06
$8,000-$11,999	2.13	2.98	2.22
$12,000-$14,999	2.10	1.95	2.68
$15,000 and over	2.08	1.88	2.26
Age			
Less than 25	2.29	2.07	1.67
25-34	2.17	2.00	2.43
35-44	1.88	1.76	2.67
45-54	2.24	2.16	2.30
55-64	2.13	1.83	2.18
Over 64	1.88	1.63	1.84
Planning Regions			
Northwest	1.87	1.43	1.18
Northeast	1.98	1.41	1.57
Kansas City	2.21	1.93	2.17
St. Louis	2.18	2.15	2.83
Southwest	1.79	1.81	1.47
Southeast	2.50	1.36	1.88

serious in the two metropolitan planning regions. One exception to the later generalization was the median seriousness of water quality problems. Median seriousness in this case was greatest for the rural Southeast Planning Region.

Regional variation in public awareness and seriousness of natural resource problems was expected because of the diverse physical condition. The variation found was generally in the direction expected based on the limited physical information available. Further research would be needed to develop a substantive basis for testing hypotheses about the causal relationships involved. It is necessary to identify such relationships, however, before the distributional impacts of various environmental actions can be fully identified.

Expression of Willingness to Pay for Improved Quality

Identification of the preference intensities for specific public goods and services is a necessary input in economic resource allocation models. Expression of willingness to pay in monetary terms is a desirable measurement in this regard because of the comparability characteristics of the numeraire. Responses to questionnaires on willingness to pay have not proven to be a totally accurate basis for predicting consumer behavior in the private sector. Responses regarding public goods are

inclined to be even less reliable because of the intangible characteristics of many of these goods, the incentive to misrepresent the actual value, and the absence of a forced monetary evaluation such as that which takes place in purchasing a private good.

Development of detailed questions about specific public goods which would minimize the influence of the factors tending to bias responses was not in line with the exploratory nature of the study. Instead, a more general question of the respondents' willingness to pay for water, land, and air quality improvement was asked.

The limited usefulness of such responses was recognized. Quality improvement of a natural resource component was a vaguely defined product which may have meant different things to different respondents. Furthermore, the influence of the free-rider principle would have been expected to bias the responses. The responses would not suffice as input data for economic resource allocation models and were not intended as such. They do convey a general concept of the benefits from quality improvement, and periodic collection of the data would reflect shifts in willingness to pay.

Analysis of the responses suggested that 74 percent of the state's adult population were willing to pay something for water quality improvement, 67 percent were willing to pay something for land quality improvement, and 72 percent were willing to pay something for air quality

improvement, Table 9. There were 26 percent of the respondents who were unwilling to pay for land quality improvement, and approximately 20 percent were unwilling to pay for water or air quality improvement.

TABLE 9
EXPRESSION OF ANNUAL WILLINGNESS TO PAY FOR WATER, LAND, AND AIR QUALITY IMPROVEMENT

Annual Payment	Percent of Respondents Willing to Pay for		
	Water Quality	Land Quality	Air Quality
Nothing	19.9	25.8	20.5
Less than $10	28.7	26.5	26.0
$10 - $24	21.6	19.4	20.9
$25 - $49	8.5	6.7	9.6
$50 - $74	4.9	4.8	4.9
$75 - $99	1.8	1.5	2.2
Over $99	8.5	8.5	8.7
No response	6.1	6.8	7.2

Slightly over 6 percent of the respondents did not answer the question. Some commented on the vagueness of the question or improper use of present tax monies. The percentage of respondents willing to pay something may have been higher if the products had been more explicitly defined and the use of the monies collected specified.

Data on the median amount respondents were willing to pay for quality improvement were computed by income group. The median expression of willingness to pay across all income groups was $8.93, $7.84, and $9.97 annually for water, land, and air quality improvement, Table 10. If the median amounts were based only on those respondents expressing a willingness to pay some positive amount, the

values for the respective natural resource components would increase to $15.74, $15.54, and $17.30 annually.

TABLE 10
MEDIAN EXPRESSION OF ANNUAL WILLINGNESS TO PAY FOR WATER, LAND, AND AIR QUALITY IMPROVEMENT, BY INCOME GROUP

Income Group	Median Willingness to Pay Annually for[1]		
	Water Quality	Land Quality	Air Quality
Less than $4,000	$ 4.60	$ 2.60	$ 4.17
$4,000 - $7,999	8.72	6.17	8.22
$8,000 - $11,999	8.70	7.72	9.77
$12,000 - $14,999	13.25	9.67	15.00
More than $14,999	19.11	11.61	18.47
All groups	$ 8.93	$ 7.84	$ 9.97

[1]Respondents willing to pay nothing are included in the median computation.

A strong relationship between willingness to pay and income was suggested. As income increased, the median expression of willingness to pay annually for quality improvement in all three resource components increased substantially.

Another view of the income effect was developed by examining the percentage of respondents expressing a willingness to pay various amounts for water, land, and air quality improvement on a yearly basis, Table 11. As income increased, a larger percent of the respondents expressed a willingness to pay for improved quality, as seen by moving down the "willingness to pay more than" columns. Similar examination of the "willingness to pay nothing" column reflected a smaller percent of the respondents were unwilling to pay something as income increased.

TABLE 11
EXPRESSION OF ANNUAL WILLINGNESS TO PAY FOR WATER, LAND, AND AIR QUALITY IMPROVEMENT BY INCOME GROUP

Income Group	Willingness to Pay More Than					Willingness to Pay		No Response	Total
	$99	$74	$49	$24	$9	Something	Nothing		
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Water Quality									
Less than$4,000	3.1	4.1	5.1	8.2	22.5	61.3	25.5	13.2	100.0
$ 4,000-$ 7,999	5.3	7.1	11.2	17.0	43.3	70.8	22.8	6.4	100.0
$ 8,000-$11,999	6.9	8.4	13.8	23.2	43.4	79.4	16.7	3.9	100.0
$12,000-$14,999	11.8	13.5	18.5	27.4	52.9	76.4	18.5	5.1	100.0
Over $14,999	15.6	18.4	26.2	39.7	59.6	76.6	18.4	5.0	100.0
Land Quality									
Less than$4,000	6.1	8.1	10.1	12.1	23.3	48.8	35.7	15.5	100.0
$ 4,000-$ 7,999	6.4	7.8	11.9	14.8	35.9	63.4	29.2	7.4	100.0
$ 8,000-$11,999	6.4	8.4	12.3	21.2	40.4	73.9	22.2	3.9	100.0
$12,000-$14,999	8.4	9.2	15.1	21.8	46.2	71.4	22.7	5.9	100.0
Over $14,999	15.6	17.0	24.8	36.1	55.2	72.2	22.7	5.0	100.0
Air Quality									
Less than$4,000	5.1	6.1	6.1	9.0	23.3	53.9	28.5	17.5	100.0
$ 4,000-$ 7,999	5.8	7.6	9.9	16.3	41.4	67.7	24.6	7.6	100.0
$ 8,000-$11,999	7.4	9.9	15.8	28.6	47.3	79.8	16.3	3.9	100.0
$12,000-$14,999	9.2	12.6	21.0	31.9	54.6	75.6	18.5	5.9	100.0
Over $14,999	16.3	18.4	25.5	37.6	59.6	76.6	17.7	5.7	100.0

The public's indication of willingness to pay something for quality improvement was compared with their awareness and perception of the seriousness of problems associated with the three natural resource components. The income groups most aware of problems and having the highest median seriousness values were also those most willing to pay some annual amount to improve the quality of the respective natural resource components.

The research results were encouraging even though the willingness to pay questions were directed at a loosely defined good. The responses reflected a direct relationship between perception of a problem and expressed willingness to pay for problem alleviation. The problem of biased responses still remains, and the values cannot be considered representative of rational market behavior.

Willingness to pay values or the measures of problem awareness, seriousness, and importance should not be interpreted as welfare indexes which dictate appropriate actions for maximizing social welfare. Values were presented because they were welfare related, but the precise relationship is unknown. The values are intended only as an additional source of information for use in a subjective decision-making process. Problems associated with making interpersonal comparisons, incomplete knowledge on the part of the public, and the definition of a social conscience which extends over all generations are inherent in the values developed and preclude their use as an objective welfare criterion.

CHAPTER VI

PUBLIC AWARENESS, SERIOUSNESS, AND IMPORTANCE OF SALIENT NATURAL RESOURCE PROBLEMS

Natural resource planners and managers need some measures which will allow them to compare the public's perception of specific natural resource problems. Three different point estimates were developed in the analysis as a basis for making such a comparison. The percent of respondents indicating that a specific problem existed was used as a measure of problem awareness, and the median seriousness rating for those respondents suggesting a problem existed was used as a measure of seriousness. An "importance index" was developed by combining these two measures.

Responses to an open-ended questionnaire provided the basis for establishing the salient natural resource problems as perceived by the public. Forty-seven problems were developed from these responses. A short phrase was developed to identify each problem, and these are listed as side headings in the next three tables. The phrases are used consistently throughout the report to identify specific problems.

The awareness, median seriousness, and importance index presented are measures which need to be further analyzed before being accepted as valid or reliable. Furthermore, much of the value of the data is expected to be realized from a discussion and rationalization of the findings by planners and managers of natural resources. A case study of the integration of the findings into the planning process is needed before the utility of the measures can be fully appraised.

The discussion was confined mainly to comparisons at the state level, with brief references to regional findings. The examples should be viewed as types of comparisons which can be made rather than an exhaustive analysis of all possible implications. Once the specific interests of users of the data are established, further analysis may be desired.

The sampling format resulted in a different number of respondents in each region. Regional confidence limits for the point estimates varied accordingly. The number of respondents from the Southeast Planning Region was the smallest, and point estimates for the region were relatively less precise. The number of respondents in each region is included in the summary of the socio-economic characteristics of the respondents to both questionnaires and presented in Appendix A.

Awareness and Seriousness of Specific Water Quality Problems

Respondent awareness and median seriousness were computed for each of the fifteen water quality problems, and the results are summarized in Table 12. The awareness of water quality problems at the state level ranged from 72 percent of the respondents indicating a problem of individual littering of waterways to 24.6 percent indicating that inadequate water supply was a problem. The median seriousness ranged from 2.74 for industrial wastes discharged into waterways to 1.50 for inadequate water supply.

There were five water quality problems perceived to exist by a majority of all respondents. In addition to individual littering, two problems were related to the use of our waterways for disposal of industrial, municipal, and residential wastes. Other problems included the existence of muddy lakes or streams and water pollution from non-agricultural chemicals.

Industrial wastes discharged into waterways had the highest median seriousness value of 2.74. The lowest value was 1.50 for the problem of inadequate water supply.

Regional awareness and seriousness of agricultural problems were found to be closely related to the importance of agriculture and known agricultural problems of the area. A majority of respondents in the relatively important agricultural regions--Northwest, Northeast, and Southeast--

TABLE 12
RESPONDENTS' AWARENESS AND EXPRESSION OF SERIOUSNESS OF WATER QUALITY PROBLEMS FOR STATE AND PLANNING REGIONS

Problem	Percent Aware of Specific Problems							Median Seriousness of Specific Problems						
	State	Planning Regions						State	Planning Regions					
		North-west	North-east	Kansas City	St. Louis	South-west	South-east		North-west	North-east	Kansas City	St. Louis	South-west	South-east
Individual littering of waterways	72.5	64.2	60.9	68.3	81.0	68.0	80.0	2.48	2.08	1.98	2.84	2.68	2.11	2.50
Industrial wastes discharged into waterways	64.7	52.8	42.4	72.4	80.1	44.3	40.0	2.74	1.54	2.21	2.93	3.02	2.05	3.50
Municipal or residential wastes discharged into waterways	61.8	50.9	45.3	63.4	73.0	52.6	46.7	2.46	1.34	1.96	2.73	2.70	1.95	2.75
Muddy streams or lakes	57.1	58.5	50.0	65.9	62.4	36.1	66.7	2.29	2.04	1.72	2.48	2.59	1.92	2.30
Water pollution from nonagricultural chemicals	50.5	47.2	29.7	58.5	62.4	28.9	46.7	2.21	1.80	1.75	2.26	2.53	1.79	1.88
Hardness of water	48.6	58.5	56.2	57.2	34.2	55.7	73.3	1.75	1.55	1.63	1.93	1.52	1.78	1.80
Water pollution from agricultural chemicals	47.2	56.6	54.7	49.6	44.7	38.9	60.0	2.08	1.83	1.90	2.44	2.18	1.79	2.00
Flooding of agricultural land	47.2	60.4	53.1	44.7	46.5	37.1	73.3	2.00	1.94	1.91	2.20	1.97	1.85	2.58
Excess plant or algae growth in waterways	42.9	39.6	42.2	41.5	47.8	33.0	60.0	2.14	1.45	1.80	2.31	2.47	1.96	2.00
Flooding of nonagricultural land	39.1	43.4	34.4	42.3	39.4	34.0	46.7	1.76	1.38	1.42	1.96	1.83	1.73	1.38
Purity of drinking water	34.4	43.4	31.2	38.2	31.9	30.9	46.7	1.71	1.71	1.50	1.96	1.70	1.50	1.38
Streams needing channelization	33.0	32.1	32.8	38.2	31.4	27.8	53.3	1.88	1.44	1.71	2.05	1.94	1.80	2.00
Inadequate drainage of agricultural land	32.5	49.1	31.2	33.3	27.4	30.9	60.0	1.88	1.63	1.68	1.81	1.82	1.93	2.80
Inadequate drainage of nonagricultural land	31.0	39.6	25.0	37.4	30.5	22.7	33.3	1.78	1.75	1.67	1.90	1.82	1.72	1.13
Inadequate water supply	24.6	39.6	29.7	24.4	19.0	24.7	33.3	1.50	1.78	1.45	1.78	1.36	1.42	1.12

were aware of water pollution problems from agricultural chemicals and flooding of agricultural land. These problems were not recognized by a majority of respondents in the other three regions.

The problems of streams needing channelization and inadequate drainage of agricultural land were perceived by less than a third of the state respondents. Yet, both were recognized to be two of the most serious problems by a majority of the respondents in the Southeast region.

Water quality problems are listed in the table in descending order based on awareness. The problems with a high degree of awareness were generally found to be the more serious water quality problems, but this relationship was not exact. The differences between an ordering based on awareness and one based on seriousness can be identified by viewing the state median seriousness column. One of the exceptions was hardness of water which 48.6 percent of all respondents and a majority of the respondents in five of the six regions perceived to be a problem. The median seriousness of this problem was only 1.75, reflecting the perception that it was not a very serious problem although it was thought to be widespread throughout most of the state.

Awareness and Seriousness of Specific Land Quality Problems

The land component of the natural resource base was associated with the largest number of specific problems. A

total of twenty-one problems were identified, and the awareness and median seriousness of these problems are presented in Table 13. Individual littering of the landscape was recognized by 79 percent of the state respondents. This was the highest awareness rate of all problems associated with the three natural resource components. The range of awareness for land quality problems was from 79 percent for littering to 22 percent for problems associated with livestock or poultry facilities. A majority of the respondents were aware of five of the twenty-one land quality problems identified.

The land quality problems with the highest and lowest median seriousness were the same as the findings for awareness. Individual littering of the landscape had the highest value of 2.58, and livestock or poultry facilities had the lowest value of 1.74. The ordering throughout the range of land quality problems was not consistent, however, as shown in the state median seriousness column. As you move down the column, an increase in median seriousness indicates disagreement between an ordering based on awareness and one based on median seriousness.

Resource depletion is a problem with all exhaustible resources, and questions relating to the depletion were included in the survey. A majority of the respondents were aware of depletion of woodland resources and depletion of fish and wildlife resources. Depletion of soil fertility,

TABLE 13
RESPONDENTS' AWARENESS AND EXPRESSION OF SERIOUSNESS OF LAND QUALITY PROBLEMS FOR STATE AND PLANNING REGIONS

Problem	Percent Aware of Specific Problems							Median Seriousness of Specific Problems						
	State	Planning Regions						State	Planning Regions					
		North-west	North-east	Kansas City	St. Louis	South-west	South-east		North-west	North-east	Kansas City	St. Louis	South-west	South-east
Individual littering of landscape	79.4	75.5	76.6	85.4	77.4	78.4	93.3	2.58	2.16	2.26	2.80	2.85	2.27	2.50
Insects and pests	58.1	69.8	56.2	54.5	54.9	61.9	73.3	2.15	2.00	2.07	2.11	2.30	1.96	2.92
Weeds and brush	58.1	73.6	65.6	59.3	47.3	64.9	80.0	2.08	2.25	1.98	2.12	2.28	1.81	2.17
Depletion of fish and wildlife resources	54.8	50.9	46.9	57.7	60.6	46.4	46.7	2.44	1.64	2.00	2.68	2.79	2.13	2.00
Depletion of woodland resources	54.4	50.9	48.4	54.5	58.8	52.6	40.0	2.39	1.84	2.00	2.83	2.67	2.02	2.00
Farmland shifting to urban and industrial uses	54.4	50.9	37.4	68.3	61.1	36.1	46.7	2.39	1.73	1.90	2.57	2.75	1.71	2.00
Preservation of scenic or historical areas	49.7	45.3	26.6	52.8	62.4	32.0	60.0	2.13	1.59	1.80	2.10	2.32	1.96	1.75
Disposal of solid wastes	47.4	43.4	46.9	48.8	53.1	36.1	40.0	2.50	2.00	2.00	2.83	2.74	2.25	3.00
Availability of open spaces	46.5	32.1	26.6	53.7	61.5	26.8	26.7	2.29	1.21	1.21	2.44	2.61	1.75	1.16
Availability of natural areas with streams	46.4	39.6	32.8	55.3	55.3	23.7	66.6	2.18	1.75	1.57	2.19	2.43	1.66	2.00
Soil erosion on construction sites or roadbanks	45.0	41.5	39.1	44.7	49.1	39.2	60.0	2.13	1.35	1.89	2.20	2.29	2.03	2.67
General appearance of landscape	43.6	39.6	43.8	45.5	49.1	30.9	40.0	2.02	1.56	1.70	2.11	2.33	1.58	2.00
Soil erosion on cleared woodland	43.1	43.3	45.3	41.5	41.2	45.4	60.0	2.04	1.77	1.73	2.00	2.18	2.00	2.88
Soil erosion on crop and pasture lands	42.2	49.1	56.2	43.1	31.9	49.5	60.0	1.98	1.81	1.83	2.02	2.05	1.97	2.00
Quality of recreational facilities available	40.8	45.3	32.8	46.3	45.1	27.8	33.3	2.01	1.36	1.57	2.38	2.14	1.75	2.00
Availability of good hunting and fishing	39.8	32.1	28.1	49.6	47.3	24.7	20.0	2.17	1.57	1.79	2.19	2.37	1.94	2.75
Depletion of soil fertility	39.4	39.6	39.1	39.0	38.5	43.3	33.3	2.11	1.56	2.00	2.44	2.13	2.12	2.00
Availability of parks and picnic areas	34.4	24.5	26.6	38.2	42.0	21.6	40.0	1.97	1.22	1.44	2.27	2.19	1.31	1.25
Availability of lake-type recreation	34.4	34.0	23.4	33.3	46.0	17.5	26.7	2.07	1.40	1.33	2.58	2.38	1.27	1.16
Surface mining	23.2	22.6	28.1	22.0	22.6	25.8	13.3	2.03	1.17	2.10	2.29	2.00	2.29	2.00
Livestock or poultry facilities	21.6	32.1	25.0	21.1	17.3	22.7	33.3	1.74	1.69	1.72	1.94	1.55	1.86	1.33

a long-standing issue of great prominence in the 1930's, was not recognized, however, as a problem by a majority of the respondents. The median seriousness value was also lower for the soil fertility problem than the other two resource depletion issues.

Recent environmental concerns have concentrated more on chemical use, waste disposal, and resource management, in general; whereas prior natural resource concerns were more oriented toward the soil. The change was probably associated with a growing importance of problems other than soil erosion, but the advent of commercial fertilizers may have lessened the importance of soil fertility in the minds of the public.

The availability of natural areas with streams and the availability of lake-type recreation, two incompatible uses of a river, were recognized as problems by less than 50 percent of the state respondents. Awareness and seriousness were especially low in the Southwest Planning Region which has more abundant natural and man-made recreational facilities than any other region. At the state level and in each region, people were more aware of the problem of availability of natural areas with streams. The median seriousness of this problem was also higher at the state level and in five of the six regions. It would appear that both problems should be seriously considered when planning future resource uses.

Awareness and Seriousness of Specific Air Quality Problems

Only eight salient air quality problems were delineated in the research. Awareness and median seriousness of the problems are summarized in Table 14. The air quality problem with the highest awareness rate was exhaust from transportation vehicles, with 66 percent of the respondents suggesting it was a problem in their communities. Second in awareness, with 60 percent of the respondents, was industrial and municipal smoke and fumes.

Respondents in the Kansas City and St. Louis Planning Regions were more aware of these problems, and the median seriousness was higher for the two metropolitan areas. The dominating influence of the urban regions resulted in the two air quality problems being rated as two of the most serious natural resource problems on a statewide basis, with values of 2.68 and 2.67. The median seriousness of industrial and municipal smoke and fumes for the St. Louis Planning Region was 3.11, the highest median seriousness value for any problem at the state or regional level.

Agricultural burning was the least serious air quality problem in the state and also had the lowest awareness rate. Only 22 percent of the respondents were aware of the problem, and the median seriousness was 1.41.

Three of the eight problems--undesirable odors, poor visibility due to smog, and particles in the air harmful to health--related to specific problem effects rather than

TABLE 14
RESPONDENTS' AWARENESS AND EXPRESSION OF SERIOUSNESS OF AIR AND OTHER QUALITY PROBLEMS FOR STATE AND PLANNING REGIONS

Problem	Percent Aware of Specific Problems							Median Seriousness of Specific Problems						
	State	Planning Regions						State	Planning Regions					
		North-west	North-east	Kansas City	St. Louis	South-west	South-east		North-west	North-east	Kansas City	St. Louis	South-west	South-east
AIR QUALITY PROBLEMS														
Exhaust from transportation vehicles	66.1	54.7	37.0	78.0	81.4	39.2	53.3	2.68	1.81	1.55	2.62	3.01	1.75	1.50
Industrial and municipal smoke and fumes	59.9	49.1	39.1	71.5	73.5	35.1	46.7	2.67	1.43	1.77	2.76	3.11	1.61	2.00
Undesirable odors	53.3	43.4	35.9	57.7	70.4	26.8	40.0	2.35	1.67	1.62	2.38	2.85	1.43	2.17
Particles in air harmful to health	52.4	37.7	21.9	61.0	70.4	28.9	46.5	2.36	1.83	1.67	2.31	2.79	1.50	2.00
Poor visibility due to smog	42.2	26.4	12.5	48.8	62.8	13.4	33.3	2.05	1.08	1.17	1.81	2.38	1.33	2.25
Other open burning	29.4	39.6	29.7	19.9	27.4	27.8	46.5	1.65	1.38	1.65	1.21	1.72	1.71	2.12
Wind erosion -- dust	25.1	28.3	20.3	28.5	23.5	25.8	40.0	1.48	1.12	1.15	1.77	1.72	1.38	1.83
Agricultural burning	21.5	28.3	12.5	22.0	19.0	24.7	46.5	1.41	1.33	1.17	1.34	1.54	1.36	2.00
OTHER PROBLEMS														
Depletion of natural resources by development	48.3	35.8	35.9	59.3	59.3	26.8	26.7	2.36	1.45	1.92	2.56	2.53	2.05	3.00
Inadequate development of natural resources	36.3	41.5	28.1	44.7	39.4	19.6	46.5	2.03	1.23	1.60	1.20	2.26	1.94	2.12
Undesirable sounds and noises in rural areas	27.5	30.2	14.1	26.0	32.7	23.7	40.0	1.74	1.39	1.14	1.50	1.15	1.38	1.50

cause or source. These three problems were directed at air pollution in general regardless of the source of the problem. It was anticipated that harmful particles in the air would be considered by the public to be more serious than undesirable odors or poor visibility. The results did not bear this out to the extent expected. The median seriousness for particles in the air harmful to health was 2.36, compared to 2.35 for undesirable odors and 2.05 for poor visibility due to smog. One explanation may be that people are prone to relate more easily to problems which affect the five senses than problems of a less tangible nature.

Awareness and Seriousness of Other Natural Resource Problems

Three other problems, not directly associated with one of the three resource components, were included in the list of specific problems. One of these, undesirable sounds and noises in rural areas, was based on the responses to the open-ended questions. The responses generally referred to noise from transportation and industry. A high prevalence of the problem in rural areas was not expected, and the responses tended to confirm this.

Depletion of natural resources by development and inadequate development of natural resources were included to examine the public's perception of the general issue of "over" or "under" utilization and development of our natural

resources. Neither problem was recognized by a majority of the state respondents, but awareness and median seriousness were greater for depletion of natural resources by development.

Importance Index

Public awareness and problem seriousness, as perceived by the public, are related characteristics. The relative importance of specific problems, based independently on these two characteristics, resulted in a similar but different ordering. For example, hardness of water quality, which 49 percent of the respondents suggested as a problem, ranked sixteenth based on awareness. The problem ranked fortieth based on median seriousness, with a value of 1.75. Both factors are relevant to the social importance of a natural resource problem and should influence an overall social importance index.

An ordering of natural resource problems, based on awareness alone, would reflect majority voting without vote trading. If this were the governing rule, then problems with the highest awareness would receive the most public support for problem alleviation. Such an ordering would be characteristic of the type of collective decision-making explored by Arrow.[1]

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[1]Kenneth Arrow, Social Choice and Individual Values (New York: Wiley, 1963).

The data collected on public awareness and median seriousness of natural resource problems were combined to form a social importance index. The potential range of the index was from zero to 2,312. If all respondents indicated no problem existed, the index value would have been zero. The maximum value would have reflected acknowledgment of an extremely serious problem by each respondent. The actual range was from 1,208 for individual littering of landscape to 212 for agricultural burning, Table 15.

According to the importance indexes developed, the dominant natural resource problems were associated with all three components of the environment. Four of the ten most important problems were water quality problems, four were land quality problems, and two were air quality problems. Over 50 percent of the respondents were aware of these problems, and the median seriousness was greater than 2.25.

A standardized importance index was developed as a basis for making regional comparisons, and these are summarized in Appendix E. The most important problem in the state, individual littering of landscape, also had the highest land quality problem index value for every region except St. Louis. Comparison of the St. Louis Planning Region's awareness and problem seriousness with comparable figures for the state and other regions suggested that the problem was not necessarily of less importance in the St. Louis region but rather that other problems were of more importance.

TABLE 15
RESPONDENTS' AWARENESS, PERCEPTION OF SERIOUSNESS, AND IMPORTANCE INDEX FOR SALIENT NATURAL RESOURCE PROBLEMS

Problem	Importance Index	Percent of Awareness	Median Seriousness[1]
Individual littering of landscape	1208	79.4	2.58
Individual littering of waterways	1056	72.5	2.48
Industrial wastes discharged into waterways	1007	64.7	2.74
Exhaust from transportation vehicles	1000	66.1	2.68
Industrial and municipal smoke and fumes	907	59.9	2.67
Municipal or residential wastes discharged into waterways	882	61.8	2.46
Depletion of fish and wildlife resources	781	54.8	2.44
Muddy streams or lakes	778	57.1	2.29
Depletion of woodland resources	778	54.4	2.39
Farmland shifting to urban and industrial uses	769	54.4	2.39
Undesirable odors	759	53.3	2.35
Particles in air harmful to health	748	52.4	2.36
Insects and pests	747	58.1	2.15
Weeds and brush	724	58.1	2.08
Disposal of solid wastes	695	47.4	2.50
Depletion of natural resources by development	679	48.3	2.36
Water pollution from nonagricultural chemicals	672	50.5	2.21
Preservation of scenic or historic areas	653	49.7	2.13
Availability of open spaces	642	46.5	2.29
Availability of natural areas with streams	610	46.4	2.18
Water pollution from agricultural chemicals	596	47.2	2.08
Soil erosion on construction sites or roadbanks	574	45.0	2.13
Flooding of agricultural land	568	47.2	2.00
Excess plant or algae growth in waterways	552	42.9	2.14
Poor visibility due to smog	539	42.2	2.05
General appearance of landscape	538	43.6	2.02
Soil erosion on cleared woodland	532	43.1	2.04
Availability of good hunting and fishing	519	39.8	2.17
Hardness of water	511	48.6	1.75
Depletion of soil fertility	503	39.4	2.11
Soil erosion on crop and pasture lands	501	42.2	1.98
Quality of recreational facilities available	498	40.8	2.01
Inadequate development of natural resources	451	36.3	2.03
Availability of lake-type recreation	432	34.4	2.07
Flooding of nonagricultural land	417	39.1	1.76
Availability of parks and picnic areas	415	34.4	1.93
Streams needing channelization	380	33.0	1.88
Inadequate drainage of agricultural land	366	32.5	1.88
Purity of drinking water	356	34.4	1.71
Inadequate drainage of nonagricultural land	334	31.0	1.78
Other open burning	313	29.4	1.65
Undesirable sounds and noises in rural areas	312	27.5	1.74
Surface mining	293	23.2	2.03
Wind erosion -- dust	253	25.1	1.48
Livestock or poultry facilities	231	21.6	1.74
Inadequate water supply	230	24.6	1.50
Agricultural burning	212	21.5	1.41

[1]Based upon 1 = not serious; 2 = slightly serious; 3 = very serious; and 4 = extremely serious

Examination of regional awareness and seriousness of another problem, exhaust from transportation vehicles, suggested that it was less important in the Northwest, Northeast, Southwest, and Southeast Planning Regions than at the state level. Both awareness and problem seriousness in these regions were considerably less than for the state in general.

Association Between Problem Seriousness and Population Characteristics

Several studies of the public's perception of environmental quality issues have addressed the question of who was concerned. The basic hypothesis in these studies was the public perception of a natural resource problem was associated with several socio-economic characteristics, such as age, income, and education. The studies generally related to only part of the total natural resource base and defined the problem in very broad terms.

In this study, Chi-square and Kendall rank-order correlation analyses were used to analyze the relationships in a comprehensive framework which included all segments of the natural resource base. Considerably more detail was given to most problems, and some not previously analyzed were included.

Chi-square test for association

A Chi-square test for association was used to individually test the null hypothesis of no association

between public perception of the forty-seven salient problems and population density, family income, occupation, sex, age, education, and planning regions. Results of the analysis are briefly presented in Table 16. Chi-square values and degrees of freedom are presented for each variable pair in Appendix F.

The null hypothesis of no association between the public's perception of specific problems and planning regions was rejected at the 5 percent level for thirty-five of the forty-seven salient problems. The null hypothesis, with respect to population density, was rejected thirty-one times; occupation, thirty-two times; age, twenty-five times; family income, seventeen times; education, nine times; and sex, once.

Past studies have found a statistically significant association between the socio-economic characteristics included in the study and the public's perception of several natural resource problems. The results were not always consistent, but the implication was that the benefits from correcting natural resource problems were not equally distributed throughout society. The findings of this study did not support the general implication of an association between all of these socio-economic characteristics and all salient natural resource problems. Rather, the analysis suggested that, for the State of Missouri, the existence of an association depended on which problem was under

TABLE 16
ASSOCIATION OF PROBLEM SERIOUSNESS WITH SOCIO-ECONOMIC CHARACTERISTICS
FOR FORTY-SEVEN SALIENT NATURAL RESOURCE PROBLEMS

Problem	Results of Test for Association with:[1]						
	Planning Region	Population Density	Family Income	Occupation	Sex	Age	Education
Inadequate water supply	P<.05	P<.05	NS	NS	NS	NS	NS
Purity of drinking water	NS	NS	NS	NS	NS	P<.001	P<.01
Hardness of water	P<.001	P<.001	P<.01	P<.001	NS	P<.01	P<.01
Individual littering of waterways	P<.001	P<.001	P<.001	P<.001	NS	P<.001	NS
Industrial wastes discharged into waterways.	P<.001	P<.001	P<.001	P<.001	P<.05	P<.001	P<.05
Municipal or residential wastes discharged into waterways	P<.001	P<.001	P<.001	P<.001	NS	P<.001	NS
Water pollution from agricultural chemicals.	P<.01	P<.05	NS	P<.001	NS	NS	NS
Water pollution from nonagricultural chemicals	P<.001	P<.001	P<.001	P<.001	NS	P<.001	P<.01
Streams needing channelization	NS	NS	NS	P<.01	NS	NS	NS
Flooding of agricultural land	P<.02	NS	NS	NS	NS	NS	NS
Flooding of nonagricultural land	NS	NS	NS	P<.001	NS	P<.05	NS
Inadequate drainage of agricultural land	P<.001	NS	NS	NS	NS	NS	NS
Inadequate drainage of nonagricultural land.	NS	NS	NS	NS	NS	NS	NS
Muddy streams or lakes	P<.001	P<.001	P<.02	P<.01	NS	NS	NS
Excess plant or algae growth in waterways	P<.02	P<.01	NS	P<.01	NS	NS	NS
Livestock or poultry facilities	NS	NS	NS	NS	NS	NS	NS
Disposal of solid wastes	P<.001	P<.001	P<.01	P<.001	NS	P<.05	P<.05
Individual littering of landscape	P<.001	P<.001	P<.01	P<.05	NS	P<.02	NS
Farmland shifting to urban and industrial uses	P<.001	P<.001	NS	P<.01	NS	P<.01	NS
Availability of open spaces	P<.001	P<.001	NS	P<.05	NS	P<.01	NS
Preservation of scenic or historical areas	P<.001	P<.001	NS	P<.01	NS	P<.05	NS
Depletion of soil fertility	NS	NS	NS	NS	NS	NS	NS
Depletion of woodland resources	P<.001	P<.001	NS	NS	NS	P<.02	NS
Depletion of fish and wildlife resources	P<.001	P<.001	NS	P<.001	NS	NS	NS
Availability of lake-type recreation	P<.001	P<.001	P<.05	P<.05	NS	P<.01	NS
Availability of parks and picnic areas	P<.001	P<.001	NS	P<.001	NS	P<.01	NS
Availability of natural areas with streams	P<.001	P<.001	P<.02	P<.001	NS	P<.01	NS
Quality of recreational facilities available	P<.01	NS	P<.02	P<.05	NS	P<.02	NS
Availability of good hunting and fishing	P<.01	P<.001	NS	NS	NS	NS	NS
General appearance of landscape	P<.01	P<.01	NS	NS	NS	P<.01	NS
Soil erosion on construction sites or roadbanks	P<.01	NS	NS	P<.02	NS	NS	NS
Soil erosion on crop and pasture lands	P<.001	P<.02	NS	NS	NS	NS	NS
Soil erosion on cleared woodland	NS	NS	NS	NS	NS	NS	NS
Insects and pests	P<.01	NS	NS	P<.05	NS	NS	NS
Weeds and brush	P<.001	P<.001	NS	P<.05	NS	P<.02	NS
Surface mining	NS	NS	NS	NS	NS	P<.001	NS
Wind erosion -- dust	NS	NS	NS	NS	NS	P<.01	NS
Exhaust from transportation vehicles	P<.001	P<.001	P<.001	P<.001	NS	P<.01	NS
Industrial and municipal smoke and fumes	P<.001	P<.001	P<.01	P<.001	NS	P<.02	P<.01
Agricultural burning	NS	NS	NS	NS	NS	NS	NS
Other open burning	NS	P<.01	NS	P<.05	NS	NS	NS
Undesirable sounds and noises in rural areas	NS	NS	NS	P<.05	NS	NS	NS
Particles in air harmful to health	P<.001	P<.001	P<.001	P<.001	NS	P<.01	P<.05
Undesirable odors	P<.001	P<.001	P<.001	P<.001	NS	P<.05	P<.02
Poor visibility due to smog	P<.001	P<.001	P<.01	P<.01	NS	NS	NS
Inadequate development of natural resources.	P<.001	P<.01	NS	P<.05	NS	NS	NS
Depletion of natural resources by development	P<.001	P<.001	P<.01	P<.01	NS	NS	P<.01

[1]Considered not significant (NS) if P>.05.

consideration. If this is the case, the distribution of benefits from alleviation of some natural resource problems may be more equally distributed than the general implications of past research would suggest.

Correlation analysis

Correlation analysis is a more powerful test for linear association between variables than the Chi-square analysis but is not adaptable to variables measured in nominal units. Kendall rank-order correlation analysis was used to test for linear association between public perception of specific natural resource problems and all ordinally measured socio-economic characteristics. A total of 180 variable pairs were included in the analysis, and the results are summarized in Table 17.

A more powerful test would be expected to identify additional significant relationships. In the Chi-square analysis seventy-eight of the 180 variable pairs were rejected under the hypothesis of independence. An additional thirty-six variable pairs were found to have a significant association at the 5 percent level in the correlation analysis. These variables are identified in the table with a plus subscript.

Nonlinear relationships

One finding not anticipated was that the correlation analysis did not reflect a significant association for

TABLE 17

KENDALL RANK-ORDER CORRELATION COEFFICIENTS FOR ORDINAL SOCIO-ECONOMIC CHARACTERISTICS PAIRED WITH PUBLIC PERCEPTION OF SPECIFIC WATER, LAND, AND AIR QUALITY PROBLEMS

Problem	Population Density	Family Income	Age of Respondent	Education of Respondent
WATER QUALITY PROBLEM				
Inadequate water supply	-.1446 (.001)	-.0738+ (.016)	.0967+ (.003)	-.0262 (.224)
Purity of drinking water	-.0567+ (.050)	-.0000 (.499)	.0172- (.309)	.0932 (.003)
Hardness of water	-.1600 (.001)	.0029- (.466)	.0094- (.393)	.0893 (.005)
Individual littering of waterways	.1971 (.001)	.0668 (.027)	-.0775 (.012)	.0582+ (.046)
Industrial wastes discharged into waterways	.3797 (.001)	.1671 (.001)	-.1089 (.001)	.1364 (.001)
Municipal or residential wastes discharged into waterways	.2288 (.001)	.1407 (.001)	-.0292- (.199)	.0883+ (.005)
Water pollution from agricultural chemicals	.0082- (.407)	.0370 (.142)	.0593+ (.043)	.0422 (.111)
Water pollution from nonagricultural chemicals	.3236 (.001)	.1186 (.001)	-.1178 (.001)	.1363 (.001)
Streams needing channelization	-.0042 (.452)	.0214 (.268)	.1098+ (.001)	-.0105 (.380)
Flooding of agricultural land	-.0147 (.336)	-.0167 (.315)	.1252+ (.001)	-.0677+ (.025)
Flooding of nonagricultural land	.0551 (.055)	.0178 (.304)	.0765 (.013)	-.0335 (.166)
Inadequate drainage of agricultural land	-.0859+ (.006)	-.0339 (.163)	.0784+ (.012)	-.0775+ (.012)
Inadequate drainage of nonagricultural land	.0388 (.131)	.0138 (.344)	.0771+ (.013)	-.0790+ (.011)
Muddy streams or lakes	.1929 (.001)	.0905 (.004)	-.0930+ (.004)	.1221+ (.001)
Excess plant or algae growth in waterways	.1122 (.001)	-.0033 (.462)	.0221 (.261)	.0215 (.267)
LAND QUALITY PROBLEM				
Livestock or poultry facilities	-.0757+ (.014)	-.0133 (.350)	.1046+ (.001)	.0357 (.151)
Disposal of solid wastes	.1356 (.001)	.1118 (.001)	-.0184- (.297)	.1323 (.001)
Individual littering of landscape	.1205 (.001)	.1086 (.001)	-.0783 (.012)	.0983+ (.002)
Farmland shifting to urban and industrial uses	.1991 (.001)	.0371 (.142)	.0011- (.487)	.0150 (.332)
Availability of open spaces	.2756 (.001)	.0502 (.073)	-.0691 (.023)	.0337 (.165)
Preservation of scenic or historical areas	.2348 (.001)	.1050+ (.001)	-.0560- (.052)	.1077+ (.001)
Depletion of soil fertility	-.0580+ (.047)	-.0120 (.364)	.0247 (.237)	.0144 (.338)
Depletion of woodland resources	.0656 (.029)	.0011 (.487)	.0014- (.483)	.0106 (.379)
Depletion of fish and wildlife resources	.1383 (.001)	.0020 (.477)	.0035 (.460)	.0462 (.090)
Availability of lake-type recreation	.2045 (.001)	.0852 (.007)	.0610 (.039)	.0156 (.326)
Availability of parks and picnic areas	.1388 (.001)	.0380 (.136)	.0175- (.306)	.0241 (.242)
Availability of natural areas with streams	.1958 (.001)	.0841 (.007)	-.0515- (.068)	.0750+ (.015)
Quality of recreational facilities	.1033+ (.001)	.0578 (.047)	.0304- (.189)	.0413 (.116)
Availability of good hunting and fishing	.1974 (.001)	.0321 (.177)	.0296 (.196)	.0040 (.454)
General appearance of landscape	.1280 (.001)	.0342 (.161)	-.0044- (.450)	.0640+ (.032)
Soil erosion on construction sites or roadbanks	.0826+ (.008)	.0105 (.381)	.0320 (.177)	.0057 (.435)
Soil erosion on crop and pasture lands	-.1562 (.001)	-.0395 (.126)	.1126+ (.001)	-.0317 (.180)
Soil erosion on cleared woodland	-.0345 (.159)	.0078 (.410)	.0411 (.117)	.0141 (.341)
Insects and pests	-.0235 (.248)	-.0257 (.228)	-.0576+ (.048)	.0322 (.176)
Weeds and brush	-.1247 (.001)	-.0795+ (.011)	.1014 (.002)	.0007 (.492)
Surface mining	-.0639+ (.032)	-.0590+ (.044)	.0790 (.011)	-.0139 (.343)
AIR QUALITY PROBLEM				
Wind erosion -- dust	.0123 (.361)	-.0097 (.389)	.0341- (.162)	.0111 (.374)
Exhaust from transportation vehicles	.4465 (.001)	.1434 (.001)	-.1005 (.002)	.1211+ (.001)
Industrial and municipal smoke and fumes	.3645 (.001)	.1088 (.001)	-.1586 (.001)	.1248 (.001)
Agricultural burning	-.0174 (.307)	-.0456 (.093)	.1294+ (.001)	.0189 (.292)
Other open burning	-.0430- (.107)	.0349 (.156)	.0445 (.099)	.0764+ (.013)
Undesirable sounds and noises in rural areas	.0821+ (.009)	-.0346 (.158)	.0388 (.131)	-.0046 (.446)
Particles in air harmful to health	.3933 (.001)	.1241 (.001)	-.1376 (.001)	.1356 (.001)
Undesirable odors	.3312 (.001)	.0913 (.004)	-.1033 (.001)	.0853 (.007)
Poor visibility due to smog	.3980 (.001)	.1248 (.001)	-.0592+ (.043)	.1405+ (.001)

+ Variable pairs sig. at 5 percent level above but not in X^2 analysis

- Variable pairs sig. at 5 percent level in X^2 analysis but not above

sixteen of the seventy-eight variables identified in the Chi-square analysis. Twelve of these were associated with the age variable. Such results were interpreted as suggesting that a nonlinear relationship existed between these variable pairs, and they are identified in the table with a minus subscript.

To explore the rationale of a nonlinear relationship, five variable pairs related to recreation were examined further. The median seriousness was generally highest for the 18-25 age group but declined substantially for the 26-35 age group, Table 18. Median seriousness gradually increased through the next three age groups and then declined substantially for the last and oldest age group. The varying direction of seriousness for all five problems tended to substantiate the conclusion that the relationships were of a nonlinear nature.

The five problems were associated with recreational activity in some way, and the basis for the association could be the same in each case. A hypothesis of this nature was that the high financial costs of participation in many recreational activities were more prohibitive for some periods of the family cycle than others. The 18-25 age group generally has close family ties, and even if married, they have access to the parental families' investment in recreational equipment. The investment cost for consumption by this age group would be a minimum, and participation in

TABLE 18
MEDIAN SERIOUSNESS OF SELECTED LAND QUALITY PROBLEMS BY AGE GROUP

Problem	Age Groups					
	18-25	26-35	36-45	46-55	56-65	Over 65
Quality of recreational facilities available.....	1.50	.27	.48	.37	.59	.27
General appearance of landscape.....	2.17	.35	.35	.50	.44	.35
Availability of parks and picnic areas.....	.38	.24	.30	.22	.42	.24
Availability of natural areas with streams.....	1.88	.47	.71	.42	.97	.32
Depletion of woodland resources.....	2.83	.85	1.21	1.56	1.77	.63

recreational activities would be expected to be relatively high.

The 26-35 age group is made up predominantly of individuals starting new families and having limited finances and higher priorities for nonrecreational goods and services. As the family unit increases in age, it accumulates wealth and the ability to participate in recreational activities increases.[2] Individuals of retirement age are less inclined to have younger family members to provide for, are less active, and probably are more prone to purchase access to recreational facilities when they plan to participate. Under these conditions, they would be expected to be less concerned about the five problems.

Direction of linear association

The segments of society most favored when natural resource problems are solved can be inferred by the direction of the significant associations. The general concensus of past research has been that the public's perception of the natural resource problems was directly related to income, population density, and education and indirectly related to age. The implication was that natural resource development and environmental quality improvement favored the general welfare of individuals who

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[2]For similar findings see Glenn Gillespie, "An Evaluation of the Factors Affecting the Demand for Water-Oriented Outdoor Recreation." (unpublished Ph.D. dissertation, University of Missouri, 1966).

were affluent, well-educated, young, and lived in large urban areas.

The research results tended to refute the existence of any general relationship of this nature for all salient natural resource problems. The correlation analysis identified thirty of the 180 variable pairs with a significant association at the 5 percent level and a sign opposite to that dictated by the implication of past research. Another thirty-three variable pairs have signs opposite to those expected, but the correlations were not found to be statistically significant.

Some of the variable pairs with signs opposite to those dictated by past research findings were examined further. An attempt was made to present a logical explanation for the direction of the association found. For example, the water quality problems of inadequate water supply, purity of drinking water, and hardness of water are generally more of a problem for private or small public water systems in Missouri and would be oriented toward rural areas, the lowest population density group. The reversals in the direction of the correlation between population density and these water quality problems may be reflecting a variation in the physical settings of the different population density groups.

Several of the variable pairs, having a significant association and a sign opposite to the general concensus, were agricultural problems paired with population density.

These problems were inadequate drainage of agricultural land, livestock or poultry facilities, depletion of soil fertility, soil erosion on crop and pasture lands, soil erosion on cleared woodland, weeds and brush, and surface mining. Such problems would be expected to be more serious for rural people and small communities heavily dependent on agriculture. In other words, less dense population groups would be expected to view the problems more seriously, accounting for the negative association found.

Only four problems were found to have a significant negative correlation with income. No logical basis for a direct association can be presented. The problems were oriented toward rural areas, and the negative correlation may have been the indirect result of a relationship between income and population density.

Natural resource problems are generally thought to have more serious implications for the young because of the future effects of present use and development decisions. For this reason the young were expected to view specific problems more seriously, resulting in a negative correlation between age and perception of problems. The results of the general questions concerning the water, land, and air resource components tended to support this theory.

The correlation analysis of specific problems did not support a comprehensive tendency of this nature. In fact, just as many of the significant correlations were

positive as negative. A basis for part of the positively correlated variable pairs was suggested by the fact that they were rural-oriented problems, and rural people were older than urban dwellers on the average. It was also possible that historical emphasis on soil, woodland, and wildlife resource conservation has resulted in older generations being more concerned about some of these problems than the young.

It was apparent from the analysis that generalized concepts about the distribution of the public's perception of natural resource problems within socio-economic characteristics cannot be universally applied to all problems. The research suggested that each salient problem must be treated as a unique case, not necessarily following any specific distributional pattern.

Partial correlation analysis of selected air quality problems

A wide variation in air quality between the two largest metropolitan areas of Missouri and the rural communities was recognized. How much the public's perception of the problem was influenced by their geographical location was suggested earlier in Tables 7 and 8. The highest awareness rate and median seriousness value were found for the highest population density group. The lowest values were found for respondents from rural communities.

The variation was more vividly pointed out by comparing the distribution of responses for all counties having low air quality deterioration with the two metropolitan counties of Jackson and St. Louis. Both metropolitan counties had serious air quality problems and represented counties with the highest air quality deterioration code. The comparison is summarized in Table 19 for the two air quality problems, exhaust from transportation vehicles and industrial and municipal smoke and fumes. The problem awareness rate was considerably higher for the metropolitan county respondents with over 80 percent aware of a problem. Less than 50 percent of the respondents from counties with low air quality deterioration were aware of a problem but did not generally view it as very serious. In contrast, the respondents in the metropolitan counties aware of a problem generally viewed it as being very serious. These comparisons suggested the dramatic influence the physical condition can have on public perception.

Absence of specific data on the physical condition limited the inclusion of other aspects of the quality of the natural environment as factors for analysis. The air quality factor was included in a correlation analysis with two problems, exhaust from transportation vehicles and industrial and municipal smoke and fumes, and the ordinally measured socio-economic characteristics.

TABLE 19
COMPARISON OF RURAL AND SELECTED METROPOLITAN RESPONDENTS' PERCEPTION OF TWO AIR QUALITY PROBLEMS

County Grouping of Problems	Percent Respondents Indicating Awareness of a Problem Perceived to be				
	No Problem	Not Serious	Slightly Serious	Very Serious	Extremely Serious
Exhaust from transportation vehicles:					
All counties with low air quality deterioration	58.8	21.8	11.2	5.9	2.4
Some counties with high air quality deterioration	11.6	5.2	21.0	33.8	28.5
Industrial and municipal smoke and fumes:					
All counties with low air quality deterioration	63.7	18.1	10.5	4.7	2.9
Some counties with high air quality deterioration	16.8	6.9	19.1	27.5	29.8

The socio-economic characteristics and the air quality variable had a significant correlation with both air quality problems, Table 20. The highest correlation was .4541 for population density paired with perception of vehicle exhausts. Air quality paired with the same problem, perception of vehicle exhausts, had a correlation of .4466. The correlation of industrial and municipal smoke was highest for these two variables also. It was .4108 for air quality and .3941 for population density.

A significant correlation was found between the socio-economic characteristics themselves and between the characteristics and air quality. The correlations suggested the possibility that the significant correlations between the public's perception of the two air quality problems and the other factors were of a spurious nature. This possibility was examined with partial correlation analysis by controlling first for the influence of socio-economic characteristics and then air quality.

Partial correlation of air quality paired with public perception of the two air quality problems, while individually controlling for the influence of selected socio-economic characteristics, is summarized in Table 21. The simple correlation between public perception of the problem of vehicle exhausts and air quality was .4466. By controlling for the influence of population density, the correlation was reduced to .2060. Only slight reductions

TABLE 20

KENDALL RANK-ORDER CORRELATION COEFFICIENTS FOR AIR QUALITY AND SELECTED SOCIO-ECONOMIC CHARACTERISTICS PAIRED WITH THE SAME SOCIO-ECONOMIC CHARACTERISTICS AND PUBLIC PERCEPTION OF TWO AIR QUALITY PROBLEMS

Variables	Population Density	Income	Age	Education	Exhaust from Transportation Vehicles[1]	Industrial and Municipal Smoke and Fumes[1]
Air quality deterioration	.6915 (.001)	.1455 (.001)	.1109 (.001)	.0857 (.001)	.4466 (.001)	.4108 (.001)
Population density		.1741 (.001)	-.1450 (.001)	.0782 (.003)	.4541 (.001)	.3941 (.001)
Income			-.1875 (.001)	.3323 (.001)	.1623 (.001)	.1275 (.001)
Age				-.2789 (.001)	-.1086 (.001)	-.1463 (.001)
Education					.1272 (.001)	.1166 (.001)
Exhaust from transportation vehicles						.6746 (.001)

[1] The listwise deletion routine for missing values resulted in slightly different observations being used in the compilation of Tables 17 and 20. Therefore, duplicate correlations do not reflect the exact same values.

resulted from controlling for the influence of family income, age, and education.

TABLE 21
Kendall Partial Rank-Order Correlation Coefficients for Public Perception of Two Air Quality Problems Paired with Air Quality While Controlling for the Influence of Selected Socio-economic Characteristics

Problem	Control Variables			
	Population Density	Family Income	Age	Education
Exhaust from transportation vehicles	.2060	.4333	.4399	.4434
Industrial and municipal smoke and fumes	.2083	.3997	.4013	.4075

Similar results were found for the problem of smoke and fumes. The simple correlation was reduced from .4108 to .2083 when controlling for the influence of population density. Controlling for the influence of other socio-economic characteristics had minor effects.

The results suggested that the relationships between air quality and socio-economic characteristics were inflating the simple correlation coefficients for air quality problems. They did not, however, imply that the relationship was completely spurious.

The relationship between air quality and public perception was then accepted, and the relationship between socio-economic characteristics and public perception was questioned. Partial correlation coefficients between

socio-economic characteristics and public perception of the two air quality problems were computed while controlling for air quality.

In the analysis the simple correlation coefficients were reduced from 20 to 50 percent, as shown in Table 22. Here again, the relationship between air quality and socio-economic characteristics appeared to be inflating the simple correlations. The coefficients were not reduced to zero, however, and the hypothesis that the relationships between socio-economic characteristics and public perception were completely spurious was rejected.

TABLE 22
Kendall Simple and Partial Rank-Order Correlation Coefficients for Public Perception of Two Air Quality Problems Paired with Selected Socio-economic Characteristics While Controlling for the Influence of Air Quality

Problem	Socio-economic Variables			
	Population Density	Family Income	Age	Education
Exhaust from transportation vehicles				
Simple	.4541	.1623	-.1086	.1272
Controlled	.2248	.1099	-.0665	.0997
Industrial and municipal smoke and fumes				
Simple	.3941	.1275	-.1463	.1166
Controlled	.2148	.0751	.1111	.0896

The analysis was for only two air quality problems, and a similar evaluation of water and land quality problems is needed. The results of the partial correlation analysis

of the limited number of problems supported the diagrammatic relationship presented in Figure 2. The implication was that omission of the physical quality factor inflated the strength of at least some of the relationships found between socio-economic characteristics and public perception. The inflation factor was not known and cannot be determined without including different physical aspects of the environment in the analysis. Research to develop standardized measures of environmental quality is needed to improve estimates of these relationships.

CHAPTER VII

SUMMARY AND CONCLUSIONS

A basic objective of natural resource planning is the allocation of natural resources in a manner which reflects the best interests of present and future generations. Assuming that individuals are capable of deciding what is best for themselves, public preferences should be influential in the resource allocation process. A review of the natural resource planning process failed to identify any semblance of individual consumer sovereignty.

It is impossible to determine what future generations' preferences will be. Our society is also becoming highly technically oriented, requiring more accurate information on an increasing number of subjects for rational decision-making. These problems do not negate the usefulness of the present generation's preferences as a decision variable but suggest that subjective decision-making should be a multi-dimensional process. Adequate information must be made available to the public, however, before their preferences can be expected to reflect rational decisions.

Public preferences do presently influence resource allocation decisions through various channels, including the

political process and group activity. Expression of preferences established through the existing channels has often been made after some form of plan has been proposed or construction has commenced--a very inopportune time for making adjustments. Such influences are not necessarily representative of the general public. Although identification of public preferences on a broader scale is possible, planners are not motivated to do so under the present institutional arrangement.

The study was established to explore the possibility of providing additional information on the general public's preferences as a partial basis for making natural resource decisions and injecting some form of "workable" consumer sovereignty into the planning process. It was recognized that complete knowledge of the public's preferences, if obtainable, would not be an economically justifiable objective. Limited funding of planning entities was taken into consideration, and an inexpensive framework for data collection was developed. Federal, state, and local entities involved in planning should be able to finance primary data collection and analysis of the nature presented in the research.

State and federal agencies involved in planning have functional responsibilities for a subset of the total natural resource base. The agencies' interests focus on the development of certain resources, and these interests

provide an incentive for influencing the findings of aggregate preference identification studies. Several institutional arrangements could be formulated for collecting unbiased aggregate preference data. The approach taken in the research was to contract data collection with an outside organization unaffected by the findings.

Primary data for the research was collected through two separate mail questionnaires. The first questionnaire was directed at several general aspects of the environment and included open-ended questions to identify salient problems associated with the land, water, and air components of the resource base. Problems identified in this questionnaire were then listed in a second questionnaire directed at awareness and perceived seriousness.

Two different point estimates were developed to make comparisons between salient natural resource problems. A measure of problem awareness was established as the percent of respondents indicating that a specific problem existed. The median seriousness rating for those respondents aware of a problem was used as a measure of seriousness. The four seriousness categories--not serious, slightly serious, very serious, and extremely serious--were assigned numerical weights of 1 to 4. The weights were assumed to reflect midpoints of each seriousness category and were used to develop median values.

The two point estimates reflected different aspects of a problem or of the utility which could be derived from

problem alleviation. Awareness was a measure of the existence of a problem; whereas seriousness reflected the magnitude of an existing problem. The two factors were combined to form an importance index as a more comprehensive basis for comparing the salient natural resource problems defined in the study.

The importance index developed had a possible range from zero to 2,312. The high value reflected all 578 respondents indicating a specific problem of extreme seriousness with a weight of 4. The low value reflected no awareness of a problem by any of the individuals completing the questionnaire.

The individuals surveyed were generally found to be concerned about their natural environment. They viewed their communities as having serious natural resource quality problems and were willing to pay something to improve the quality of the natural resource base. The quality of the natural environment, however, was not viewed as the most serious problem confronting their communities. The quality of the natural environment was indicated to be a problem by 84 percent of the state respondents; whereas awareness of crime and drug addiction was 93 percent and 89 percent, respectively.

Less than 1 percent of the respondents were willing to pay $100 or more for improvement in the quality of the water, land, or air component of the natural resources in

their communities. Nevertheless, they were generally willing to pay something for quality improvement. Over 70 percent indicated a willingness to pay something to improve water and air quality, and nearly 68 percent indicated a willingness to pay for land quality improvement.

Responses to questions on the change in water, land, and air quality over the last ten years suggested that the public did not view all aspects of their communities' natural environment as deteriorating. Water quality was thought to have improved by 23 percent of the respondents, and another 34 percent thought it had not changed. A total of 51 percent thought land quality had improved or not changed, and 40 percent felt the same way about air quality.

During the course of the research, forty-four salient water, land, and air quality problems and three general problems were defined. Awareness of the forty-seven problems varied from 79 to 22 percent. The four degrees of seriousness were assigned numerical weights of 1 through 4, and median seriousness values based on these weights ranged from 1.41 to 2.74. These values reflected a range from the "not" to the "very" serious category.

The most serious water quality problem was perceived to be the discharge of industrial wastes into waterways, with a median seriousness of 2.74 and an awareness rate of 65 percent. Individual littering of waterways was recognized by 72 percent of the respondents, but its median

seriousness value was only 2.48. Three additional water quality problems--municipal and residential wastes discharged into the waterways, muddy streams and lakes, and pollution from nonagricultural chemicals--were perceived to exist by over 50 percent of the respondents.

Littering of the landscape was recognized by 79 percent of the respondents, and this was the highest awareness rate for any problem identified. The problem was also considered to be the most serious land quality problem with a median seriousness value of 2.58, reflecting the perception of a very serious problem. Insects and pests, weeds and brush, fish and wildlife resource depletion, woodland resource depletion, and shifting of farmland to industrial uses were additional land quality problems with an awareness rate greater than 50 percent.

Exhaust from transportation vehicles was perceived as the most prevalent air quality problem, with a 66 percent statewide awareness rate. Second in awareness was industrial and municipal smoke and fumes which was recognized by 60 percent of the respondents. These two problems were both perceived to be very serious as indicated by median seriousness values of 2.68 and 2.67.

Statewide awareness of the two air quality problems was less than the most important water and land quality problems. The air quality problems were very prevalent and serious, however, in the urban regions of Kansas City and St. Louis. In fact, a median seriousness value of 3.11 for

the problem of industrial and municipal smoke and fumes in the St. Louis region was the highest seriousness value identified in the study.

The highest salient problem importance value found was 1,208 for individual littering of the landscape. The least important problem identified was agricultural burning with an index value of 212. All three basic components of the natural resource base had problems which ranked high in importance. At least one water, land, and air quality problem was included in the highest four importance indexes, and each was equal to or greater than 1,000.

Awareness, seriousness, and problem importance varied between regions for some problems and displayed high uniformity for others. The implication was that the product mix of natural resource development plans which reflect the general public's preferences should vary from one community to the next. To accomplish this, national planning guidelines need to have some flexibility.

Past studies of various environmental quality problems have identified several socio-economic characteristics which had a significant association with public perception. The same socio-economic characteristics, however, were not identified in each study. In this research the association between selected socio-economic characteristics and public perception of forty-seven salient natural resource problems was analyzed in detail with Chi-square and Kendall rank-order correlation analyses.

The relationship between the public's perception of the forty-seven problems and seven socio-economic characteristics was first analyzed using a Chi-square analysis. None of the socio-economic characteristics were found to have a universally significant association across all forty-seven problems. In fact, sex was found to have an association with only one problem. Planning regions had a significant association with thirty-five problems, occupation with thirty-two, population density with thirty-one, age with twenty-five, family income with seventeen, and education with nine.

Four of the seven variables were measured at the ordinal level--population density, family income, age, and education. These were included in a Kendall rank-order correlation analysis. Significant associations were found, but the analysis did not identify any socio-economic characteristic which had an association with the public's perception of all specific natural resource problems. The significant correlation coefficients were generally below .5000, and many were less than .2500.

The direction of the associations found in the analysis by pairing each socio-economic characteristic with the forty-seven problems was not consistent across all problems. For example, population density was negatively correlated with inadequate water supply and depletion of soil fertility, but positively correlated with individual

littering of the landscape or waterways and availability of open space.

A variable considered influential in formulating the public's perception of natural resource problems was the community's existing physical condition. Studies in the past have been directed mainly at the influence of socio-economic characteristics on the public's perception of natural resource problems and have not included the physical condition as a variable.

Limited data was available to establish this type of a reference point, but an attempt was made to quantify air quality deterioration in the vicinity of each sample point. The air quality variable was included in a Kendall rank-order correlation analysis with two air quality problems --exhaust from transportation vehicles and industrial and municipal smoke and fumes. These relationships were further analyzed in a partial rank-order correlation analysis.

Correlation coefficients for air quality deterioration, paired with public perception of exhaust from transportation vehicles and industrial and municipal smoke and fumes, were .4466 and .4108. The coefficients were reduced to .2060 and .2083 when the variable pairs were included in a partial correlation analysis and controlled for the influence of population density. They were reduced by less than 10 percent, however, when individually controlled for the influence of family income, age, and education.

Partial correlation analysis was restructured to examine for spurious associations between public perception of these two problems and socio-economic characteristics. Again, the coefficients were reduced from 25 to 50 percent, but the results did not indicate that any of the relationships examined were completely spurious.

The lack of adequate physical data on the natural environmental setting in which each respondent lived limited the number of variable pairs which could be used in the partial correlation analysis. The results of the limited analysis, however, indicated that the physical condition was an important determinant of public perception of natural resource problems.

Distribution of benefits from problem alleviation can be based on the existence and direction of significant associations of the type studied. The general implication of past studies has been that alleviation of natural resource problems favored the general welfare of individuals in society who were young, well-educated, affluent, female, white-collar workers or lived in urban areas. The research results of this study tended to refute the existence of a general relationship applicable across all salient natural resource problems. Many of the problems were not found to have a significant association, and the direction of the association for individual socio-economic characteristics paired with the forty-seven problems was inconsistent. A

related finding was that the strength of the relationships was probably over-stated due to the omission of the physical condition as a variable in the analysis.

All of the relationships need to be better understood before the affects of socio-economic characteristics on public perception or the beneficiaries of natural resource development can be properly assessed. Further examination of the relationships between public perception and other variables is an area of needed research.

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APPENDIX A

Sample Questionnaires

National Family Opinion, Inc.

POST OFFICE BOX 474
TOLEDO, OHIO 43654
20461-2
40-S72039

Dear Homemaker,

Today I have some questions for you about the quality of the natural environment and your opinions about it on both the STATE and LOCAL levels.

The quality of the natural environment has become an issue of importance to some people. The purpose of this questionnaire is to help establish how you as a citizen of Missouri view environmental quality problems in your community and state.

The definition of natural environment as used in this study refers to the land, air, water, vegetation, rivers, lakes, wildlife, appearance of landscape, etc., but is not intended to include environmental quality problems associated with community problems, such as low quality housing, poor streets, or social problems - for instance - high crime rates.

Some of the questions are based upon a division of the natural environment into three basic resources -- air, land, and water. When answering these questions, consider not only the use, quality, and quantity of these basic resources but also all of their associated attributes. That is, when considering questions on the quality of the land resources, consideration should also be given to its associated attributes, such as wildlife, vegetation, recreation, etc.

Thank you for your time and opinions in this important study!

Sincerely,

Carol

Carol Adams

1. How would you describe your concern for the quality of the natural environment in your community and state? Would you say you are:

	NATURAL ENVIRONMENT IN YOUR COMMUNITY	NATURAL ENVIRONMENT IN STATE OF MISSOURI
Extremely concerned.....	☐	☐
Very concerned.....	☐	☐
Slightly concerned.....	☐	☐
Not at all concerned.....	☐	☐

2. Considering YOUR COMMUNITY - in your opinion, how serious is the problem of:

CHECK ONE FOR EACH QUALITY	EXTREMELY SERIOUS	VERY SERIOUS	SLIGHTLY SERIOUS	NOT AT ALL SERIOUS	NO PROBLEM	DON'T KNOW
Water quality....	☐	☐	☐	☐	☐	☐
Land quality.....	☐	☐	☐	☐	☐	☐
Air quality.....	☐	☐	☐	☐	☐	☐

3. Thinking of the past 10 years in your community, how would you describe the change in the quality of the natural environment for:

CHECK ONE FOR EACH QUALITY	GREATLY IMPROVED	SLIGHTLY IMPROVED	NO CHANGE	SLIGHTLY DETERIORATED	GREATLY DETERIORATED	DON'T KNOW
Water quality....	☐	☐	☐	☐	☐	☐
Land quality.....	☐	☐	☐	☐	☐	☐
Air quality.....	☐	☐	☐	☐	☐	☐

4. If improving the quality of the natural environment meant higher prices for both public and private goods and services, what is the MAXIMUM yearly payment you would be willing to make to improve the quality of EACH of the basic resources: water, land, and air?

CHECK ONE FOR EACH QUALITY	NOTHING	LESS THAN $10	$10-24	$25-49	$50-74	$75-99	$100 or more
Water quality....	☐	☐	☐	☐	☐	☐	☐
Land quality.....	☐	☐	☐	☐	☐	☐	☐
Air quality.....	☐	☐	☐	☐	☐	☐	☐

5a. Below are listed some of the problems facing communities today. Please indicate how serious each of these problems is to you in your community by checking the appropriate box to rate its seriousness.

CHECK ONE FOR EACH QUALITY	EXTREMELY SERIOUS	VERY SERIOUS	SLIGHTLY SERIOUS	NOT AT ALL SERIOUS	NO PROBLEM	DON'T KNOW
Drug addiction.....	☐	☐	☐	☐	☐	☐
Quality of natural environment.....	☐	☐	☐	☐	☐	☐
Crime.....	☐	☐	☐	☐	☐	☐
Welfare of poor.....	☐	☐	☐	☐	☐	☐

5b. Again, considering these same problems listed in 5a, please rank each of these problems according to your opinion of their seriousness in your community. Place the numbers "1", "2", "3", or "4" in the space provided. For the problem that you consider to be the most serious, place a "1" in the blank; for the problem that you consider to be the least serious, place a "4" in the blank and so forth. Be sure to use each number only once.

Drug addiction	_____
Quality of natural environment	_____
Crime	_____
Welfare of poor	_____

6. A) Thinking of those natural environmental quality problems that exist in your community, please write in those things which you consider water quality problems. State the problem(s) to the best of your knowledge. Then in B, check the appropriate box to indicate how serious you feel EACH problem is in your community.

A) WATER QUALITY PROBLEMS	B) EXTREMELY SERIOUS	VERY SERIOUS	SLIGHTLY SERIOUS	NOT AT ALL SERIOUS
1 _____	☐	☐	☐	☐
2 _____	☐	☐	☐	☐
3 _____	☐	☐	☐	☐

C) For each of the water quality problems that you listed in part A, please write in what you consider the main cause of the problem to be. Be certain to write these in the same order as you have given them in part A; that is, for the problem that you listed first in Part A, list the cause for that problem on the first line below.

C) CAUSE OR SOURCE

1 _____

2 _____

3 _____

7. A) Thinking of those natural environmental quality problems that exist in your community, please write in those things which you consider land quality problems. State the problem(s) to the best of your knowledge. Then in B, check the appropriate box to indicate how serious you feel EACH problem is in your community.

A) LAND QUALITY PROBLEMS	B) EXTREMELY SERIOUS	VERY SERIOUS	SLIGHTLY SERIOUS	NOT AT ALL SERIOUS
1 _____	☐	☐	☐	☐
2 _____	☐	☐	☐	☐
3 _____	☐	☐	☐	☐

C) For each of the land quality problems that you listed in part A, please write in what you consider the main cause of the problem to be. Be certain to write these in the same order as you have given them in part A; that is, for the problem that you listed first in Part A, list the cause for that problem on the first line below.

C) CAUSE OR SOURCE

1 _____

2 _____

3 _____

8. A) Thinking again of those natural environmental quality problems that exist in your community, please write in those things which you consider air quality problems. State the problem(s) to the best of your knowledge. Then in B, check the appropriate box to indicate how serious you feel EACH problem is in your community.

A) AIR QUALITY PROBLEMS	B) EXTREMELY SERIOUS	VERY SERIOUS	SLIGHTLY SERIOUS	NOT AT ALL SERIOUS
1 _____	☐	☐	☐	☐
2 _____	☐	☐	☐	☐
3 _____	☐	☐	☐	☐

C) For each of the air quality problems that you listed in part A, please write in what you consider the main cause of the problem to be. Be certain to write these in the same order as you have given them in part A; that is, for the problem that you listed first in part A, list the cause for that problem on the first line below.

C) CAUSE OR SOURCE

1 _____

2 _____

3 _____

National Family Opinion, Inc.

POST OFFICE BOX 474
TOLEDO, OHIO 43654

20461-3
40-S72039

Dear Homemaker,

Please give this questionnaire to the MALE HEAD OF THE HOUSEHOLD to answer.

TO THE MALE ANSWERING THE QUESTIONNAIRE:

Today's questionnaire concerns some of the natural environmental quality problems which may or may not exist in your LOCAL COMMUNITY. By natural environment I mean the problems which concern the land, air, water, vegetation, rivers, lakes, wildlife, appearance of landscape, and etc.. The questionnaire is similar to one you answered for me a few months ago; however, I need your answers to this additional questionnaire in order to complete the study.

The quality of the natural environment has received much attention in the last few years. A wide range of problems has been identified on a national scale. The purpose of this questionnaire is to determine whether you feel these problems exist in your community and, if they do, how serious they are. If you find there is a problem(s) facing your community that is not included in the list I have provided, please write it/them in the space given at the end of the questionnaire.

Thank you for your time and opinions on this study.

Sincerely, Carol

Some of the sources and effects of the natural environmental quality problems confronting our nation are listed below. For each item listed, indicate whether you think this is a problem in YOUR LOCAL COMMUNITY and if so, how serious it is. Identify any natural environmental quality problems facing your community and not listed by writing them in the space provided at the end of the questionnaire.

	PROBLEM? NO	PROBLEM? YES	EXTREMELY SERIOUS	VERY SERIOUS	SLIGHTLY SERIOUS	NOT SERIOUS
Inadequate water supply	☐	☐ -->	☐	☐	☐	☐
Purity of drinking water	☐	☐ -->	☐	☐	☐	☐
Hardness of water	☐	☐ -->	☐	☐	☐	☐
Individual littering of waterways	☐	☐ -->	☐	☐	☐	☐
Industrial wastes discharged into waterways	☐	☐ -->	☐	☐	☐	☐
Municipal or residential wastes discharged into waterways	☐	☐ -->	☐	☐	☐	☐
Water pollution from agricultural chemicals	☐	☐ -->	☐	☐	☐	☐
Water pollution from nonagricultural chemicals	☐	☐ -->	☐	☐	☐	☐
Streams needing channelization	☐	☐ -->	☐	☐	☐	☐
Flooding of agricultural land	☐	☐ -->	☐	☐	☐	☐
Flooding of nonagricultural land	☐	☐ -->	☐	☐	☐	☐
Inadequate drainage of agricultural land	☐	☐ -->	☐	☐	☐	☐
Inadaquete drainage of nonagricultural land	☐	☐ -->	☐	☐	☐	☐
Muddy streams or lakes	☐	☐ -->	☐	☐	☐	☐
Excess plant or algae growth in waterways	☐	☐ -->	☐	☐	☐	☐
Livestock or poultry facilities	☐	☐ -->	☐	☐	☐	☐
Disposal of solid wastes	☐	☐ -->	☐	☐	☐	☐
Individual littering of landscape	☐	☐ -->	☐	☐	☐	☐
Farmland shifting to urban and industrial uses	☐	☐ -->	☐	☐	☐	☐
Availability of open spaces	☐	☐ -->	☐	☐	☐	☐
Preservation of scenic or historical areas	☐	☐ -->	☐	☐	☐	☐
Depletion of soil fertility	☐	☐ -->	☐	☐	☐	☐
Depletion of woodland resources	☐	☐ -->	☐	☐	☐	☐
Depletion of fish and wildlife resources	☐	☐ -->	☐	☐	☐	☐
Availability of lake-type recreation	☐	☐ -->	☐	☐	☐	☐
Availability of parks and picnic areas	☐	☐ -->	☐	☐	☐	☐
Availability of natural areas with streams	☐	☐ -->	☐	☐	☐	☐
Quality of recreational facilities available	☐	☐ -->	☐	☐	☐	☐
Availability of good hunting and fishing	☐	☐ -->	☐	☐	☐	☐
General appearance of landscape	☐	☐ -->	☐	☐	☐	☐
Soil erosion on construction sites or roadbanks	☐	☐ -->	☐	☐	☐	☐
Soil erosion on crop and pasture lands	☐	☐ -->	☐	☐	☐	☐
Soil erosion on cleared woodland	☐	☐ -->	☐	☐	☐	☐
Insects and pests	☐	☐ -->	☐	☐	☐	☐
Weeds and brush	☐	☐ -->	☐	☐	☐	☐
Surface mining	☐	☐ -->	☐	☐	☐	☐
Wind erosion -- dust	☐	☐ -->	☐	☐	☐	☐
Exhaust from transportation vehicles	☐	☐ -->	☐	☐	☐	☐
Industrial and municipal smoke and fumes	☐	☐ -->	☐	☐	☐	☐
Agricultural burning	☐	☐ -->	☐	☐	☐	☐
Other open burning	☐	☐ -->	☐	☐	☐	☐
Undesirable sounds and noises in rural areas	☐	☐ -->	☐	☐	☐	☐
Particles in air harmful to health	☐	☐ -->	☐	☐	☐	☐
Undesirable odors	☐	☐ -->	☐	☐	☐	☐
Poor visibility due to smog	☐	☐ -->	☐	☐	☐	☐
Inadequate development of natural resources	☐	☐ -->	☐	☐	☐	☐
Depletion of natural resources by development	☐	☐ -->	☐	☐	☐	☐
_____	☐	☐ -->	☐	☐	☐	☐
_____	☐	☐ -->	☐	☐	☐	☐

APPENDIX B

Socio-economic Characteristics of Respondents First and Second Questionnaires

TABLE 1
SOCIO-ECONOMIC CHARACTERISTICS OF RESPONDENTS
TO FIRST AND SECOND QUESTIONNAIRES

Socio-economic Characteristics	First Questionnaire		Second Questionnaire	
	Number	Percent	Number	Percent
Sex				
Female	376	51	306	53
Male	356	49	272	47
Age				
Less than 25	24	3	15	3
25-34	179	25	126	22
35-44	116	16	87	15
45-54	129	18	108	19
55-64	143	19	120	21
Over 64	141	19	122	21
Education				
8th grade	111	15	93	16
High school	383	52	311	54
4 years college	201	28	152	26
Over 4 years college	36	5	21	4
Population Density				
Rural	178	24	151	26
Urban:				
Less than 50,000	99	14	80	14
50,000-499,999	25	3	19	3
500,000-1,999,999	145	20	106	18
2,000,000 and over	285	39	222	39
Family Income				
Less than $4,000	98	14	77	13
$4,000-$7,999	171	23	138	24
$8,000-$11,999	203	28	155	27
$12,000-$14,999	119	16	95	16
$15,000 and over	141	19	113	20
Occupation				
Professional and technical	123	17	88	15
Managers and proprietors	99	14	79	14
Clerical	65	9	53	9
Sales	37	5	31	6
Craftsmen and foremen	103	14	75	13
Operatives	88	12	69	12
Service workers	22	3	16	3
Farm laborers and foremen	0	0	0	0
Laborers	6	1	6	1
Farmers and farm managers	69	9	59	10
Retired, unemployed, etc.	112	16	94	17
Planning Regions				
Northwest	64	9	53	9
Northeast	84	12	64	11
Kansas City	168	23	123	21
St. Louis	289	39	226	39
Southwest	109	15	97	17
Southeast	18	2	15	3

APPENDIX C

Statistical Tests Employed

STATISTICAL TESTS EMPLOYED IN THE ANALYSIS

Median

$$M_d = L_i + i\left(\frac{N/2 - F_{i-1}}{f_i}\right)$$

Where i = median class interval

L_i = lower limit of median class

F_i = cumulative frequency through i-th interval

f_i = frequency of i-th interval

N = total number of cases

$N/2$ = $(N+1)/2$ when N is odd

Chi-square

$$X^2 = \sum_{i=1}^{n} \frac{(f_o^i - f_e^i)^2}{f_e^i}$$

With $(r-1)(c-1)$ degrees of freedom

Where f_o^i = observed frequency of i-th cell

f_e^i = expected frequency of i-th cell

Kendall Rank-Order Correlation

$$R = \frac{S}{\sqrt{\tfrac{1}{2}W(W-1)T_x}\ \sqrt{\tfrac{1}{2}N(N-1)-T_y}}$$

Where S = the actual score. Given the rankings of variable one in natural order and paired with ranks of second variable, then S is the number of ranks to the right of each rank for second variable which is larger minus number of ranks which are smaller.

$\tfrac{1}{2}N(N-1)$ = $\binom{N}{2}$ or maximum possible score

T_x = $\tfrac{1}{2}\Sigma t(t-1)$ t = the number of tied observations in each group of ties on the first variable

T_y = $\tfrac{1}{2}\Sigma t(t-1)$ t = the number of tied observations in each group of ties on the second variable

Kendall Partial Rank-Order Correlation

$$\gamma_{xy.z} = \frac{\gamma_{xy} - \gamma_{zy}\ \gamma_{xz}}{\sqrt{(1-\gamma_{zy}^2)\ (1-\gamma_{zx}^2)}}$$

Where γ_{xy} = Kendall rank-order correlation between variables x and y

γ_{zy} = Kendall rank-order correlation between variables z and y

γ_{xz} = Kendall rank-order correlation between variables x and z

APPENDIX D

Comparison of Importance Index Rating Techniques

TABLE 1
NATURAL RESOURCE PROBLEM IMPORTANCE INDEX BASED
UPON TWO DIFFERENT WEIGHTING TECHNIQUES

Problem	Importance Index Based upon:	
	Equal Interval Technique	Sigma Scoring Technique
Inadequate water supply	230	219
Purity of drinking water	356	335
Hardness of water	511	475
Individual littering of waterways	1055	1040
Industrial wastes discharged into waterways	1006	1019
Municipal or residential wastes discharged into waterways	881	878
Water pollution from agricultural chemicals	596	640
Water pollution from nonagricultural chemicals	672	657
Streams needing channelization	380	356
Flooding of agricultural land	568	588
Flooding of nonagricultural land	417	379
Inadequate drainage of agricultural land	366	354
Inadequate drainage of nonagricultural land	334	320
Muddy streams or lakes	778	765
Excess plant or algae growth in waterways	552	547
Livestock or poultry facilities	231	219
Disposal of solid wastes	695	683
Individual littering of landscape	1208	1189
Farmland shifting to urban and industrial uses	769	758
Availability of open spaces	642	620
Preservation of scenic or historical areas	653	620
Depletion of soil fertility	503	484
Depletion of woodland resources	778	760
Depletion of fish and wildlife resources	781	777
Availability of lake-type recreation	432	419
Availability of parks and picnic areas	415	380
Availability of natural areas with streams	610	589
Quality of recreational facilities available	498	480
Availability of good hunting and fishing	519	504
General appearance of landscape	538	514
Soil erosion on construction sites or roadbanks	574	561
Soil erosion on crop and pasture lands	501	486
Soil erosion on cleared woodland	532	515
Insects and pests	747	730
Weeds and brush	724	706
Surface mining	293	277
Wind erosion -- dust	253	206
Exhaust from transportation vehicles	1000	991
Industrial and municipal smoke and fumes	897	917
Agricultural burning	212	176
Other open burning	313	287
Undesirable sounds and noises in rural areas	312	254
Particles in air harmful to health	748	703
Undesirable odors	759	728
Poor visibility due to smog	539	505
Inadequate development of natural resources	451	432
Depletion of natural resources by development	679	662

APPENDIX E

Natural Resource Problem Importance Indexes

TABLE 1
STANDARDIZED NATURAL RESOURCE PROBLEM IMPORTANCE INDEXES BY STATE AND REGION

Problem	State	Planning Regions					
		North-west	North-east	Kansas City	St. Louis	South-west	South-east
Inadequate water supply	.40	.74	.47	.42	.28	.36	.47
Purity of drinking water	.62	.70	.52	.78	.57	.52	.80
Hardness of water	.88	1.02	.97	1.15	.60	1.00	1.40
Individual littering of waterways	1.83	1.42	1.20	1.90	2.18	1.49	2.13
Industrial wastes discharged into waterways.	1.74	.89	.92	2.07	2.38	.94	1.13
Municipal or residential wastes discharged into waterways	1.53	.87	.92	1.67	1.96	1.13	1.20
Water pollution from agricultural chemicals.	1.03	1.08	1.03	1.25	1.03	.70	1.27
Water pollution from nonagricultural chemicals	1.16	.83	.52	1.38	1.60	.53	.87
Streams needing channelization	.77	.51	.61	.85	.65	.46	1.07
Flooding of agricultural land	.98	1.21	1.03	1.00	.97	.72	1.73
Flooding of nonagricultural land	.72	.66	.58	.86	.75	.61	.73
Inadequate drainage of agricultural land	.63	.89	.53	.68	.53	.61	1.47
Inadequate drainage of nonagricultural land.	.58	.53	.45	.75	.58	.41	.40
Muddy streams or lakes	1.35	1.21	.84	1.66	1.61	.70	1.67
Excess plant or algae growth in waterways	.96	.62	.77	.84	1.18	.68	1.20
Livestock or poultry facilities	.40	.55	.42	.43	.31	.43	.60
Disposal of solid wastes	1.20	.91	.94	1.36	1.43	.82	1.13
Individual littering of landscape	2.09	1.70	1.78	2.37	2.20	1.56	2.33
Farmland shifting to urban and industrial uses	1.33	.92	.75	1.74	1.67	.68	1.00
Availability of open spaces	1.11	.43	.39	1.32	1.67	.49	.47
Preservation of scenic or historical areas	1.13	.74	.55	1.18	1.55	.66	1.27
Depletion of soil fertility	.87	.68	.80	.96	.87	.95	.67
Depletion of woodland resources	1.35	.94	.98	1.50	1.58	1.14	.80
Depletion of fish and wildlife resources	1.33	.91	.94	1.50	1.65	1.03	1.00
Availability of lake-type recreation	.71	.55	.38	.76	1.12	.28	.40
Availability of parks and picnic areas	.72	.34	.44	.89	.97	.32	.60
Availability of natural areas with streams	1.06	.70	.58	1.29	1.39	.42	1.40
Quality of recreational facilities available	.86	.72	.58	1.08	1.02	.52	.67
Availability of good hunting and fishing	.90	.55	.53	1.13	1.16	.49	.47
General appearance of landscape	.93	.66	.77	1.02	1.17	.53	.87
Soil erosion on construction sites or roadbanks	.99	.68	.75	1.04	1.15	.82	1.53
Soil erosion on crop and pasture lands	.87	.91	1.06	.90	.68	1.00	1.60
Soil erosion on cleared woodland	.92	.72	.83	.87	.93	.96	1.73
Insects and pests	1.29	1.43	1.19	1.18	1.31	1.24	2.33
Weeds and brush	1.25	1.66	1.31	1.30	1.09	1.21	1.87
Surface mining	.51	.30	.64	.51	.49	.61	.27
Wind erosion -- dust	.44	.38	.27	.54	.44	.39	.73
Exhaust from transportation vehicles	1.73	1.15	.73	2.07	2.44	.74	1.00
Industrial and municipal smoke and fumes	1.57	.89	.69	1.77	2.20	.67	1.00
Agricultural burning	.37	.43	.16	.40	.34	.39	1.00
Other open burning	.54	.62	.48	.53	.51	.54	1.07
Undesirable sounds and noises in rural areas	.54	.49	.17	.52	.72	.37	.80
Particles in air harmful to health	1.29	.72	.38	1.47	1.96	.48	1.07
Undesirable odors	1.31	.79	.58	1.41	1.99	.44	1.00
Poor visibility due to smog	.93	.32	.16	.93	1.62	.20	.73
Inadequate development of natural resources.	.78	.60	.44	1.02	.93	.49	1.07
Depletion of natural resources by development	1.21	.62	.69	1.46	1.56	.59	.80

APPENDIX F

Chi-square Analysis

TABLE 1

RESULTS OF A CHI-SQUARE TEST FOR INDEPENDENCE BETWEEN FORTY-SEVEN NATURAL RESOURCE PROBLEMS AND SELECTED SOCIO-ECONOMIC CHARACTERISTICS

Problem	Computed Chi-square Value	Degrees of Freedom	Significance Level
Inadequate water supply			
Planning regions	34.48	20	.05
Population density	27.67	16	.05
Family income	15.95	16	.50
Education	16.31	12	.20
Sex	4.90	4	.30
Age	27.76	20	.20
Occupation	42.27	36	.50
Purity of drinking water			
Planning regions	25.91	20	.20
Population density	14.28	16	.70
Family income	21.63	16	.20
Education	26.77	12	.01
Sex	5.31	4	.30
Age	46.64	20	.001
Occupation	43.56	36	.50
Hardness of water			
Planning regions	49.40	20	.001
Population density	56.41	16	.001
Family income	33.60	16	.01
Education	26.39	12	.01
Sex	2.35	4	.70
Age	38.21	20	.01
Occupation	73.26	36	.001
Individual littering of waterways			
Planning regions	74.41	20	.001
Population density	49.71	16	.001
Family income	45.22	16	.001
Education	7.57	12	.90
Sex	7.13	4	.20
Age	48.65	20	.001
Occupation	82.44	36	.001
Industrial wastes discharged into waterways			
Planning regions	158.49	20	.001
Population density	155.11	16	.001
Family income	67.38	16	.001
Education	23.36	12	.05
Sex	11.39	4	.05
Age	58.15	20	.001
Occupation	130.84	36	.001

TABLE 1--Continued

Problem	Computed Chi-square Value	Degrees of Freedom	Significance Level
Municipal or residential wastes discharged into waterways			
Planning regions	82.62	20	.001
Population density	72.13	16	.001
Family income	40.81	16	.001
Education	20.52	12	.10
Sex	6.81	4	.20
Age	54.46	20	.001
Occupation	73.60	36	.001
Water pollution from agricultural chemicals			
Planning regions	40.38	20	.01
Population density	29.18	16	.05
Family income	21.10	16	.20
Education	17.51	12	.20
Sex	6.65	4	.20
Age	26.65	20	.20
Occupation	75.66	36	.001
Water pollution from non-agricultural chemicals			
Planning regions	86.59	20	.001
Population density	94.70	16	.001
Family income	49.49	16	.001
Education	31.82	12	.01
Sex	.80	4	.95
Age	58.36	20	.001
Occupation	95.65	36	.001
Streams needing channelization			
Planning regions	23.48	20	.30
Population density	16.55	16	.50
Family income	22.80	16	.20
Education	20.85	12	.10
Sex	2.56	4	.70
Age	31.04	20	.10
Occupation	54.60	36	.10
Flooding of agricultural land			
Planning regions	35.82	20	.02
Population density	21.92	16	.20
Family income	16.80	16	.50
Education	9.67	12	.70
Sex	5.77	4	.30
Age	28.85	20	.10
Occupation	43.38	36	.50

TABLE 1--Continued

Problem	Computed Chi-square Value	Degrees of Freedom	Significance Level
Flooding of nonagricultural land			
Planning regions	18.11	20	.70
Population density	21.96	16	.20
Family income	12.67	16	.70
Education	14.93	12	.30
Sex	5.77	4	.30
Age	33.06	20	.05
Occupation	70.49	36	.001
Inadequate drainage of agricultural land			
Planning regions	54.96	20	.001
Population density	22.69	16	.20
Family income	16.03	16	.50
Education	17.38	12	.20
Sex	1.25	4	.90
Age	26.22	20	.20
Occupation	42.81	36	.50
Inadequate drainage of nonagricultural land			
Planning regions	23.87	20	.30
Population density	10.71	16	.90
Family income	13.25	16	.70
Education	8.06	12	.80
Sex	.57	4	.98
Age	27.81	20	.20
Occupation	40.33	36	.70
Muddy streams or lakes			
Planning regions	71.56	20	.001
Population density	54.10	16	.001
Family income	31.92	16	.02
Education	13.20	12	.50
Sex	6.95	4	.20
Age	27.49	20	.20
Occupation	61.66	36	.01
Excess plant or algae growth in waterways			
Planning regions	39.53	20	.02
Population density	32.30	16	.01
Family income	16.60	16	.50
Education	19.50	12	.10
Sex	.78	4	.95
Age	13.53	20	.90
Occupation	60.02	36	.01

TABLE 1--Continued

Problem	Computed Chi-square Value	Degrees of Freedom	Significance Level
Livestock or poultry facilities			
Planning regions	24.12	20	.30
Population density	17.11	16	.50
Family income	19.08	16	.30
Education	9.49	12	.70
Sex	.46	4	.98
Age	27.08	20	.20
Occupation	24.64	36	.90
Disposal of solid wastes			
Planning regions	46.00	20	.001
Population density	48.18	16	.001
Family income	23.66	16	.10
Education	21.89	12	.05
Sex	5.82	4	.30
Age	34.86	20	.05
Occupation	74.37	36	.001
Individual littering of landscape			
Planning regions	52.32	20	.001
Population density	43.60	16	.001
Family income	32.58	16	.01
Education	18.52	12	.20
Sex	4.10	4	.50
Age	37.50	20	.02
Occupation	64.79	36	.05
Farmland shifting to urban and industrial uses			
Planning regions	73.69	20	.001
Population density	68.88	16	.001
Family income	40.86	16	.001
Education	14.46	12	.30
Sex	3.12	4	.70
Age	44.08	20	.01
Occupation	69.39	36	.01
Availability of open spaces			
Planning regions	123.45	20	.001
Population density	112.47	16	.001
Family income	24.89	16	.10
Education	11.82	12	.50
Sex	3.62	4	.50
Age	41.00	20	.01
Occupation	56.01	36	.05

TABLE 1--Continued

Problem	Computed Chi-square Value	Degrees of Freedom	Significance Level
Preservation of scenic or historical areas			
Planning regions	67.74	20	.001
Population density	61.48	16	.001
Family income	17.72	16	.50
Education	12.30	12	.50
Sex	4.25	4	.50
Age	34.97	20	.05
Occupation	69.47	36	.01
Depletion of soil fertility			
Planning regions	26.72	20	.20
Population density	13.21	16	.70
Family income	10.63	16	.90
Education	7.38	12	.90
Sex	2.20	4	.80
Age	29.62	20	.10
Occupation	45.39	36	.50
Depletion of woodland resources			
Planning regions	50.27	20	.001
Population density	39.30	16	.001
Family income	13.56	16	.70
Education	14.54	12	.30
Sex	2.59	4	.70
Age	35.90	20	.02
Occupation	45.63	36	.50
Depletion of fish and wildlife resources			
Planning regions	56.10	20	.001
Population density	49.23	16	.001
Family income	14.51	16	.70
Education	7.12	12	.90
Sex	4.05	4	.50
Age	22.30	20	.50
Occupation	71.62	36	.001
Availability of lake-type recreation			
Planning regions	72.16	20	.001
Population density	76.38	16	.001
Family income	28.42	16	.05
Education	11.75	12	.50
Sex	2.78	4	.70
Age	37.84	20	.01
Occupation	52.48	36	.05

TABLE 1--Continued

Problem	Computed Chi-square Value	Degrees of Freedom	Significance Level
Availability of parks and picnic areas			
Planning regions	49.24	20	.001
Population density	47.09	16	.001
Family income	24.45	16	.10
Education	18.74	12	.10
Sex	8.25	4	.10
Age	40.32	20	.01
Occupation	70.97	36	.001
Availability of natural areas with streams			
Planning regions	72.24	20	.001
Population density	62.73	16	.001
Family income	30.32	16	.02
Education	15.98	12	.20
Sex	1.17	4	.90
Age	42.68	20	.01
Occupation	78.76	36	.01
Quality of recreational facilities available			
Planning regions	41.93	20	.01
Population density	32.99	16	.01
Family income	29.84	16	.02
Education	10.10	12	.70
Sex	5.85	4	.30
Age	37.04	20	.02
Occupation	57.47	36	.05
Availability of good hunting and fishing			
Planning regions	44.35	20	.01
Population density	42.39	16	.001
Family income	15.26	16	.70
Education	8.80	12	.80
Sex	3.42	4	.50
Age	44.54	20	.01
Occupation	39.93	36	.70
General appearance of landscape			
Planning regions	38.16	20	.01
Population density	34.86	16	.01
Family income	25.45	16	.10
Education	11.02	12	.70
Sex	2.68	4	.70
Age	37.65	20	.01
Occupation	44.68	36	.50

TABLE 1--Continued

Problem	Computed Chi-square Value	Degrees of Freedom	Significance Level
Soil erosion on construction sites or roadbanks			
Planning regions	39.17	20	.01
Population density	22.75	16	.20
Family income	20.32	16	.30
Education	5.07	12	.98
Sex	2.10	4	.80
Age	29.35	20	.10
Occupation	49.20	36	.02
Soil erosion on crop and pasture lands			
Planning regions	51.14	20	.001
Population density	30.95	16	.02
Family income	25.57	16	.10
Education	6.81	12	.90
Sex	1.48	4	.90
Age	29.69	20	.10
Occupation	47.43	36	.30
Soil erosion on cleared woodland			
Planning regions	28.89	20	.10
Population density	13.97	16	.70
Family income	20.09	16	.30
Education	9.98	12	.70
Sex	3.90	4	.50
Age	28.10	20	.20
Occupation	45.78	36	.50
Insects and pests			
Planning regions	42.53	20	.01
Population density	20.60	16	.20
Family income	15.49	16	.50
Education	9.17	12	.70
Sex	2.27	4	.70
Age	15.05	20	.80
Occupation	66.90	36	.05
Weeds and brush			
Planning regions	57.01	20	.001
Population density	54.66	16	.001
Family income	19.11	16	.30
Education	8.44	12	.80
Sex	6.20	4	.20
Age	37.32	20	.02
Occupation	64.50	36	.05

TABLE 1--Continued

Problem	Computed Chi-square Value	Degrees of Freedom	Significance Level
Surface mining			
Planning regions	14.70	20	.80
Population density	15.73	16	.50
Family income	20.94	16	.20
Education	14.24	12	.30
Sex	4.21	4	.50
Age	47.04	20	.001
Occupation	52.39	36	.10
Wind erosion -- dust			
Planning regions	22.15	20	.50
Population density	24.96	16	.10
Family income	16.59	16	.50
Education	18.59	12	.10
Sex	.87	4	.95
Age	38.18	20	.01
Occupation	49.53	36	.20
Exhaust from transportation vehicles			
Planning regions	166.36	20	.001
Population density	204.90	16	.001
Family income	54.96	16	.001
Education	22.33	12	.05
Sex	4.59	4	.50
Age	38.51	20	.01
Occupation	152.11	36	.001
Industrial and municipal smoke and fumes			
Planning regions	139.93	20	.001
Population density	152.13	16	.001
Family income	37.48	16	.01
Education	26.98	12	.01
Sex	2.84	4	.70
Age	35.28	20	.02
Occupation	96.69	36	.001
Agricultural burning			
Planning regions	28.26	20	.20
Population density	14.95	16	.70
Family income	11.80	16	.80
Education	20.32	12	.10
Sex	1.59	4	.90
Age	24.81	20	.30
Occupation	48.40	36	.20

TABLE 1--Continued

Problem	Computed Chi-square Value	Degrees of Freedom	Significance Level
Other open burning			
Planning regions	24.07	20	.30
Population density	24.37	16	.10
Family income	15.28	16	.70
Education	17.05	12	.20
Sex	3.15	4	.70
Age	19.06	20	.70
Occupation	57.56	36	.05
Undesirable sounds and noises in rural areas			
Planning regions	30.38	20	.10
Population density	34.07	16	.01
Family income	12.12	16	.80
Education	5.96	12	.95
Sex	3.08	4	.70
Age	22.81	20	.50
Occupation	52.79	36	.05
Particles in air harmful to health			
Planning regions	128.98	20	.001
Population density	138.45	16	.001
Family income	45.74	16	.001
Education	21.20	12	.05
Sex	4.08	4	.50
Age	40.58	20	.01
Occupation	111.91	36	.001
Undesirable odors			
Planning regions	127.11	20	.001
Population density	125.57	16	.001
Family income	41.28	16	.001
Education	25.42	12	.02
Sex	6.73	4	.20
Age	34.55	20	.05
Occupation	84.30	36	.001
Poor visibility due to smog			
Planning regions	161.05	20	.001
Population density	168.06	16	.001
Family income	32.78	16	.01
Education	13.94	12	.50
Sex	2.78	4	.70
Age	24.98	20	.30
Occupation	63.16	36	.01

TABLE 1--Continued

Problem	Computed Chi-square Value	Degrees of Freedom	Significance Level
Inadequate development of natural resources			
Planning regions	53.51	20	.001
Population density	32.51	16	.01
Family income	23.04	16	.20
Education	15.58	12	.30
Sex	2.84	4	.70
Age	18.71	20	.70
Occupation	56.20	36	.05
Depletion of natural resources by development			
Planning regions	78.00	20	.001
Population density	76.82	16	.001
Family income	38.14	16	.01
Education	26.26	12	.01
Sex	6.38	4	.20
Age	30.96	20	.10
Occupation	64.36	36	.01

VITA

Richard Greenhalgh, born [redacted], in Webster County, Nebraska, grew up on a farm and graduated from a rural consolidated high school. After farming two years he attended Nebraska State Teachers' College and later the University of Nebraska, graduating with a B.S. in Vocational Education in 1961. He taught one year at Hebron, Nebraska, and then returned to the University of Nebraska, receiving an M.S. in Agricultural Economics in January 1965. Since graduation he has been employed by the Economic Research Service and was transferred to Columbia, Missouri, in August 1970 to pursue a doctorate.

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