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The Role of Social Scientists in River Basin Planning: a Critique

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ABSTRACT

This article is a critique of a river-basin water planning project conducted recently on an inter-disciplinary basis at North Dakota State University. It was financed by the Office of Water Resources Research (OWRR) of the United States Department of Interior. Discussed are some of the procedural and substantive deficiencies of the project, resulting from the disproportionately small size of the social science component of the research group.

Introduction

For ten weeks during the summer of 1971, I took part in a faculty fellowship program at North Dakota State University (the purpose of which was to determine the best use of the water resources in the Red River (North) Valley.) The interdisciplinary team of 13 Ph.D. and 8 M.S. degree holders from 14 regional colleges and universities was organized under a U.S. Department of Interior and State of North Dakota water resource grant of $115,410. The group was composed of five engineers, three biologists, one physicist, five chemists, one limnologist, one geologist, one sociologist, one economist, one agricultural economist, one home economist, and one geographer. The grant was administered through North Dakota Water Resources Research by two members of the N.D.S.U. engineering department faculty, Dr. Ordean Anderson and Dr. Melvin Forthun. The major thrust of this effort is that the social sciences were under-represented and that this

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imbalance decreased not only the group's effectiveness but the quality of the final report, *River*. It is hoped that the lesson from this experience analyzed below will benefit similar efforts in the future.

Highlights of the experience contributed greatly to the enjoyment experienced and knowledge gained during the ten-week period. One highlight of the summer program was a day's visit by the world-reknown architectural planner, Ian McHarg. It was a hurried visit as the event was not originally planned for the research agenda. The program directors called McHarg's home in Pennsylvania to ultimately locate him in California only after being apprised of the research group's intention to use his book as a presentation model and the group's desire to discuss the project with McHarg–after seven weeks of the program had already run its course. Several aspects of McHarg's comments to the group will form the basis, for development below, of some of my major criticisms of the group effort.

Another highlight was a bus trip to Winnipeg taken at the start of the program during which the group inspected the physical characteristics of a great part of the subject river basin area. Also impressive was the research group's intensive confrontation with a battery of hydraulic engineers and natural scientists whose demonstrations were designed to inculcate the group with at least a superficial analytical framework for accomplishment of the program's objectives.

Group efforts culminated in a 170-page, single-spaced report that recommends exhaustive water management guidelines deemed necessary within the next 20 years. The group purported to use systems analysis as its analytical method and McHarg's overlay method as its presentational format. Because systems analysis is often confused with other methods for choosing between social alternatives, succinct contrast of these methodologies is offered below for clarity. Discussion of the attributes of the overlay method occurs in another section because the presentation format was devised in a later phase of the research group's deliberation.

Benefit-cost analysis is used as the basis for choice between different possible government project expenditures. Given a specific goal, both benefits and costs of alternative ways of reaching a goal are compared to determine which yields the greatest dollar value of benefit per value of cost [1]. For example, a big dam might be compared to a series of small dams to determine which would result in the greatest benefit-cost ratio in furthering irrigation and controlling floods. Operations research is used to make relatively non-quantifiable governmental choices. Operations research might be used, for example, to choose between diplomacy, bombs, or some combination as a public policy designed to contain communism [2].

Systems analysis is of broader scope than either benefit-cost analysis or operations research. In systems analysis, one is not concerned with a simple means-end problem but with the very selection of an optimal mix of

objectives [2]. Planning-programming-budgeting systems (commonly referred to as PPBS) is basically systems analysis applied to governmental operations that allow comparisons among alternative expenditure mixes [3].

The systems approach, involving three procedural phases, was specified as the group's method for arriving at a water "plan" for the Red River Basin. In proceding through the three phases of the systems analysis method the group alternated between group discussions pertaining to completion of each respective phase and individual (or small team) work sessions in the gathering of information of which the group should have been cognizant in the phase completion process. The first phase consisted of generating background information on the study area–the characteristics of the Red River Basin–and preparing a preliminary report on what the participants believe they will accomplish, how they should divide themselves to work on the project, and what would be required in the way of information to complete the project. The second phase involved developing alternative approaches to the requirements for the general objective established in the first phase, redefining the objective to some extent, and evaluating alternatives. The last phase involved trade-offs of the alternatives and selection of the final approach to satisfy the general objective.

Project Deficiencies

The full title of the report that the interdisciplinary research group's efforts culminated in is *Recommendations for Improving the Valley Environmental Resources River*. It was prepared by two directors, Dr. Ordean Anderson, and a small contingent of the research group for publication [4]. The group purported to use systems analysis in attempting to inquire into physical, biological, cultural, and economic factors of water use. The chapter headings include designations such as Description, Water Use and Uses, Water Quantity, Quality, Economics, and Possible Legal and Administrative Structures for Water Resources Management (the latter composed by this writer) [4].

The Abstract section of *River* describes man's responsibility for water (and associated) uses as arrived at through the use of systems analysis. This theme, in implying a departure from laissez-faire philosophy, necessitates recommendation of a comprehensive basin zoning system, local involvement in basin-wide planning, a public water-use education program, and careful study before irreversible large-scale changes are made in water uses.

It is my position that neither *River* nor the deliberators culminating in it took sufficient cognizance of the social dimensions of river basin planning. In the words of the President in his 1965 message on national beauty:

> "Our conservation must not be just the classic conservation of protection and development, but a creative conservation of restoration and innovation. Its concern is not

with nature alone but with the total relation between man and the world around him."

The lost opportunities for integrating physical with social dimensions of river basin planning were many and varied. There was no detailed catalogue of basin activity to relate to present or future projected water needs. There was neither itemization of governmental entities presently controlling water use nor discussion of the political dimensions of modifying these to cope with the present realities of water conservation. Any insufficiency of investigation into the social dimensions of water planning has profound implication for both short- and long-run maximization of public welfare. These implications are discussed below.

River comprehensively described the evolution of nature but largely ignored the evolution of river basin society in relation to it. For example, in neither the sociological section (pp. 114-123), nor in Basin Description (p. 3), nor in that part devoted to Basin Economics (p. 114-123) was there any detailed inventory of human social or economic activities for indication of present or future projected water needs at different basin locations. Neither the Flood Control (p. 75) nor the Water Quality sections were systematically related to use patterns resulting from Industrial (p. 37) or to Agricultural (p. 31) location patterns.

Although the matrix format was utilized in Chapter VII (pp. 124-135) to suggest the participants' choice between alternative types of enforcement agencies, there was neither itemization of existing governmental water control institutions nor mention of the political dimensions of supplanting or supplementing the old with the new control and enforcement agencies. There is no reference to the water planning predispositions of area political leaders in *River* much less comprehensive social survey.

Another example of the social scientific inadequacy of the summer's effort was the failure of the research group to avail itself of an idea that seemed to be McHarg's most substantial contribution: the suggestion that "dirty" North Dakota water be used for commercial purposes in the basin and that "clean" Minnesota water be used for human consumption. Although this would seem to make sense on a basin planning basis, the obstacles to implementation could be substantial. However, exploration of the political, social, and economic implications of this possibility was rendered impractical by the group's make-up. Completely aside from the problem of determining needs, the group's preoccupation with description to the exclusion of detailed social inventory, made formulation of a strategy for implementing McHarg's suggestion impossible. The absence of this type inquiry would place governmental officials brash enough to effect implementation with insufficent knowledge of possible alternative action strategies, in a position of proxy for social scientists on the one hand and the basin citizenry on the other.

As indicated in the following quotation, this deficiency would deny the cross-cultural influence of exposure to many points of view in the planning as well as in the implementational process.

> The legal process attempts to structure the decision-making process so that decisions will be consistent with public goals. The people of the community decide, through their official representatives, the basic pattern of development of the community—the comprehensive plan, the zoning ordinance, the subdivision regulations, and the building codes. If change is to be made, it is submitted first to those who specialize in this aspect of public decision-making: the plan commission and the planners. This unit of government hears, considers, and then recommends to the elected representatives of the people, the city council. The council, after due notice and hearing, decides what is best for the community. Other units of government which may be affected (such as agencies concerned with parking, streets and traffic, utilities, and schools) are also consulted. If these units of government are autonomous, and if their services are needed, then their consent must also be obtained [5].

Social science surveys can operate to anticipate revelation of planning dimensions at preliminary public hearings, commonly required by law. This anticipation enables officials to prepare for such public discussion by formulating public policy mix (subsidies, taxes, plan modification, etc.) appropriate to easing of tensions arising from conflicting interests aired at public hearings. This assumes that the authorities in complying with legal notice requirements, stimulate sufficient public interest to necessitate substantial public justification of any plan implemented. Indeed, the very justification process, itself, may bring to light desirable plan alterations.

It was McHarg's position that planners not concern themselves with implementational problems but merely confront governmental authorities with alternative physical consequences. It is my feeling that social inquiry is required not only for strategic purposes but to identify basin needs in light of river basin population desires in order to give proper weight to the alternative welfare optimization potential of different plans. This has special relevance to the shading process in McHarg's overlay presentational technique, described below.

Thus, Glennan suggests the need for such weighting in the evaluation of general manpower programs:

> "When programs have objectives that go beyond simply maximizing the return on public investments irrespective of who receives the benefits, a simple benefit-cost ratio is an insufficient indicator of program outcome.—Perhaps the most frequently advanced idea is the use of a system of weights reflecting the relative value society places on increases in the well-being of specific groups in society.—Clearly, however, a set of weights is implicit in the actions of Congress and various executive departments." [6]

Furthermore, should socially revealed preferences indicate that the

political consensus was inimical to man's long-run interests, it would seem incumbent on an evenly balanced scientific team to devise an educational strategy toward acceptance of a plan inducive to long-run human survival and comfort. Thus, the social sciences must be inextricably involved with the natural, not only in determining alternative water-use plans but in implementation of the alternative that in the short and long run best serves the interest of man. The insights of scientists, politicians, and the public in general, all taken together, may serve to protect the interests of those who will one day live in the area being planned, but are not yet born or not yet old enough to protect their own interests.

Deficiency Causes

This section discusses some substantive and procedural difficulties flowing from a narrow investigational approach as well as preconceptions resulting in the use of this approach. The administrative and personnel procedures followed by the research group were probably influenced by the experience of the administrators of the water planning project at the aforementioned Systems Engineering Design Summer Faculty Fellowship Programs conducted at the Marshall Space Flight Center and the University of Alabama at Huntsville [7]. The Huntsville groups' projects of designing an orbiting vehicle in 1967 and of determination of the nature of orbital research in 1969 used conventional systems analysis modus operandi. The group composition at Huntsville reflected the relatively exclusive physical scientific nature of that project and may have had some influence in determining the River Basin Group's composition.

Defense of the composition of the research group centers around two questions. The first is whether "planners" should ever involve themselves with the strategy of plan implementation. McHarg, for example, limits the planners' function to presentation of alternatives; the directors of this fellowship projet insisted that the population fluidity of the Red River basin area precluded formation of any usable catalogue of present or future social water-use needs or desires in the interest of welfare and implementation considerations. If the directors are correct, there would appear to have been little need for social scientific effort in the water-use planning of the Red River basin. This conclusion would suggest a relatively mechanistic planning function undetermined by the configuration of present or future human aspirations.

In response to the directors' position, Ronald Johnson, Associate Professor of Sociology at Virginia Polytech, formerly of the University of North Dakota and Bemidji State College states:

> "The population of almost all counties in the Red River Basin has been declining over the past 20 years. Counties which are gaining in population have drawn from their immediate hinterland insofar as the civilian population is concerned. It would be safe

> to estimate that the socio-economic characteristics of this (Red River Basin) area have changed little in the past two decades nor, barring drastic economic development programs, should we expect major socio-economic changes in the future of the basin."

This indicates the utility of social planning in regard to Red River Basin water use. Turning to the question of limitations to a "planner's" scope of inquiry, it is appropriate to ask: What is meant by the term "physical planner"? How does he differ from the "social planner"?

Today, Ian McHarg, for example of the physical planner, is helping, according to a recent front page article in the *Wall Street Journal* (August 1971), to pioneer a planning method that is reshaping his profession of landscape architecture [7]. But not too many years ago, according to the article, he was a rather lonely proponent of the method he likes to call "ecological determinism," until he wrote a book, eloquent and stirring, full of bright maps and beautiful photographs, philosophy and polemic [8]. This book, along with some lively TV exposure, catapulted him into prominence. In addition to these accomplishments, he is a teacher and founder of the University of Pennsylvania's department of landscape architecture. Once his profession dealt with little more than a kind of exterior decoration whereas today the profession grapples wih everything from the quality of urban life to the deteriorating environment.

The function of the social planner is perhaps suggested by reference to the fate of one of Professor McHarg's better known planning efforts, the Wallace-McHarg Plan (Wallace is a member of McHarg's landscape firm) for an area West of Baltimore. Although the plan drew national acclaim, eight years after its completion the area residents still hadn't adopted its central recommendations: a conservation trust and a real-estate syndicate that would enable valley owners to share in development profits [9].

Mr. Toth, a former associate of McHarg, maintains that a significant shortcoming of McHarg's method is the lack of a method of social implementation, requiring social scientific effort. Mr. Toth's observation applies not only to McHarg's Maryland project, but also to the *River* deliberations in two ways. Not only was the research group hampered by a shortage of social scientists, but I was the only one of the social scientists that had the prior research experience shown by a terminal degree. And, unfortunately, I could not use my training to develop some social dimensions for contribution to the project. Because I held both a law degree and a Ph.D. in economics, I had to devote my time exclusively to exploring the legal implications of river basin planning (Chapter VII, *River*). Without sufficient social scientific input into this kind of effort, not only does a plan fail to adequately relate water to human needs, but the lack of inquiry into implementational strategies may well render the physical plan little more than an academic exercise.

The first suggestion of procedural deficiency was contained in the

literature designed to induce college professors to join the Office of Water Resources Research Faculty Fellowship. It described the group as follows:

> "Interdisciplinary in its approach, the design team will represent such academic disciplines as agriculture, chemistry, ecology, economics, engineering, forestry, geography, geology, law, mathematics, medicine, political science, and physics."

It is significant that there was no mention of sociology in this enumeration. And as the program progressed, it became increasingly apparent that the social scientific input into *River* (the final report) would be practically nonexistent because of the imbalance in the group, the greater research experience of the natural scientists, the difference in the level of effort put forth by the social scientists vis-a-vis the natural scientists, and lack of direction in group discussions.

The time lost in fruitless argument during the occasional sessions of the whole group contributed to the inadequacies of the final report. The group spent a major portion of its time in many of these sessions arguing about issues that ultimately proved to be largely academic. For instance, although the time constraint dictated how detailed the final report could be, valuable time was spent arguing this issue. Preoccupation with this kind of wrangling suggested strongly the need for a psychologist to act as a group action expert.

Fellowship group consternation at inconsistencies and ambiguities that developed in the group's relations with the directors cannot be considered atypical. According to Vachon, in a similar exercise (wherein participants concentrated on determining characteristics of an orbital research laboratory in 1967 and 1969), the staff was confronted by the participants with the assertion that they had not been given enough detailed information to achieve the finished project. This lack of detail in both the space and water projects was justified by the directors on the grounds that part of the systems approach is to have the participants develop criteria, procedures, and detailed approaches on their own [7].

An example of confusion that resulted from the lack of leadership was the working of participants out of specialty in the final phases of the program. Initially, the directors indicated that it was desirable for all of the participants to study, analyze, and become familiar with all phases of the project in the interest of interdisciplinary input as well as future public exposition of the results. Then, nearing the end of the project, the directors expressed irritation at the participants working out of academic specialty. The directors expressed concern that no facet of the project would receive sufficiently expert treatment under those circumstances. This complaint was directed primarily at physical scientists trying to handle the social scientific problems involved and, as such, reflected the aforementioned imbalance in the group composition.

The directorship probably should have included at least one social scientist who presumably would have had some idea of what was needed in the way of social science input and how to procure it. The inadequacy of representation presented those social scientists participating (4 out of 20) with the impossible task of inventorying the Red River Basin in 10 weeks and identifying social problems that might be met with skillful management of the basin's resources. Furthermore, the manpower disparity was aggravated by the nature of the first two weeks' orientation lectures, absolutely none of which were sociological in content.

These disparities proved to be unfortunate in reference to the particular situation confronting the faculty fellows at the time of the water research program. In light of the existence of a commission (Souris-Red-Rainy River Basins Commission) set up jointly by North Dakota, South Dakota, Minnesota, and the federal government under authority of the Water Resources Planning Act of 1965, the main opportunity for fellowship contribution could only have resulted from true group interdisciplinary interaction resulting in a uniquely interdisciplinary product. The Commission, with a small permanent staff, and many part-time scientists, was and is presently engaged in extensive research into planning three river basins, including the Red River Basin. The fellowship compositional imbalance diluted any interdisciplinary character of the group and, therefore, rendered its effort something of a duplication of basin planning being simultaneously undertaken by the Commission.

Project Improvement

This section is concerned with ways in which both the investigational phase and subsequent presentational strategies (the second inextricably involved with the first) might have been improved. Reference below to the appendix outline, environmental education, and the overlay method are intended to furnish insight into the more comprehensive scope of consideration that would have been possible with a better balanced investigational effort. The brief discussion of educational dimensions indicates the magnitude and complexity of the communication problem involved in inducing the adult citizenry to realize the urgency of circumscribing traditional "freedoms" in the interest of environmental preservation in light of social scientifically revealed human needs and aspirations.

I drew up the outline referred to above (in the appendix to this paper), cataloging different possible dimensions to river basin water planning during the organizational phase of the project. Although this outline is not sufficiently comprehensive to enumerate all possible water planning activities, its scope is broad enough for it to serve as a demonstration of types of social scientific investigation appropriate to this kind of planning. The asterisks in

the outline identify those items briefly discussed as most obviously needing the attention of social scientists. It is recognized that there is both duplication and overlapping in the outline. Although the outline is reasonably comprehensive it gives little insight into the way that planning information should be assembled for purposes of presentation and analysis. The manner of presentation should correspond to the educational and other environmental conditioning of those to whom the plan or alternative plans are being presented.

In this regard the following quotation would indicate that the various levels of formal education must strive to increase emphasis on dissemination of ecological information by relating more disciplines to that problem and, in that process, decompartmentalizing the different disciplines.

> "The most critical problem facing humanity today is an ecological one of relating human societies harmoniously to their environments. Before conditions caused by radioactive fallout, pollution, exploding populations, the greenhouse effect of increased atmospheric carbon dioxide, and intersocietal aggression can be treated, the knowledge of the humanities and the behavioral sciences, as well as the natural sciences, must be integrated. Our recent awareness of critical environmental problems has created a favorable climate of thought for an intellectual orientation of knowledge relevant to contemporary world problems. But the task of orienting knowledge in a contemporary ecological context seems overwhelming. Knowledge has become so complex that depth of understanding requires specialization. Appreciable understanding of other disciplines is often necessary to a satisfying performance in a given specialty, but comprehension of the unity of knowledge appears difficult to achieve [10]."

The difficulties involved in this integration of conventional divisions of knowledge suggest a gradual approach as well as consideration of any opportunity costs involved. Perhaps the relation between the use of the environment with other facets of human life should be inculcated at early educational levels to achieve conditioning facilitative to life-long realistic thought and action.

Alessio's analysis indicates that the per capita income losses suffered because resources devoted to environmental clean up can be minimized by policies designed to educate the population about the costs and benefits of environmental control [11]. In the necessary trade off between real income growth and decrease in environmental pollution the amount of growth in per capita income lost depends ultimately on the sensitivity of the region's (river basin's) population growth rate to environmental quality, and on the sensitivity of the region's preference for environmental quality to rising levels of per capita income.

Although this indicates the magnitude of the problem of educating today's children to approach problems in an interdisciplinary manner, there is a much more urgent matter. This is determination of effective methods of presentation of water-use and other plans to an adult citizenry unprogrammed

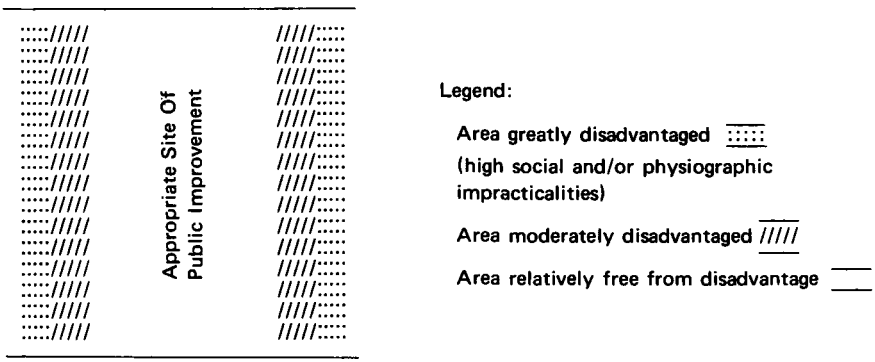

Figure 1. Overlay method. (Source: McHarg, *Design For Nature*, pp. 34-41.)

for interdisciplinary analysis and criticism. The fellowship group eventually settled on Ian McHarg's "overlay" method of presentation as the most effective.

McHarg uses the overlay method (demonstrated in Fig. 1) to minimize location of human structures (usually public) on the natural environment that destroy or despoil existing social values and encourage placements that avoid areas of high social costs, incur the least penalties in construction costs, and create new values. For example, it has often been found advisable to place playgrounds containing relatively simple and durable structures in urban areas that flood easily rather than business or household structures. This often enhances the attractiveness and utility of areas adjacent to rivers and avoids the costs of flood insurance, levee construction and maintenance, or flood damage. Social scientific investigation would aid in determining:

1. choice of playground site between many flood areas,
2. size of the recreation facility in light of population projections,
3. nature of any recreation area in light of present and future recreational preferences and
4. design implementational strategies.

McHarg identifies critical factors affecting physical construction of a public "improvement" and ranks these from least to greatest cost. He then attempts to identify social values so as to be able to rank them from high to low. (See Table 1.) He maps physiographical obstructions (for example, poor foundation for construction), so that the darker the tone on a transparent overlay map, the greater the obstruction's contribution to construction cost. He similarly maps social values so that the darker the tone, the higher the value. Presumably the social values are McHarg's because he does not reveal any sophisticated procedure for determining social attitude toward any plan

Table 1. Characteristics Considered So as to Contribute to Map Shading Indicative of Minimum Social Cost of Public Improvement:

A. Physiographic	C. Social
1. slope	1. Land values
2. surface drainage	2. historic values
3. soil drainage	3. scenic values
4. bedrock foundation	4. recreational values
5. soil foundation	5. water values
6. erosion susceptibility	6. forest values
	7. residential values
B. Danger	8. wildlife values
1. flood inundation	9. institutional values
2. other storms	

he derives. When the transparent social value map is imposed on the transparent physiography map, the least-cost areas for construction are revealed.

Physiographical factors are shaded according to intensity. The danger factors are shaded as to amenability to public improvement site. The social factors are shaded according to desirability of preserving values included in the social category. Each factor, with its three grades of values, is then photographed as a transparent print. The transparencies of the first group are superimposed upon one another and from this a summary map is produced that reveals the sum of physiographic factors influencing location of a public improvement. Each subsequent parameter is then superimposed on the preceding until all parameters are overlaid. The darkest tone then represents the sum of social values and physiographic obstructions to the proposed edifice. The lightest tone reveals the areas of least social value representing the least direct cost of the public improvement. Even where market values are used for the shading process, this is not accurately reflective of social values because market values indicate not what all people desire but only what those with sufficient financial resources to register their desires are willing to pay.

The public improvement should be located in that area of least social value and cost. Although claiming this as an ecological method is to flatter it, it does have the merits of incorporating the parameters currently employed in such selection procedures and of adding new and important social considerations, revealing their locational characteristics, permitting comparison, disclosing aggregates of social values and costs. According to McHarg, whatever limitations of inprecision it may have, the "overlay" method does enlarge and improve existing method [No. 8, p. 34].

Although the very use of the overlay presentation method would suggest

the need for investigation into the nature of area social values, the OWRR group failed to overlay maps of physical characteristics with tones suggestive of the latter. The research group, lacing the social scientists to make even a rudimentary social investigation, cut short their use of the overlay method in such a manner as to indicate that area social features were either nonexistent or unimportant.

Not coincidentally, the procedure followed to gain McHarg's evaluational comments the afternoon of his appearance, both during the deliberations and finally to write the *River* report, was much the same. Information as to the present physical character of the basin was derived by engaging in conjecture as to how it came to be what it is today by moving forward through time from hundreds of centuries ago. This involved speculation as to how the ice ages contributed to present configurations of waterflow and the like. In effect, this line of investigation, as used by the OWRR research group, stopped at area physical description without proceeding further to the comprehensive social investigation and description so necessary to meaningful planning.

Social values are classifiable into two types. The first are of life-or-death urgency. An example would be the recent substantial increase in pollution-caused lung cancer in some thickly populated area. The second would be a comparatively marginal planning decision such as the placement of a water recreational facility in one location as opposed to another. The second might be more important than the first, but not as obviously important because the consequences of the choice might be felt in the more distant future. Many ecological imbalances are less obvious in agricultural regions than in congested metropolitan areas, and logic would indicate that remedies to these would need more sociological effort inducive to selling different components of a water-use plan in the Red River Basin than, say, in New York.

An example of the second type of social value is the potentially controversial suggestion made by McHarg, mentioned above. The basin household consumption of Minnesota "clean" water and the industrial use of "dirty" Dakota water requires social determination of the initial acceptibility of this exchange in conjunction with development of feasible strategies for conditioning the populace to accept this aspect of basin-wide planning. Section J in the appendix outline would suggest social surveys to identify such use conflicts in facilitation of resolution by compromise.

Of course, there are methods other than McHarg's overlay for effective reflection of extensive social scientific research. For example, Lichfield demonstrates in a recent article how a Planning Balance Sheet can be used as a design tool in the process of plan-making and as a method of setting out the rationale behind the Plan recommended by professional planners [12]. The foregoing presentation format should be considered as supplemental to the overlay and other methods. Comprehensive political surveys periodically

Matrix	1	2	3	4 →
I	2, 9, 22	5, 11, 32	7, 15, 24	14, 21 36
II	22, 33	25, 34, 35		
III	2, 17 9			
IV				

Example Environmental Characteristics

I. Forest area.
II. Area flooded in 1950.
III. Non-urban silt & clay soil foundation.
IV. Slope in excess of 10%.

Example Social Characteristics

1. Defeated last school bond issue.
2. Within 10 miles of nearest recreation lake.
3. Population density over 500 per square mile.

a.

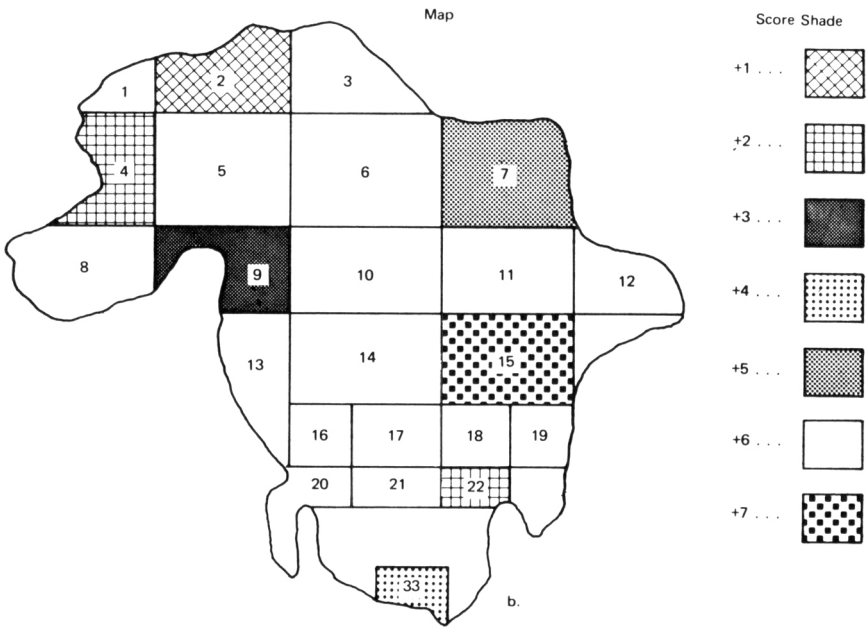

Figure 2. Characteristics matrix and map social characteristics.

engaged in by both political parties may not only demonstrate the feasibility of the following approach but actually serve as data sources.

Figure 2a reflects a matrix format for visual demonstration of social dimensions of river basin planning. On the vertical portion of the matrix are enumerated possible physical characteristics; on the horizontal portion are listed possible social characteristics. In the matrix, then, are entered appropriate numbers of the applicable basin areas as indicated in the basin map, Fig. 2b. Social science research should result in this division of the river basin into areas containing population as socially and physically homogenous within each area as possible. This increases the relevancy of a particular implementational strategy: only one strategy is required for any particular area.

Each characteristic is given a "weight" as to the impact and direction of its influence on plan acceptance. Since the collective nature of any communities' plan (or other) preferences is at best very difficult to quantify, the assigning of such weights is more of an art than a science. Involved in this process is evaluation of interview samples and/or questionnaire samples in conjunction with the use of common sense. Examples of pertinent social characteristics are past voting preferences (candidates as well as bond issues), population density, party registration, property valuation, and average age. Examples of physical characteristics would be proximity to various types of recreation areas, primary area use (farming, residential, or industrial), time of last flood (if any), characteristics of last flood, and geological characteristics. Cross reference of physical with social characteristics in this manner (Fig. 2a) would tend to give a more comprehensive indication of required implementation strategy because many physical habitat characteristics will interact with social to influence attitudes toward implementation. The cross referencing also would give some indication of the degree to which certain social and physical characteristics causally appear together.

The next step in construction of our map of implementational strategy is to assign from the weighting system, referred to above, a number representing an implementational numerical score. For example, people living in a flood zone without previously developed flood protection (one or more of the numbered areas of the basin map, Fig. 2b) could be expected to favor a basin plan offering increased flood protection construction, by virtue of their location, alone. It might be ascertained, on the other hand, that in the recent past the people in this area voted against bond issues designed to finance public improvements, portending a negative attitude towad public expenditures. Depending on the relative weight assigned to these and other factors, this locational aspect might contribute a weight of +4 to the composite (including consideration of the numbers representing weights of *all* physical and social factors) whereas the bond voting aspect might yield −2 resulting in a net weight score of +2.

A color would be assigned each possible area composite net weight score. The pattern of colors (and/or shading) imposed on the map (Fig. 2b) would indicate which areas could be expected to require much "selling" effort and which areas would not. The configuration of placement of any area's number in the matrix (Fig. 2a), on the other hand, would reveal the nature of the educational strategy required (if any). Area square 22 reflects the characteristics of the above example.

Such a matrix and ancillary subdivided map (Fig. 2b) could be composed for several alternative plans. Indeed, the indicated magnitude of required public acceptance effort might be one basis for choosing between plan alternatives. Enumerated as social and physical characteristics, respectively, could be projections of future attitudes and/or future water needs. These characteristics might warrant a zero "acceptibility" weight insofar as the basin citizenry were unaware of projected future conditions and/or were indifferent to them.

Conclusion

It would be neither fair nor adequate to leave this evaluation on an exclusively critical note. Some very definite accomplishments can be chalked up to the credit of the project directors and the group of 21 scientists. One accomplishment was the seemingly (to a social scientist, at least) thorough physical description of the river basin, mentioned above. In spite of the inadequacy of the final report caused by group imbalance, each member did tend to become aware of some dimensions of planning problems confronting practitioners of the other involved disciplines. One of the project directors propagated the ingenious idea of having area graduate students from different disciplines from different colleges partially earn their graduate degrees by engaging in different kinds of group projects involving systems' analysis. The participants are examining the obstacles to implementation of this type of regional intercollegiate, interdisciplinary program of student research. Although the final report and the research it culminated in would have differed substantially with a better balanced research group, the result was certainly sufficiently substantial to form the basis for further research effort in the Red River Basin. Perhaps the greatest contribution of the effort was the potential benefit accruing to other similar efforts from the "imbalance" lesson to be learned.

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APPENDIX

Tentative Dimensions:

River Basin Water Use Planning (with Special reference to industry and power in the Red River Basin)

A) Problem Types
   1) Impact of industrial use and population on river (or other water body) whose water supply was once (but no longer) adequate.
   *2) Consideration of inter-basin transfers.

B) Procedures
   *1) Identify problem areas (items on this outline).

*2) Specify desired information.
*3) Examine information (once gathered) with reference to problem areas.
  a) statistical
  b) other
*4) Catalogue conclusions drawn from #3.
*5) Compose plan with reference to #4 above and predetermined group objectives.
  a) difficulties of planning too far into the future.
  b) in light of #A being critical of unnecessary permanent commitment of resources

C) Possible Objectives
  1) Economic efficiency.
  *2) Maximization of environmental quality.
  *3) Increase of regional development.
    a) example increase retail activity from increase in area recreational activity
  *4) Change in Agri-business from change in agricultural income.
  *5) In-migration or out-migration effects.
  *6) Change in composition of labor force.
  *7) Equity (from change in income distribution, for example).
  *8) Change in rate of urbanization.
  *9) Reduction of farm production risk (less dependence on rainfall with increased irrigation opportunities, for example).
  10) Maximization of national well-being from Regional Development.

D) Plan Assumptions that might be specified
  *1) As to future international conflicts' nature.
  *2) As to future institutional milieu.
  *3) As to future public value standards.
  *4) As to future levels of employment.
    a) national
    b) regional
  *5) As to relationships between various parameters.
    a) between development and population change, for example
    b) between population and change in water needs, for another example
  6) Others.

E) Areas of Initial Inventory
  *1) Population composition.
  *2) Labor force composition and participation rate.
  *3) Types of industry.
  *4) Area business cyclic income fluctuation.
    a) counteracting government policies
      1) National
      2) State

b) effect of water projects on this income pattern
*5) Industry by type: Quantitative importance.
a) primary—agriculture and/or mining
b) secondary—manufacturing
c) tertiary—services (broadly defined)
6) Area physical characteristics.
7) Water supply data.
8) Water quality data.

F) Technical Constraints and Considerations
1) Future water supplies in re demand.
2) Periodical equipment and water-use method obsolescence.
3) Weather modification.
4) Storage.
5) Operation of law of diminishing returns.
*6) Operation of law of diminishing marginal utility.
*7) Price elasticities.
8) Relation of plant size to externalization of water wastes.

G) Institutional Constraints and Considerations
*1) Legal
a) Inadequacy of legal system
1) obstructs development of market system for transfer of water resource use.
2) fails to deal with multiple-use externalities (unresponsiveness of common law concepts of nuisance and waste).
3) need for class action suits in plan enabling legislation.
4) need for new legal devices to increase cooperation between different areas and levels of government.
5) gross inefficiency: i.e. court congestion.
6) need for environmental code (maybe as part of plan)
a) law
b) ethics
7) possibly greater use of eminent domain in acquisition of water rights required to implement any comprehensive plan.
*2) Educational
a) increase environmental training at all school levels
b) train more environmentally-oriented teachers in all disciplines at all levels.
c) continuing education environmental programs.
*3) Governmental
a) excuses for governmental intervention in market processes
1) external economies
2) economies of scale
3) social costs
b) choice of proper implementation organization form
1) government corporation (TVA for example)
2) federal or state departments

3) interagency committees
a) federal
b) state
4) other
*c) structures for resolution of ambiguity as to enabling legislation or plan, itself
1) standing committees
2) special investigations
3) national or area conferences
4) independent study
*d) focus of Power of Planning and/or Implementing Agency
1) local, national, regional, state, or other possible levels
2) broadness of defined powers for flexibility.
*4) Political
a) impractibility of population dispersal for purposes of pollution abatement
b) initial acceptibility
c) public conditioning to acceptance
d) French indicative planning as a conditioning device
e) schooling (see above)
f) financing of Plan Projects
1) Revenue Bonds
2) State appropriation
3) Federal appropriation
4) Charges and taxes as general revenue
5) Cost-sharing concepts

*H) Decision and Action Criteria
1) Benefit-Cost
a) primary vs. secondary aspects
b) monetary vs. non-monetary aspects
c) appropriate discount rate determination
2) Consideration of intangibles
3) Agricultural and industrial trends (preservation of land now for future population use?)
4) Need for feed-back mechanisms in the interest of modification
a) plan
b) implementation process

*I) Industrial Pollution Control
*1) Types
a) direct regulation
b) subsidization
c) incentive pricing
d) industry-wide action
*2) Need for interim regulation till plan fully implemented
3) Recycling

4) Zoning concepts and policies
5) Surveillance (policing)
6) Permit-issue standards
*7) Effect of regulation on income, employment and prices.
*8) Special Industrial Considerations
    a) packaging
    b) automation of surveillance (ex-Cincinnati)
    c) cost of waste treatment plants financed by user costs based on waste of each plant handled.
    d) use of industrial wastes as fuel
    e) autos used by industry (filter-out effect on water)
    f) thermal pollution: power plants
        1) penalty payments for excessive coolant volume
        2) discharge of heat far out to sea
        3) eventual increase in magnetohydrodynamics

*J) Conflict Potentials
*1) Causes
    *a) lack of communication
        1) between agencies
        2) between public and agencies
    *b) Piecemeal Action
    *c) fragmentation of thought (must unify disciplines toward solution of water problems)
*2) Interests of upstream users vs. downstream
*3) Payment for plan improvements
4) Setting of quality standards
*5) International (ex-Canada & U.S.)
    a) division of costs and benefits on international projects
    b) upstream versus downstream use
*6) Water rationing vs. seeking new water supplies
*7) Competition between basins in setting low quality standards in the race to attract industry.
*8) Insurance devices vs. flood reform
    a) private vs. government insurance
*9) Zoning
    a) users
    b) as to lake and/or river fills
*10) Conflicting uses (for example diversion of water from rivers for irrigation, etc. decreases navigability)
*11) Inconsistent powers and duties in re plan implementing agencies.