

SOCIO-ECONOMIC CONSIDERATIONS IN WATER RESOURCES PLANNING¹*Asit K. Biswas*²

ABSTRACT. Historically, the main objective of water resources development has been economic efficiency, and the technique for its evaluation has been benefit-cost analysis. Gradually other objectives have emerged, and these in order of their emergence are regional income redistribution, environmental quality and social well-being. These multi-objectives have given rise to multifarious problems, and have made the planning process much more complex than ever before. The different objectives are not mutually exclusive, and, hence, contributions to one can only be made at the expense of others. Trade-off studies between different objectives are difficult to make. It is suggested that one way to overcome this difficulty could be to design a system to perform optimally in terms of one objective, subject to a specified level of performance of the other, which in effect becomes a constraint. The paper also discusses the pros and cons of the desirability of public participation in our decision-making processes, and the necessity of developing social sciences models to aid water planning and management.

(KEY TERMS: water resources planning and management; multi-objective planning; environmental quality; public participation and involvement; social sciences modelling)

INTRODUCTION

During the last decade, a very major change has taken place in our perception of the interrelationship between man and his environment. No where is this change more apparent than in our concepts of resources utilization and management. No longer is society as a whole willing to accept that economic indices, like increase in the Gross National Product, increase in per capita income (both in real terms), traditional benefit-cost analyses, are the sole criteria of progress. On the contrary, it is being increasingly realized that the total benefits that accrue to the society from our natural resources management cannot be totally measured by the market mechanism, Biswas & Durie [1971]. Since some of the benefits created are external to market transactions, and are to a large measure unquantifiable, they are often omitted from resource allocation considerations and the decision-making framework. Consequently, there are often policy decisions which result in misallocation of resources and non-maximization of the society's

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² Chief, Ecological Systems Research Division, Planning & Finance Service, Department of Environment, Ottawa, Canada.

welfare. Also worth noting is a major deficiency in our current concept of economic analyses, that is, benefits are estimated, but these analyses usually do not contain any information on the nature of the beneficiaries. Dorfman [1969] suggests:

. . . who is helped and who is harmed lies very close to the heart of every political decision. The next important step, then, in the developing art of preparing project reports will be to include information on this point.

. It is inevitable that a Government undertaking will help some citizens more than others, indeed quite frequently some citizens are called upon to make sacrifices at least in the form of heavier tax liabilities.

Information on the nature of beneficiaries, as distinct from the nature of benefits, is not emphasized. . . in current and recommended practice in project analysis.

MULTI-OBJECTIVE PLANNING

The objectives of water resources planning and management, or any other type of natural resources planning and management for that matter, have drastically changed over the years. Broadly speaking, this can be attributed to our increasing awareness and understanding of our social needs and goals. Historically, the main objective of water resources development in North America has been economic efficiency, and the technique used for its evaluation has been benefit-cost analysis. For example, the 1902 Federal Reclamation Act required economic analysis of projects, and the 1936 Flood Control Act stipulated that benefits to whomsoever they may accrue should exceed costs. Gradually to this single objective of economic efficiency, other objectives have been added. These, in order of their emergence, are regional income redistribution, environmental quality and social well-being. The addition of these three objectives has undoubtedly broadened the decision-making framework, and is an improvement over the past practice which was pretty much limited to economic efficiency analyses. The endeavour of the planners to achieve these multi-objectives within the planning framework simultaneously stems, to a great extent, from the needs and desires of the society, and, hence, if the planning analyses are properly conducted, they would presumably expedite social and political acceptance of the plans.

The multi-objectives, however, have given rise to multifarious problems, and have made the planning process much more complex than ever before. The dimensions of the complexities can be realized by the facts that currently relatively few methodologies exist for quantification of social and community goals and objectives, and even for the single objective of economic efficiency, we do not have ideal analytical tools. For example, Pollard and Moore [1969], in their discussion on community planning, stated:

Development of community goals and survey of public attitude are areas in which the state of the art is not far advanced. There is a current theory to the effect that there is no such thing as 'Community Goals.' Certainly no adequate method has thus been found for measuring them or determining what they should be.

For the analyses of economic efficiency objectives, the identification and measurement of benefits "to whomsoever they accrue" and "all costs" are difficult tasks even at the best of circumstances. Often adequate and compatible data are not available. In addition,

there are many methodological problems associated with the evaluation of secondary and intangible benefits and costs. The dimensions of the latter problems are further heightened by the addition of another objective in the planning process, that of environmental quality. Traditional economic analyses cannot evaluate intangible benefits and costs, except in a rather subjective fashion. (For a critical review of the techniques currently available for evaluation of environmental intangibles, and some of the methodological problems associated with these processes, see Biswas and Coomber, [1973]. And yet, in this age of environmental awareness and conservation, the quality of life, which is reflected somewhat in the social implications of planning, is a very important criterion. Inclusion of environmental quality as an objective of water resources development recognizes the fact that the welfare of the society has other dimensions besides economics, and, hence, the real question is not whether environmental quality should be considered as a planning objective, but rather how should it be considered objectively within the planning framework. Another question might be whether environmental quality objective can really be separated from social well-being objective.

Addition of environmental quality and social well-being to the other two traditionally accepted objectives of water resources development, economic efficiency and regional income redistribution, poses a major problem for the planners: how should benefit and loss functions be constructed for all the objectives individually and collectively. The use of economic efficiency criterion as a decision-making tool is a matter of expediency, as they primarily deal with tangible and quantifiable factors, and, hence, they can be analyzed objectively. In contrast, the social-political elements of the objectives are intangible and non-quantifiable, and, hence, would have to be treated rather subjectively. In addition, the objectives constituting the multi-dimensional functions are not mutually exclusive -- in fact, often conflicting. Therefore, contributions to one can only be made at the expense of the other. This gives rise to two rather important questions: how should the different objectives be traded off against each other, and on what basis, especially when the subjectivity of some of the decision parameters are realized, and, secondly, who should make a decision on the final mix of alternatives -- planners, politicians, public or some mixture of the three, and how?

The analyses of trade-offs between the various objectives can be quantitative, qualitative or, as is usually the case, both. A system can be designed to perform optimally in terms of one objective, subject to a specified level of performance of the other, which in effect becomes a constraint. If the environmental quality objective is known, some contributions to achieving it can be measured in economic efficiency terms by considering consumer or producer willingness-to-pay. If this is not possible, such contributions can be treated as constraints which have to be met by the planning process. For example, the levels of dissolved oxygen in a stream or an estuary can be treated as a constraint rather than a value to be maximized by arguing that from an ecological point of view, a dissolved oxygen level of, say, 5 p.p.m. is quite adequate, and any improvement on that level would be primarily of aesthetic nature and is difficult to measure in terms of economic efficiency, Biswas, 1973b. Thus, the level of dissolved oxygen, which may form one part of the overall environmental quality criterion, is decided on ecological and aesthetic considerations (or any other for that matter), and then economic efficiency is maximized subject to this constraint. Alternately, environmental quality objectives can be maximized subject to the constraint of economic efficiency. In other words, if both economic efficiency and environmental quality objectives are to be considered for planning analyses, one can be included in the objective function and the other can be treated as a constraint.

However, there are several aspects of environmental quality that cannot be measured in terms of economic efficiency or can be quantified meaningfully for evaluation and comparison of alternate plans. The environmental quality objective is a composite of diverse elements, and some of these are rather abstract from an analytical viewpoint. Even for the clearcut cases of air or water pollution, the losses and damages are difficult to measure, and, hence, for a subtler form of environmental pollution, evaluation of these estimates will be extremely subjective, and will differ greatly from planner to planner, depending on their perception of the problem. In other words, inclusion of environmental quality as an objective of water resources development has made the planning process less susceptible to objective criteria and more dependant on the perceptions and subjective analyses of the planner. Thus, intangible social disbenefits, in terms of environmental degradation, may provide sufficient justification for rejecting a development project, irrespective of economic efficiency objectives. Inclusion of environmental quality objective in our planning process has made the process more complex, but it has undoubtedly made the planner's task much more important and rewarding than ever.

On the question of the selection of the final plan, it often is very much of a political process. The planners do not make the final decision, nor do they pass legislative actions which directly or indirectly effect planning. They do, however, where possible, point out the cost-effectiveness of the various alternative courses of action as well as their social, environmental and technical feasibilities, and this information assists the decision-makers to arrive at responsible decisions. Thus, the real decision-making lies with the politicians. In fact, water resources planning, project authorization and level of funding are all essentially political processes. Hence, *the planners decide the feasibility of the project, and politics decides the implementation of the plan*. As Ogden [1970] has pointed out:

No matter how sound a project may be physically, no matter how profitable it will be economically, it will come about only if effective political leaders can champion its cause in the right way at the right time.

The story of the Grand Coulee Dam will illustrate the point. The dam was proposed in 1918 by Rufus Wood, and yet the decision to build it was taken in the spring of 1933 because of the personal interest of Senator Clarence C. Dill of Washington, a pre-convention Roosevelt Democrat in 1932. President Roosevelt promised a dam to Senator McNary, Republican minority leader, to reduce unemployment in Oregon. Senator Dill, not to be put off, demanded a dam too. Roosevelt, according to Dill, initially offered him \$40 million. Dill protested vigorously: "We can't even put concrete across the river for that!" Roosevelt increased the offer to \$50 million, and Dill again objected. "Sixty million, Clarence, and that's as far as I will go!" said Roosevelt. And so the final decision to build the Grand Coulee was taken, initially as a low dam and a work-making project. Later, plans for the original high dam were reinstated by Harold Ickes [Biswas, 1973].

PUBLIC PARTICIPATION

A major function of planning is to meet some sort of public need. This presents a major problem: how can the planners become aware of the actual needs of the society, and on what basis and time frame? This can be brought about in two ways. Firstly, the public, through interest groups or their elected representatives, can identify and inform

the planners of their needs and desires. Secondly, planners may perceive some courses of action which have to be performed to achieve the stated and accepted goals of the society.

For the most part, it will be true to say that planners are not the ultimate decision-makers with respect to planning, and are rarely given the full opportunity to utilize their knowledge and skill. The main objective of planning is to satisfy social needs, and, traditionally, in a democratic society, the social decision-making is done by the elected representatives of the people. Ideally, planners should receive clearcut directives from policy-makers on goals and objectives through which planning can proceed (figure 1). But in the real world that is hardly the case. Generally the stated social-political goals are not specific enough to be of great assistance to the resource planners, and as such the use of these fundamental objectives, against which major policy questions of water resources development and management can be tested, often lead to an

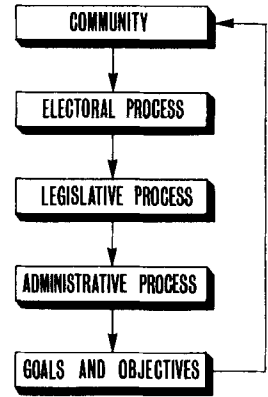


Figure 1

intangible wilderness. The agency policies or objectives which guide the planners may prove to be too specific or too limiting. In addition, the planning process is still further complicated by consideration of new objectives like environmental quality and social well-being, however they may be defined, which necessitates consideration of intangible and indirect values in which the society is interested but which have never been adequately defined, except in rather a nebulous fashion.

There is another major problem with regard to definition and even subjective evaluation of societal values, goals and objectives. These are seldom static. Basic individual values, needs and desires change with time and advancing technology. In addition, an individual's perception and attitude are strongly influenced by the culture in which he lives, the experience he has encountered previously, the situation that confronts him at any point in time, and the role he plays or is expected to play as a member of the system [Kneese & Smith, 1969]. Since the societal values are formed by some form of agglomeration of the individual ones, they are also dynamic. For example, the growth at any cost philosophy of the nineteenth and early twentieth centuries has gradually been superseded by growth subject to environmental quality and social well-being. This only makes the planners' task more difficult since it means that they would have to feel the pulse of the public constantly.

This brings us to the question of increasingly more demand for public participation and involvement in the planning framework and decision-making process. This concern was probably first officially manifested in the Economic Opportunity Act of 1964 (P.L. 88-253) which included a policy statement suggesting "maximum feasible participation." Moynihan has discussed further development of this new concern in poverty programs [1969, 1969a]. In the same context, Miller and Rein [1969] pointed out that: "Maximum feasible participation emerged unclear, unexamined and misunderstood. Because it served many agendas, it enjoyed a vitality which permitted it to grow. . . ." And Wengert [1971] suggests:

Thus despite its lack of clarity, its hidden premises, and the absence of common agreement as to implementation, the phrase "maximum feasible participation" was promoted on many fronts, particularly by a group of professional social reformers, who often regarded participation as a therapeutic device to overcome the alienation and anomie which was believed

to characterize a large number of urban poor. For others, participation is regarded simply as a tactic for gaining political power and influence. . . . The implication is clear that in many cases talk about "rights" to participate are euphemisms for pressure tactics and the manipulation of vociferous masses for partisan or self-seeking advantages. Where little attention is paid to the problems of priorities and choices, and to the processes of coordination and integration, the conclusion seems inescapable that the symbols of democracy are being used for other than democratic purposes.

The concept of "maximum feasible participation" soon spread to water planning and management programs. In a pioneering experiment, the U. S. Corps of Engineers used the University of Michigan to find out the preferences of local citizens for the planning of the Susquehanna River Basin. The University approached the problem in a novel way. They first identified the "influentials" in the study area, and then conducted a series of workshops and public forums, over a period of months, to increase the information base of the participants, which presumably would improve the quality of decisions to be made [Havlick, 1970]. Three alternative proposals were then presented for their consideration. Admittedly, this type of approach has many shortcomings (i. e., selection of "influentials" presents built-in "establishment" biases, people outside the study area were not considered, and yet they are affected by the development, personal stake of individuals and groups in different proposals, etc.) but even then it is much better to have this type of citizen participation in water resources planning than having none at all.

Increased public participation in the planning process does not mean that the public will more readily accept agency plans -- but it does suggest that the plans may be more acceptable to the population as a whole. There are many problems in meaningfully and successfully involving the public in our planning and decision-making processes. This is rather a virgin area. Proven techniques and methodologies do not exist, data are often lacking, institutional arrangements were not designed to incorporate this type of activity and many planners are openly skeptical about their advantages. In addition, it is virtually certain that some people or pressure groups will support a plan, and it is equally certain that some will oppose it. Techniques for resolution of such conflicts, if available, are rather rudimentary at present. The summation of the special interests of the various groups will not provide the aggregate public interest. According to Break [1967]:

Essential though it is to effective democracy, active citizen participation in political decision-making is no guarantee of success in government. Under the right circumstances it results in programs that are well adopted to voter wishes. . . . Under less favourable circumstances, however, it can produce divisive debate and stalemates instead of action. . .

Increased public participation in our planning process is no panacea. In fact it could result in a difficult moral dichotomy on the part of the planners. The public may be more concerned with achieving short term individual and societal goals and objectives rather than long term goals for the society as a whole. The planner's task is to take an objective and balanced viewpoint. Hence, the question is what should the planner's role be when the public has a strong preference for a course of action, which the planner feels is a passing fancy and is not going to be beneficial on a long-term basis? Does he go along with the public opinion or does he suggest what he thinks is the best for the society which may be different to the public perception of the solution to the problem? If he follows the second alternative, under what circumstances should he recommend it and on what basis? Does he have moral authority to follow this course of action? The planner's conviction and sincerity may be unquestioned, but what if he is wrong? These are difficult questions, and need further intensive research before they can be answered.

In a recent editorial, Warne [1970] has suggested:

Administrators responsible for public works and public services had better keep their cool under the attacks of new radical environmentalists. If water rationing or power brownouts become common ten years from now, because of the abandonment at this time of sensible planning to supply foreseeable needs, it is those who are responsible for administering the planning and construction programs who will then be pilloried. Their responsibilities to the public cannot be escaped, regardless of the feverish heat applied by virulent environmentalism.

Admittedly, illogical and irrational development policies are as meaningless as ecological objectives which do not consider the role and relationship of the man to the environment. No one would seriously question Warne's implicit assumption that the planners should attempt to achieve the long-term goals of the society. The real questions which Warne bypasses, however, are *what* goals are being sought, *whose* goals, *how* have these been determined and *who* decides if these are the right long range societal goals?

It is often implicitly assumed that one possible advantage of increasingly more public participation in our decision-making process is that it will broaden the public's information base which might result in acceptance of a plan which might otherwise have been rejected. This probably is rather an optimistic view since knowing and believing are two different states of mind. As Cardinal Newman has pointed out: "Deductions have no power of persuasion. . . . Many a man will live and die upon a dogma: no man will be a martyr for a conclusion." Caldwell [1971] suggests:

To change people through education may require strategies and methods not available to formal schooling in pluralistic or democratic society. Knowledge in itself cannot be relied upon for action. Linked to a purpose toward which a coherent plan of action is programmed, knowledge may have a powerful reinforcing effect. Thus, the expectation of voluntary social acceptance of environmental quality goals implies the rise of an action-oriented ideology, a system of belief in which knowledge is joined to moral conviction.

SOCIAL SCIENCES MODELLING

During the last decade or so, tremendous progress has been made on the development of physical models for water resources planning and management but commensurate progress on social sciences modelling is sadly lacking. Within the social sciences area, several models currently exist which consider some economic and demographic parameters, but very few, if any, include sociological and institutional factors. Biswas and Reynolds [1969] have recently presented a comprehensive review of the current status of socio-economic modelling in water management, and Biswas [1971] has further discussed some of the possible uses of these types of modelling to improve the decision-making process.

Mathematical modelling is a problem solving technique wherein attempts are made to build a replica of a real world system or situation with the objective of experimenting with the replica to gain some insight into the real world problem. Since modelling is a scientific method used for analyses of observed data to understand and explain different phenomena and as a predictive tool, its role in social sciences should be similar to that in physical sciences [Biswas, 1973]. Social scientists are becoming increasingly aware of the potential of the mathematical models to analyse social phenomena. Rex [1961], for example, categorically states that the "important question for the sociologist is not whether he should interpret observed human behaviour in terms of models, but what sort

of models he should apply.”

It is often argued that social phenomena cannot be modelled since it involves consideration of human behaviour which is often random and unpredictable. This argument is not really valid. One can possibly compare the unpredictability of human behaviour to the uncertainty associated with weather forecasting. Our existing knowledge for predicting human behaviour is probably at a similar stage as that of meteorological forecasting a hundred years ago. Through the establishment of new meteorological theories, weather forecasting has now become a science rather than an art. Admittedly, these forecasts are not always totally accurate, but they do serve a useful purpose. Similarly the potential for meaningful analysis and prediction of social phenomena is there; it has only to be developed. And it can only be developed by realizing the tremendous contributions the social scientists can make to our planning process, and by making specialized efforts to get the social scientists really involved as our equal partners. Without a concerted effort by social and physical scientists, it is difficult to visualize how the potential can be exploited.

CONCLUSION

Increasing public awareness of environmental problems and our overall social responsibility has added new dimensions to natural resources planning processes in terms of new social-environmental objectives. These objectives have undoubtedly made the planning processes more relevant and meaningful but at the same time they have rendered a complicated process further complex. Increasing public participation in our decision-making processes will probably be beneficial because often time in the past the planners were not aware of the needs and desires of the society, and, consequently, planning decisions have included a rather limited response to new opportunities and lack of sensitivity to public values. However, techniques currently available for effectively integrating public participation in the planning framework are rudimentary and leave much to be desired. Intensive research efforts should be directed to this area and also to develop methodologies to build social sciences models to improve the planning process. Finally, there is a need for better understanding of the dynamic relationship between man and his environment so that balanced long-term development and conservation policies can be pursued. As Dubos [1968] has aptly pointed out:

The ecological attitude is so familiar even to many scientists that it is often taken to imply acceptance of a completely static system. . . . If the ecologist's concept of man's relationship to the total environment really did imply a steady-state system, ecological philosophy . . . would imply that the human adventure has come to an end.

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