NATURAL RESOURCES JOURNAL

Volume 20
Issue 4 *Fall 1980*

Fall 1980

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INTEGRATED RIVER BASIN PLANNING IN A HOLISTIC UNIVERSE

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INTRODUCTION

The title of this paper implies both a challenge and a conclusion: that the universe in which we live is holistic in nature. The whole is greater than the sum of its parts. For the planner, this means that river basin or watershed development, for example, should not proceed before looking at the major interrelated factors by which developmental goals and objectives are achieved, including environmental ones.

The view that environmental as well as economic goals and objectives need evaluation is now anchored in numerous laws which regulate industry. This regulation is being hotly challenged, however, by many of those who are deeply concerned with urgent economic issues in countries at lower levels of development. To them, the word environment, just as a decade or two ago the word conservation,[1] smacks of the personal preferences of those privileged enough to live beyond the stringencies and deprivations of basic human needs. In their view environmental concerns are a luxury that poorer, developing countries simply cannot afford.[2]

It can be shown, however, that the attitude of developmentalists is just as inappropriate and short-sighted as the attitude of the more rigid environmentalists who see ecological disaster lurking behind most development projects. Quite inappropriately, and contrary to fact, environmental planning is being considered by many developmentalists to be mutually exclusive, or at least highly competitive

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1. At the University of Michigan, for example, graduate students from Latin America not so many years ago protested loudly against the word "conservation" in their degree citation of Resource Planning and Conservation. They felt it was a "dirty" word that would hinder their careers in natural resources development agencies in their home countries.

2. Proponents of this view point to many examples which seem to support their view. For hundreds of years, for example, no living fish could be found in the river Thames in England because of heavy pollution. Now it is expected that soon replanted salmon (the most fastidious of fish) will live in its waters again. This supports the view that environmental concerns can be looked after later, when a society is finally rich enough to afford them.

with economic planning. Nothing could be further from the truth. Many, if not most, environmental concerns, properly evaluated within the framework of societal wants and needs, are no more than another set of economic values (i.e. values that fulfill human needs) which compete within the boundaries of finite means and available resources. If they are disregarded, their economic costs and consequences may well be large, often much larger than the initial costs of including them from the outset.

These environmental issues are set apart from other economic concerns because their full consequences are less readily apparent in the early stages of any development scheme. Moreover, those who cause environmental problems are frequently not the same people or groups that bear the costs. Slash and burn agriculture or deforestation in the upper parts of a river basin and subsequent silting, increased run-off, and flooding in the lower basin, are typical examples of such externalities, or inter-personal cost transfers.[3] As Kirk Rogers has rightly pointed out: "Hay muchos ejemplos de fracasos en el desarollo que fueron al mismo tiempo desastres ecologicos por haberse iniciado proyectos independientes orientados hacia sectores determinados, sin tomar debidamente en cuenta el equilibrio dinamico del medio natural."[4]

Many examples can also be cited where the disregard for environmental issues has had both unexpected positive results along with unanticipated and sometimes very costly side effects. Construction of the Aswan Dam created a dramatic decline in offshore fisheries at the head of the Nile delta, resulted in costly scouring of man made structures along the Nile's river bed, and brought a significant increase in the incidence of schistosomiasis. At the same time, however, there was an unexpected increase in edible fish stocks in the reservoir behind the dam, just as in Laos' Nam Ngum hydropower reservoir, where the value of landed fish now actually exceeds the value of power produced.[5]

Compared to the potential price of environmental neglect, costs of

3. The recent flooding of the Ganges River Plains in India is a dramatic example. According to knowledgeable observers, the ever-increasing flood damages along the lower Ganges are a direct result of the widespread deforestation and erosion of the Himalayan slopes. *See* DER SPIEGEL, September 24, 1978, at 187.

4. K. Rogers, Conservacion del Medio Ambiente en el Proceso de Planificacion del Desarollo–El Enfoque Integrado (May 1974) (report prepared for the Organization of American States, Washington, D.C.). Freely translated, the passage reads, "There are many examples of developmental failures that at the same time were ecological disasters, because they were initiated as independent projects that were oriented towards specific sectors and did not take into account the dynamic equilibrium of the natural environment."

5. Interview with Karl F. Lagler, University of Michigan, Ann Arbor, Michigan (April 10, 1978).

including environmental considerations in the planning process are modest. In water resources projects research shows that environmental elements may increase overall planning, design, and evaluation costs by two to eight percent of total construction costs.[6] In relation to the potential benefits (or future costs avoided) these added costs are low. Another serious constraint may be the lack of suitably trained, environmentally knowledgeable planners. The systematic inclusion of environmental considerations in overall planning and development strategies makes eminent economic and developmental sense.

This paper focuses on the usefulness and limitations inherent in a holistic approach to river basin planning. It briefly sketches the socio/economic/institutional and physical/chemical/biological universe and shows why and how the two are inextricably linked. Second, it traces the complexity of their interrelationship along spatial and temporal lines and addresses the problems of resource and information limitations imposed upon any planning effort. Finally, the needs and requirements for linking planning with subsequent implementation efforts are discussed.

PLANNING IN A RIVER BASIN OR WATERSHED

Why should integrated planning proceed in a river basin or watershed context? River basin planning has a long, and time-honored tradition, from the development of the Tennessee Valley Authority in pre-war years to the Mekong, Colombia, and Senegal development plans of more recent vintage. The linking element in all of these efforts is water; a large number of basin and watershed plans focus almost exclusively on the question of developing the water resources for various beneficial uses.[7] More often than not, however, such river basin plans have been expanded into comprehensive regional development schemes. In Mexico, for example, the various river basin commissions such as those for the Papaloapan and Balsa Rivers are full-fledged regional development agencies that take responsibility for

6. These estimates refer to historical experiences in the United States. However, they cover the whole range of multi-objective planning objectives, of which environmental directives form only a part. The basis of present U.S. water resources planning approaches can be found at 38 Fed. Reg. 24, 777 (1973).

7. *See* Colombia River Treaty, Jan. 22-Sept. 16, 1964, United States-Canada, 15 U.S.T. 1555, T.I.A.S. No. 5638, which focuses on hydroelectric power production and flood protection. *See also* Rio Grande Water Treaty, Feb. 3, 1944, United States-Mexico, 59 Stat. 1219, T.S. No. 994 and Colorado River Water Treaty, Feb. 3, 1944, United States-Mexico, 59 Stat. 1237, T.S. No. 944, which focus on water apportionment and water quality issues.

everything from water supply to road construction, schools, hospitals, rural electrification, industrial development, and agriculture.

Should such integrative regional planning be fitted within the geographic limits or expanses of a whole river basin or watershed? Would this make sense for the Nile whose origins are in the highlands of Ethiopia and the lake plateau of Central Africa, or the Rio de la Plata in South America or the Amazon Basin? The answer in these cases is, of course, no, even if some integration of water planning for such huge watersheds is called for.[8] A useful determining criteria is that in addition to the physical linkages by the flow of water there must be some strong common regional identities or conflicts of economic, social, political, and institutional interests and interactions that are more or less coincidental with the boundaries of the basin itself. Where such coincidences do not exist, or where strong linkages extend beyond them, river basins are poor units for regional planning purposes, or even for water planning purposes.[9] In such cases as the Rio de la Plata, the Senegal, and the Amazon, to mention a few, the basins are simply too large and extend across too many political, socio-economic, and cultural boundaries to be useful as comprehensive geographic planning units.[10]

Similar considerations apply to watersheds. Where they coincide with economic, political, and institutional boundaries, they may provide useful delineations for planning purposes; where they do not, other institutional arrangements might be more efficient. Nevertheless, if a watershed is large enough to justify the expense of organizational and infrastructure and manpower requirements, watershed planning and management tasks may well be efficiently organized around it.

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8. In fact, cooperation between Egypt and the Sudan on Nile water management issues is quite close. Each country pays its share for upstream development in the Sudan portion of the river.

9. This is the case in the Valley of Mexico Basin, where economic linkages extend well beyond its geographical confines. In terms of water, more than one fourth of greater Mexico City's demands are already supplied from interbasin transfers, and stormwater runoff and wastewater are diverted to yet another basin, with an outlet to the sea.

10. It is not surprising that neither the Rio de la Plata nor the Senegal River plans have seen implmenetation, and almost the same applies to the Mekong plans, which have been in limbo for quite some time. Even in much smaller and politically less divided basins (such as regions covered by the original Tepalcatepec Commission in Mexico), differences in resource endowments, culture, and other factors between upstream and downstream subregions may be such that little uniformity of purpose and overall development can be achieved. For an analysis of these difficulties, see D. BARKIN & T. KING, REGIONAL ECONOMIC DEVELOPMENT–THE RIVER BASIN APPROACH IN MEXICO (1970).

SOCIO-ECONOMIC-INSTITUTIONAL ISSUES

The Need for Problem Definition

Once an initial decision has been made that a given basin or watershed provides the appropriate spatial boundaries for planning purposes, the tasks of the planning effort must be defined. More often than not, this process starts with a delineation of the area's physical and material resources and proceeds with development plans that promise some optimal utilization of these resources in the future. Only afterwards is an attempt made to reconcile physically-oriented plans with the problems they are designed to solve. This approach is likely to be inefficient and increases the probability that unforeseen, harmful effects will result.[11]

The first and most important task of the planner is to define the people-related problems to be solved. These problems are not only water-related. Rather, the whole range of socio-economic issues existing within the planning authority's jurisdiction should be addressed and defined; poverty, lack of training, lack of access to land, and other resources, erosion, transportation, access, overpopulation, migration, rapid urbanization, lack of credit facilities, and political tensions are some examples. Since planning is done for the sake of people, an analysis of local problems must be at the heart of the planning process. Many of the problems encountered may be far removed from water-related activities, and many of the potential solutions may be equally beyond the reach, responsibility, and jurisdiction of the basin or watershed planning agency. Nevertheless, only if these problems are recognized in their entirety can useful solutions be proposed. If such solutions are beyond the scope and capacity of the basin planning agency, provisions must be made to coordinate the basic planning authority's efforts with other agencies having jurisdiction or to widen the scope of the lead agency's activities.

This was done in Alaska in the mid-sixties, when it was recognized that hydropower projects proposed by Federal Water Resources Agencies were far less cost effective than potential thermal and gas turbine generating plants.[12] The outcome was the formation of a federally initiated power authority for Alaska which was mandated

11. This approach was at the heart of the massive Mekong Basin Program, which started with the premise, "There is a river system, what can we do with it?"

12. G. SCHRAMM, THE ROLE OF LOW-COST POWER IN ECONOMIC DEVELOPMENT (1979).

to promote electric power development by any means. A similar, but far broader, mandate was given to the already mentioned Mexican River Basin Commission.

Another innovative approach to comprehensive planning and execution was developed in Mexico, although it was not tied to river basins, but rather to so-called rural "Micro-Regions." There are now some 106 regions in the country, covering about one third of all rural areas. Planning proceeds under the direction of a separate agency called Programa de Inversiones Publicas para el Desarollo Rural (PIDER), a branch of the Ministry of Planning and Budgeting. This agency coordinates its planning activities with individual state and federal agencies both at the state and micro-region level. Active participation is invited by village council and community groups. Planning ideally proceeds from the bottom up. Locally developed proposals are screened and pre-selected at the state level, with final selections and budget allocations at the central, federal level. PIDER by law, is barred from executing any of the works. It turns over detailed project design and execution to the appropriate specialized agencies, for example, the Ministry of Public Works for road building and water supply, the Ministry of Agriculture and Hydraulic Resources for irrigation works, agricultural extension or erosion control works, and the Rural Development Banks for rural credit. Planning thus proceeds from a broad-based problem recognition state to program development on a comprehensive level. Potential beneficiaries are involved from the start, as well as a wide range of local, state, and federal authorities.[13] Regardless of the organizational structure or the basin authority's legislated task, broad-based, comprehensive problem definitions must precede detailed planning and design.

Institutional Frameworks for River Basin Planning

It is clear that the optimum institutional framework will vary from county to county, depending on individual needs, history, culture, political structure, and stage of development. Moreover, within a given country, optimal institutional arrangements may vary from one region to the next. Nevertheless, a number of general criteria can act as guides for the design of an appropriate institutional framework.

If these general principles can be incorporated into the institutional design, the likelihood of sensible, responsive, and effective planning will be greatly enhanced.

13. For a discussion of the program see M. Cernea, *Monitoring and Evaluation in the PIDER Rural Development Project-Mexico* (1970) (World Bank Staff Working Paper No. 332, Washington, D.C.).

TABLE 1

GUIDELINES FOR THE DEVELOPMENT OF AN INSTITUTIONAL FRAMEWORK FOR RIVER BASIN PLANNING[14]

1. Does the institutional framework permit the consideration of a wide range of alternatives to solve observed problems, including those that may fall outside the specific responsibilities of the planning bodies?
2. Will the planning agency (or agencies) have the expertise needed for multiple objective planning and evaluation procedures, especially in the economic, social, and environmental fields?
3. Does the institutional framework facilitate the adaptation of plans to changing national, regional, and local priorities?
4. Does the institutional framework seek representation of all parties affected by specific development plans and management?
5. Does the institutional framework reward initiative and innovation among the members of the technical team and within cooperating agencies?
6. Is the technical team sufficiently free from day-to-day responsibilities so they can concentrate on long-range planning and anticipation of future problems?
7. Do the institutions have the capacity for learning and improving over time, including sufficient continuity over time and the evaluation of past programs?
8. Is there sufficient authority within the institutional framework to enforce conformity of execution with construction and operating plans?
9. Is the institutional framework capable of guaranteeing an acceptable minimum level of professional performance by the technical team?
10. Does the plan implementation stage include provisions for the timely and qualitatively and quantitatively sufficient supply of needed services by other agencies, and have provisions been made to assure continued functioning, i.e. operation, repair, and maintenance of facilities and services provided?

Another important issue is the need for coordination and cooperation at local, regional, and national levels. Planning and plan implementation do not proceed in a rarified vacuum derived from lofty, immutable principles that are a law unto themselves. Planning is done for people and people have different and often competing wants, desires, and hopes; political institutions should be designed to meet those wants. One of the best ways to condemn planning efforts to oblivion or failure is to turn the task over to a self-contained, isolated team of experts who fail to communicate with one another, the people their plans are to serve, and those with political, decision making authority. Within this dynamic, competing world of human wants and values there is no ultimate reality or single-dimensioned optimum that can be determined by scientific methods alone.[15]

14. These guidelines have been adapted, with modifications, from *Guide to the Planning and Evaluation of Multipurpose Hydraulic Projects From the Economic, Financial, Environmental and Social Points of View* (July 1978 Draft) (report prepared by the Organization for Economic Co-operation and Development, Paris).

15. For a discussion of these issues of multiple values and multiple wants see C. HOWE, BENEFIT-COST ANALYSIS FOR WATER SYSTEM PLANNING (1971) and G. SCHRAMM & R. BURT, JR., AN ANALYSIS OF FEDERAL WATER RESOURCE PLANNING AND EVALUATION PROCEDURES (1972).

Value judgments and political compromises to reconcile opposing interests will always be part of any planning-implementation process.[16]

PHYSICAL, CHEMICAL, AND BIOLOGICAL DIMENSIONS

The flow of water ties together both physical and human features within a river basin or watershed. Downstream and upstream activities and conditions are interrelated. For example, the accessibility of upstream transportation systems might be strongly dependent on downstream water levels and channel maintenance, while services and supplies such as electricity, food, and fiber from powerplants and irrigated land downstream may be vital for the economic well-being of the upstream region.[17]

River basins and watersheds are attractive units for planning purposes not only because of the obvious interdependence of water flows and availability. In addition, human activities and communication adapt to natural features: ridge tops, valley formations, and life-supporting water supplies represented by a basin's rivers and streams. Cities like Winnipeg and Vancouver in Canada, Portland, Oregon, New York City, or Buenos Aires in Argentina, located near cheap inland water and ocean transport which offered substantial development advantages.[18] Human settlements, roads, and railroads often followed the natural pathways developed by the network of waterways, so that in many regions of the world river basins have become the natural and well-delineated socio-economic and oftentimes political units.[19]

What are the major physical, chemical, and biological characteristics that tie a basin or watershed together into a complex, interdependent whole? First, are those features directly related to the flow and quantity of water; daily and seasonal flow variations, floods, and droughts are the obvious manifestations. Natural or human-

16. This point has been stressed many times by experienced water resource planners. *See, e.g.*, G. Wolman, *Selecting Alternatives in Water Resource Planning* in WATER IN A DEVELOPING WORLD: THE MANAGEMENT OF A CRITICAL RESOURCE 38 (A. Utton & L. Teclaff eds. 1978).

17. However, all of these reverse effects are related to human activity, in contrast to the direct physical upstream-downstream linkages.

18. In Winnipeg, city development at the confluence of the Red and Assiniboine Rivers proved to be a long-term disadvantage after the arrival of the railroad because of recurrent flooding. But by the time river transport had lots its vital importance, the city was firmly established and continued to grow from its original site, even though superior, floodproof land was available nearby.

19. Typical examples are the countries of Zaire, Gambia, Sudan, and Egypt in Africa, Iraq in the Middle East, and Burma in Southeast Asia.

produced contaminants such as BOD, salts, minerals, chemicals, toxic substances, and suspended solids, all affect water quality which in turn, influence the water's oxygen contents as well as the flora and fauna that live within the basin. Even more important, water quality affects consumptive use for human, agricultural, and industrial purposes.

Erosion upstream will also impact on sedimentation and flooding patterns downstream. High rates of sedimentation can reduce the life-expectancy of downstream reservoirs,[20] decrease channel depth so that flood threats increase,[21] cause high rates of sedimentation in drainage channels of irrigation works,[22] and require costly dredging to maintain channel depths for shipping and transportation.[23] Reservoirs may also trap sediments which have earlier made a valuable contribution downstream. The Aswan Dam for example, traps sediment which for thousands of years had replenished soils in the lower reaches of the Nile and made Egypt the granary of the Roman Empire. Today, artificial fertilizers have to be used instead. The higher velocity of the far cleaner river water also systematically scours the river bed and undermines existing bridge, water-intake, and docking facilities.[24]

Water pollution, from biological contaminants such as human and animal wastes, organic residues, fertilizers or pesticides, or toxic materials, salts, and minerals from industrial activities, affects human and animal health. This is true particularly in rural developing countries, where raw water intake for human consumption is the rule. In Mexico's Lerma Basin, which is famous for its small scale hog production, water pollution is so pervasive that all existing open streams in the area, including the Lerma, are anerobic. The incidence of in-

20. It has been estimated that a comprehensive program of erosion control and reforestation will increase the life expectancy of the Mangla Dam Reservoir in Pakistan by more than 50 years. *See* WEST PAKISTAN WATER & POWER DEVELOPMENT AUTHORITY, I MANGLA WATERSHED MANAGEMENT STUDY 94 (1961).

21. This has been cited as a major factor in the increasing severity of flood damage in the Ganges River flood plains in India. *See* DER SPIEGEL, Sept. 24, 1978, at 189.

22. Studies undertaken in a number of agriculturally-used watersheds in Illinois indicate that direct losses of agricultural productivity from erosion were quite modest and amounted to only about one percent of the net income from agricultural production. The majority of losses were from rapid sedimentation of natural drainage channels and reservoirs. The off-site costs were estimated to be 9-16 percent of the private net income from the erosion-prone agricultural land. *See* Guntermann, Lee & Swanson, *The Economics of Off-Site Erosion*, 10 ANNALS OF REGIONAL SCI. 117 (1976).

23. Dredging costs to maintain channel depth for the harbor of Buenos Aires exceed five million dollars per year. *See* Cano, *Argentina, Brazil and the La Plata River Basin: A Summary Review of Their Legal Relationship* in WATER IN A DEVELOPING WORLD: THE MANAGEMENT OF A CRITICAL RESOURCE 127 (A. Utton & L. Teclaff eds. 1978).

24. *See* R. MABRO, THE EGYPTIAN ECONOMY 1952-1972 at 95 (1974).

testinal diseases is several times higher than in the country as a whole, where intestinal diseases are already the second highest cause of death.[25]

Human activities have a dramatic impact on these physical relationships. Deforestation, destruction of vegetative cover through overgrazing, and inappropriate methods of agricultural crop production may increase soil erosion from a given watershed by several hundred percent.[26] Effects on run-off and water-yield are equally significant. This can be seen in Figure 1, which compares the storm-hydrographs of a given catchment area before and after reforestation. Figure 2 compares run-off data for similar cultivated plots that utilize alternative cultivation practices.

What these examples show is that human activities can have a profound effect on the physical, chemical, and biological environment of a watershed or basin. Costs of prevention are not insignificant; most of the benefits through reduction of off-site costs, however, will accrue to others.[27] Under these conditions, which prevail in most of the developing countries, public interference via subsidies, regulations, and continued supervision are needed to bring about beneficial changes in human behavior. The recent annual report of a major, decades-old, ongoing watershed protection program in an Asian country documents the difficult nature of this task.

> All types of works are done on privately owned land with the voluntary consent of the land owners.—But because of unfavorable socio-economic conditions that exist within the project, such as heavy human and cattle population, small land holdings, poverty and illiteracy, cooperation to the desired extent is not always forthcoming.—Thus many areas are left untreated and the project efforts get a serious setback.—The protection and maintenance of completed works are also a problem.—The areas have to be handed over

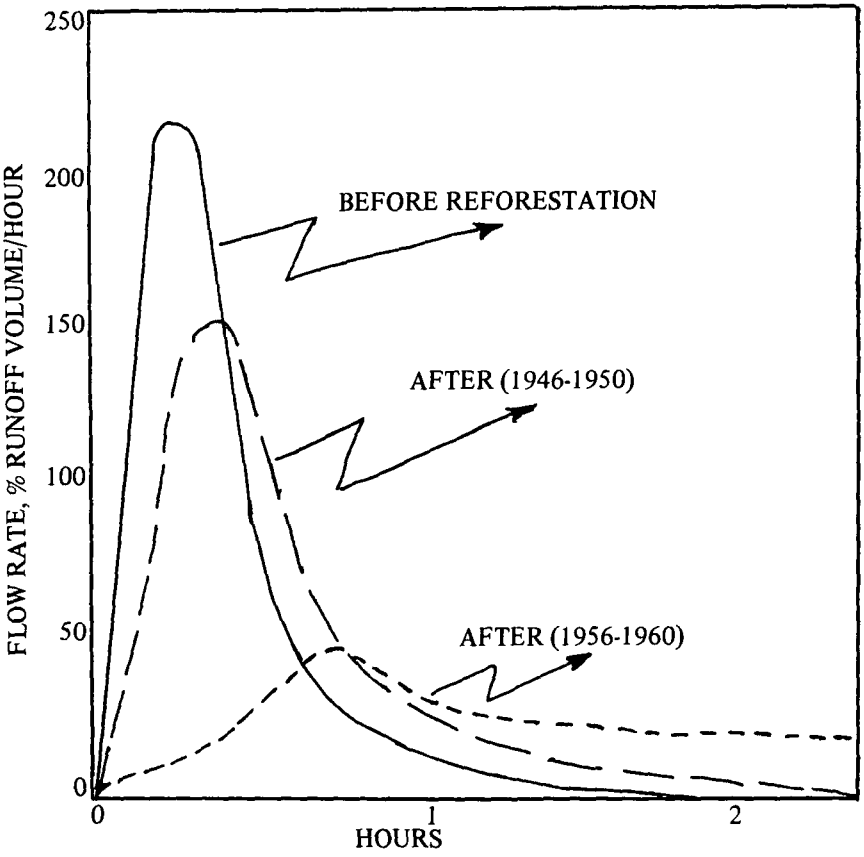
25. For a detailed study of the effects of water-borne diseases see B. WEISBROD, DISEASE AND ECONOMIC DEVELOPMENT: THE IMPACT OF PARASITIC DISEASES IN ST. LUCIA (1973).

26. In a semi-arid region of the western United States, for example, sediment yield changed by a factor of 13 when sagebrush-covered land was converted to grass cover. *See* L. M. Shown, *Sediment Yield as Related to Vegetation on Semiarid Watersheds* in BIOLOGICAL EFFECTS IN THE HYDROLOGICAL CYCLE 352 (Proceedings of the Third International Seminar for Hydrology Professors, 1971).

27. A notable exception is the value of soil and water conservation measures in areas with limited rainfall. In such regions, the added water absorption and storage capacity of the soil (resulting from appropriate conservation techniques such as terracing, deepsoil plowing, and contour plowing) may actually be high enough to justify the expense of those measures without accounting for off-site benefits. For an analysis of such programs, see Schramm, *A Benefit-Cost Model for the Evaluation of On-Site Benefits of Soil Conservation Projects in Mexico*, 13 ANNALS OF REGIONAL SCI. 19 (1979).

FIGURE 1

Storm Hydrographs Before and After Reforestation



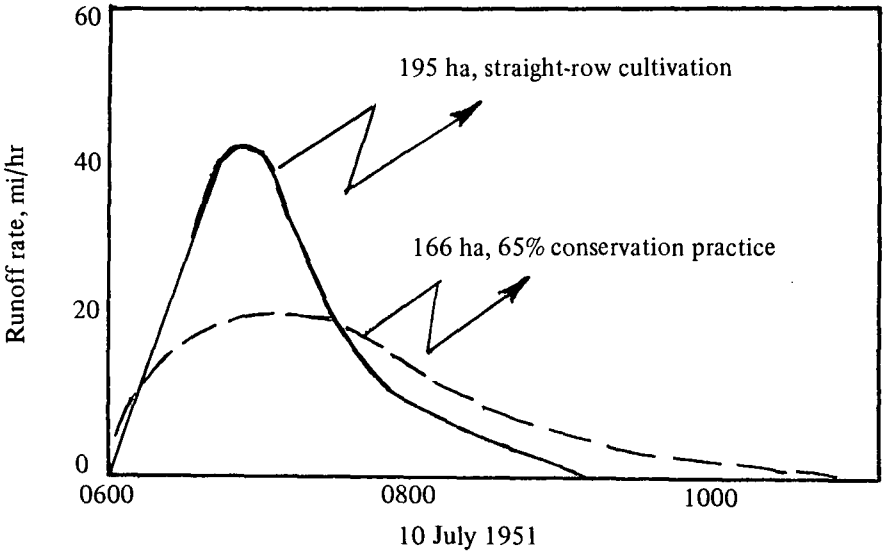
to the land owners who often fail to maintain and protect the plants raised with great effort and cost.

The pollution, deforestation, erosion, and sedimentation problems discussed here can be easily classified as environmental issues. From the economist's viewpoint, they are economic issues as well, similar to the production of hydropower or agricultural output. Other related environmental issues include the protection of wildland areas, regions suitable for national parks or similar flora and fauna reserves.[28] As Miller points out, flexible management approaches can be found for

28. The major reasons for setting aside such areas have been discussed in K. Miller, Forestry and Custodianship of the Human Habitat (paper presented at the Eighth World Forestry Conference, Djakarta, Indonesia, Oct. 16-27, 1978).

FIGURE 2

Effect of Conservation Practices on Storm Hydrographs, Nebraska



Source: Lloyd L. Harrold, "Effect of Vegetation on Storm Hydrographs," in *Biological Effects on the Hydrological Cycle* 332 (Proceedings of the Third International Seminar for Hydrology Professors, 1971).

these areas which will serve not only the needs of preservation, but also "compliment other investments, provide employment in urban lands and form an integral part of overall national development."[29]

SPATIAL COMPLEXITIES

While a watershed or basin might form a natural unit for planning purposes from both a physiographic, socio-economic, and political point of view, no planning unit is ever a homogeneous, self-contained entity. It is always linked to other regions: physically, biologically, politically, and socio-economically. Moreover, within its boundaries there usually exist a diversity of interests, differences in resource endowment, culture, climate, and many other factors. This makes it necessary to develop planning guidelines that are both flexible and multi-dimensional so that these differences can be accounted for.

The Balsa River and Papaloapan Basins in Mexico are examples of this diversity. Semi-dry uplands at 5-10,000 feet contrast to the

29. Two examples are Guatapo National Park, which protects the water supply of Caracas, Venezuela and the protected Capilano Lake watershed above Vancouver, B.C.

humid, tropical lowlands of the coastal plains. Culture and languages differ as well, with many of the mountain valleys populated by indigenous non-Spanish speaking Indians. Under such conditions, multiple and well-differentiated planning approaches must be developed for each one of these specific regions.[30]

In other situations, subregions of a given river basin planning unit maintain stronger economic, social, and cultural ties to regions outside the basin than to those within. This is true for the upper reaches of the Panuco Basin Commission in Mexico, which essentially consists of three regions; the Altiplano, the mountain valleys, and the coastal plains. The Altiplano, which contains the large Tula irrigation district, fed by tunnel from the diverted storm and waste water of the metropolitan region of Mexico, is oriented towards the capital city. Most of its agricultural output goes to markets in the city. Rapid industrialization includes power plants, cement factories, and Mexico's newest oil refinery. Links to the lower basin are quite unimportant for this sub-region. The lower mountain valleys and the coastal plains, on the other hand, are oriented towards agriculture, livestock, and export trade. Their focus of interest and main trading center is the coastal port, Tampico, at the mouth of the river. Trade and commerce within the lower basin flow to this regional center and back to the capital city, the U.S. border, the north, or overseas. In this situation, the critical planning question is where the borders between these zones of attraction lie and how they can be integrated with regions of attraction outside the basin itself.

This divergence of interests becomes more and more pronounced the larger the basin. Very large basins and their planning bodies (if they can be created at all) will be less and less comprehensive in their planning tasks, realistically focusing on water planning and management only. Such is the case for international arrangements affecting the Colombia River, the cooperative arrangements between the Sudan, Kenya, and Egypt with respect to the Nile (Ethiopia which refuses to deal with any of these countries, is not included), the Rio de la Plata treaty, or the recently concluded Amazon Cooperative Treaty. As a result large, multi-national river basin planning efforts frequently are quite ineffective. The Rio de la Plata, the Senegal, and the Mekong are present examples. A few rivers in North America and

30. This was recognized and followed to some extent by both Mexican River Basin Commissions. *See, e.g.,* T. POLEMAN, PAPALOPAN PROJECT: AGRICULTURAL DEVELOPMENT IN THE MEXICAN TROPICS (1964); A. Lamadrid, *Integrated Rural Development Project for the Papaloapan Basin in Mexico* in INTERNATIONAL WATER RESOURCES ASSOC., 2 PROCEEDINGS OF THE SECOND WORLD CONGRESS ON WATER RESOURCES 519 (1975); D. BARKIN & T. KING, *supra* note 10.

Europe, the Indus River Treaty and the Egyptian-Sudanese Cooperation in developing the reaches of the Nile River above Aswan Dam represent limited exceptions.

TEMPORAL COMPLEXITIES

Time enters into the planning and implementation phases in numerous ways. Time is needed to develop a reasonable consensus about the terms of reference for the planning task. The Colombia River Treaty required twenty years of hard bargaining between the three governments involved.[31] The Rio de la Plata Treaty negotiations were first begun in 1932, but the actual treaty was not signed until 1969, a period of 37 years.[32] Negotiations about the allocation of Rio Grande (Rio Bravo) and Colorado River Waters between Mexico and the United States span a period of seven decades.[33] Time is also needed to assemble an effective planning team and to develop an effective working relationship, a process which usually requires at least a year. Finally, years can pass before an initial development plan has been developed, negotiated with the affected parties, political bodies and financing agencies, nd adopted for implementation.

During these many years, many factors influencing the plan's focus, assumptions, and goals are likely to change. Internally, there will be an inevitable turn-over of staff and leadership. This will affect the perceptions of the planning group as a whole in many subtle ways. Political leadership of the plan's sponsors may change, and quite different directions and goals may emerge from such changes.[34]

Population growth rates, migration, discovery of new resources,[35] and changes in relative prices,[36] all will have a profound effect on planning goals and objectives. Institutions which maintain flexibility so that the plan, its focus, and the design of its components can be adapted to the new circumstances are required in any long-term plan-

31. CANADIAN DEPARTMENT OF EXTERNAL AFFAIRS, THE COLOMBIA RIVER TREATY AND PROTOCOL (1964).

32. Cano, *supra* note 23, at 130.

33. J. DAY, MANAGING THE LOWER RIO GRANDE: AN EXPERIENCE IN INTERNATIONAL RIVER DEVELOPMENT 6 (1970).

34. In recent years, Chilean governmental changes have produced changes in the water planning goals and objectives in that country. Similarly, changes can be noted in planning philosophies between the former Echevarria and the present Lopez Portillo administrations in Mexico.

35. For example, the discovery of the huge Tabasco oil fields in Mexico had immense effects on the Grijalva River Development Plan in Mexico.

36. Examples are the ten-fold increase of oil prices since 1973 and the vagaries of world sugar prices during the last half dozen years.

ning effort. The same applies to the plan's conclusions and detailed policy recommendations. A deliberate attempt must be made to allow for flexibility in the execution of the plan, otherwise a less than optimal outcome will result.[37]

TIME, RESOURCE, AND DATA LIMITATIONS IN PLANNING

Planning never proceeds without the multiple constraints of limited time, planning expertise, and data availability. Given these constraints, time, and resource budgets must reflect information and analytical priorities. Degrees of accuracy and detail of information must be assessed. For example, a partial stream diversion from a larger river with perennial flow requires information on minimum water level from which the intake has to draw. Collecting data for the construction of detailed stream hydrographs would be a total waste of time. On the other hand, the latter information would be of vital importance in constructing a large reservoir to provide over-year storage in low-flow years.

Similar considerations apply to all other data and analytical requirements. An effective way to handle the task of sorting out data and analytical needs is to draw up an initial conceptual framework which asks these basic questions:

1) For whom are we planning?
2) What are the social, economic, and cultural characteristics of the people to be served?
3) What are their needs?
4) How can these needs be met with or without our planning efforts?
5) What are the technical, legal, and institutional characteristics of the processes or projects that would help to serve these needs?
6) What do we have to know about the physical, chemical, biological, economic, institutional, and cultural universe within which the processes or projects are designed to function?
7) How much detail and accuracy is required for each type of input data in order to arrive at reasonably acceptable decisions that are unlikely to yield unpleasant or catastrophic results if the data turn out to be inaccurate (i.e., what is the range of acceptable error and what are the potential penalties of being wrong)?

37. One example is the spectacular cancellation of the half-completed Florida barge canal in 1973. The planning errors which affected the Nelson River Development in Manitoba, Canada are analyzed in G. SCHRAMM, ANALYZING OPPORTUNITY COSTS: THE NELSON RIVER DEVELOPMENT (1976).

It is obvious from the above list of basic questions that judgment and experience are vitally important ingredients in any planning effort because selectivity is essential if the planning is ever to be completed. To make sure that vital issues have not been overlooked it is useful to construct the planning effort so that periodic reviews will be undertaken by independent, outside agents. These reviewers should represent four different and preferably mutually independent functional groups:[38]

1) A shadow team of experts;
2) A steering committee primarily from the national level;
3) A political linking committee;
4) A committee representing potential beneficiaries.

The shadow team would provide periodic reviews and act in a high-level consultation capacity to the technical team. The steering committee would judge whether the proposed plans are in keeping with national priorities and objectives, particularly with reference to major sectors such as agriculture, health, industrial development, and the like. The political linking committee would act as liaison with appropriate national, regional, and local agencies. Finally, the beneficiaries committee would represent the broad range of interests to be affected by the proposed development schemes.

PLANNING-IMPLEMENTATION INTERFACES

As any planner ruefully knows, the step from planning to implementation is a large one indeed. This discussion will concentrate on some of the more common mistakes made in the planning stages and carried over to implementation, with frequently disappointing results.

One common mistake of planning methodology is to assume that sound economic criteria applied in the analysis will automatically assure economic feasibility in the real world. This is simply not so. The choice and effect of discount rates or acceptable minimum rates of return provide a singular example. In most situations, projects consist of two components, public investments and private activities. It is common practice to evaluate both on the basis of public investment criteria including the use of public or social rates of dis-

38. Similar arrangements were built into Mexico's National Water Planning effort from 1973 to 1975. A six-member panel of outside experts (three of whom were non-Mexicans) provided expert advice, an interagency committee provided linkages with other federal agencies interested in and affected by water planning efforts, and a World Bank team of technical experts provided technical advice. *See* COMISION DEL PLAN NACIONAL HIDRAULICO, MEXICAN NATIONAL WATER PLAN 1975 (1977).

count.[39] Using these rates is quite sound on the basis of well-established economic principles.[40] However, private decision makers do not make their investment decisions on the basis of social discount rates, but rather on much higher private market rates that include a substantial risk premium as well as net profit expectations.[41] As a result, many private investments and activities, confidently predicted on the basis of the original benefit-cost analysis, simply do not materialize. The overall projects turn out to be costly failures, unless government takes the further step to subsidize the private investments as well.[42]

Another factor frequently overlooked is that physical and skilled human resources needed for the successful implementation of a project simply are not available, even if full financing to pay for these services is assured. In Mexico, it was estimated in the mid-1970s that at least 15-20 years were needed before the requirements for complete and effective agricultural extension service coverage could be provided.[43] Similar shortages of other essential input factors have been widely discussed in the literature.[44]

The lack of markets for project outputs is also particularly critical for perishable products.[45] Even for standard, long-life, storable products such as cotton, coffee beans, sugar, and livestock, market limitations, quotas, and other non-trade barriers may effectively restrict the expansion of output in any one region.

Insufficient project preparation with respect to beneficiary participation and cooperation is a frequent problem. The Mexican Soil and Water Conservation Service, for example, maintains a substantial program for labor intensive erosion control consisting of terraces

39. Social rates of discount are generally defined as the "riskless" opportunity cost of funds to the government. This means that they are usually lower than private sector rates, with the result that benefits appear larger to a public decision maker compared to a private one.

40. *See* J. KRUTILLA & O. ECKSTEIN, MULTIPLE PURPOSE RIVER DEVELOPMENT (1958).

41. For an appropriate methodology to deal with these problems see Schramm, *The Design of a Resource Allocation Function,* 5 CANADIAN J. OF ECON. 522 (1972).

42. Rather negative findings about originally predicted associated private investment responses in conjunction with publicly financed irrigation rehabilitation works are presented in R. Manning & O. Ela, *An Economic Evaluation of Irrigation Rehabilitation Projects in Mexico* (Sept. 1971) (World Bank Report No. EC 180, Washington, D.C.).

43. Schramm, *Human-Institutional Factors* in WATER IN A DEVELOPING WORLD: THE MANAGEMENT OF A CRITICAL RESOURCE 187, 201 (A. Utton & L. Teclaff eds. 1978).

44. *See, e.g.,* A. Adelman, *A Linear Programming Model of Educational Planning: A Case Study of Argentina* in THEORY AND DESIGN OF ECONOMIC DEVELOPMENT (I. Adelman & E. Thornbecke eds. 1967).

45. *See* Schramm, *Input and Market Constraints in Irrigation Planning: Mexico* 55 LAND ECON. 431 (1979).

and gully check-dam construction to reduce water velocities and erosion. Local labor is hired almost exclusively and paid at government-decreed minimum wage rates that exceed rural wages. The local population supports the program enthusiastically. However, budget limitations and the understandable desire to show high completion rates make it impossible for the understaffed federal agency in charge of the program to explain to the beneficiaries in detail why the works are undertaken and what their benefits will be in the long run, even if in the short run agricultural cultivation costs might increase.[46] As a result, a large percentage of the works fall into disrepair within a short period of time and become worthless. No funds are available for government supervision and maintenance of completed works.

This raises another important issue. Planning and plan implementation are usually limited to the investment phase of a program. Thereafter many or most of the works are turned over to local committees for operation, administration, and maintenance.[47] These local committees have neither the resources, income, or know-how to maintain the works. In 1978 in the State of Zacatecas, Mexico, for example, over 50 percent of all rural water supply works were out of order, some 20 percent were only partially in operating condition, and only 30 percent were working normally. In the same state only about 60 percent of the nominally irrigated land produced a crop in 1976. Similar horror stories abound around the world. Obviously, a planning-implementation process that does not make explicit allowance for such after-investment operating and service needs is likely to waste a great deal of public money.

Finally, preventive environmental measures can also be addressed at the implementation phase. It has become clear by now to many developing countries that complete disregard of problems such as air and water pollution may carry with it high social costs that are economic costs as well. One only has to experience the air pollution levels of cities such as Mexico, Santiago de Chile, Sao Paulo, or Caracas, or look at the statistics for water-borne intestinal diseases in countries such as Mexico, India, or Thailand to come to this conclusion. In most developing countries, governments limit their reactions to such conditions to some token measures, implicitly accepting the argument that counter-measures would be far too costly for their fragile, developing economics. This reaction is correct, if applied to

46. This is because ridging and contouring increase cultivation costs.

47. This is usually true for local water supply, small-scale irrigation projects, rural roads, erosion control structures, reforestation projects, etc. It is much less of a problem for government-run services for which fees must be paid.

most existing activities,[48] or if western, industrialized standards of pollution control were to be applied. However, it is far from true when one contemplates the installation of new industrial plants or the development of new urban areas. Simple, low-cost measures, such as primary treatment for organic waste materials, water re-circulation, screens, and filters installed from the outset may prevent a significant portion of potential pollution discharges at minimum costs. Such measures, if incorporated systematically into planning, design, and construction stages, can avoid or prevent further deterioration.

SUMMARY AND CONCLUSIONS

Integrated planning takes into account all potential benefits and all potential costs that may result from proposed actions or non-actions. Environmental consequences are an integral part of these costs and benefits. Because of this, and because of the oftentimes costly consquences of initial neglect, environmental planning must be built into the overall planning process.

Planning cannot proceed in the abstract or be left to a group of experts who develop a plan in isolation. Planning is the process of continuous exchange of ideas and problem formulation. Hence planning is only successful if close contact is maintained with public bodies, beneficiaries, and other impacted groups.

Planning involves both spatial and temporal dimensions. Spatial dimensions are related to both human-social-economic relationships and to geographic features. Temporal dimensions often may extend over lengthy periods of time; many river basin development plans did not result in concrete actions until decades had passed. These periods were filled with negotiations, deadlocks among competing interests, and pressure from changes in population, human activity, technology, and developmental goals.

Planners must be flexible in their response to multiple goals and objectives. These goals and objectives will vary by sub-region, by population sub-group, or by societal sector.

Finally, planning cannot and should not proceed without strong and continuous reference to plan implementation. This involves the subsequent investment phase, and the operating period, in which maintenance and continuity of project and plan benefits as well as avoidance of unnecessary costs from neglect, become the dominant considerations. Without preparation for future continuity and opera-

48. This is due to the high costs of retrofitting.

tional viability, many well-planned projects or programs become non-functional, long before the end of their projected life expectancies. This premature failure invalidates projected benefits and planning objectives.