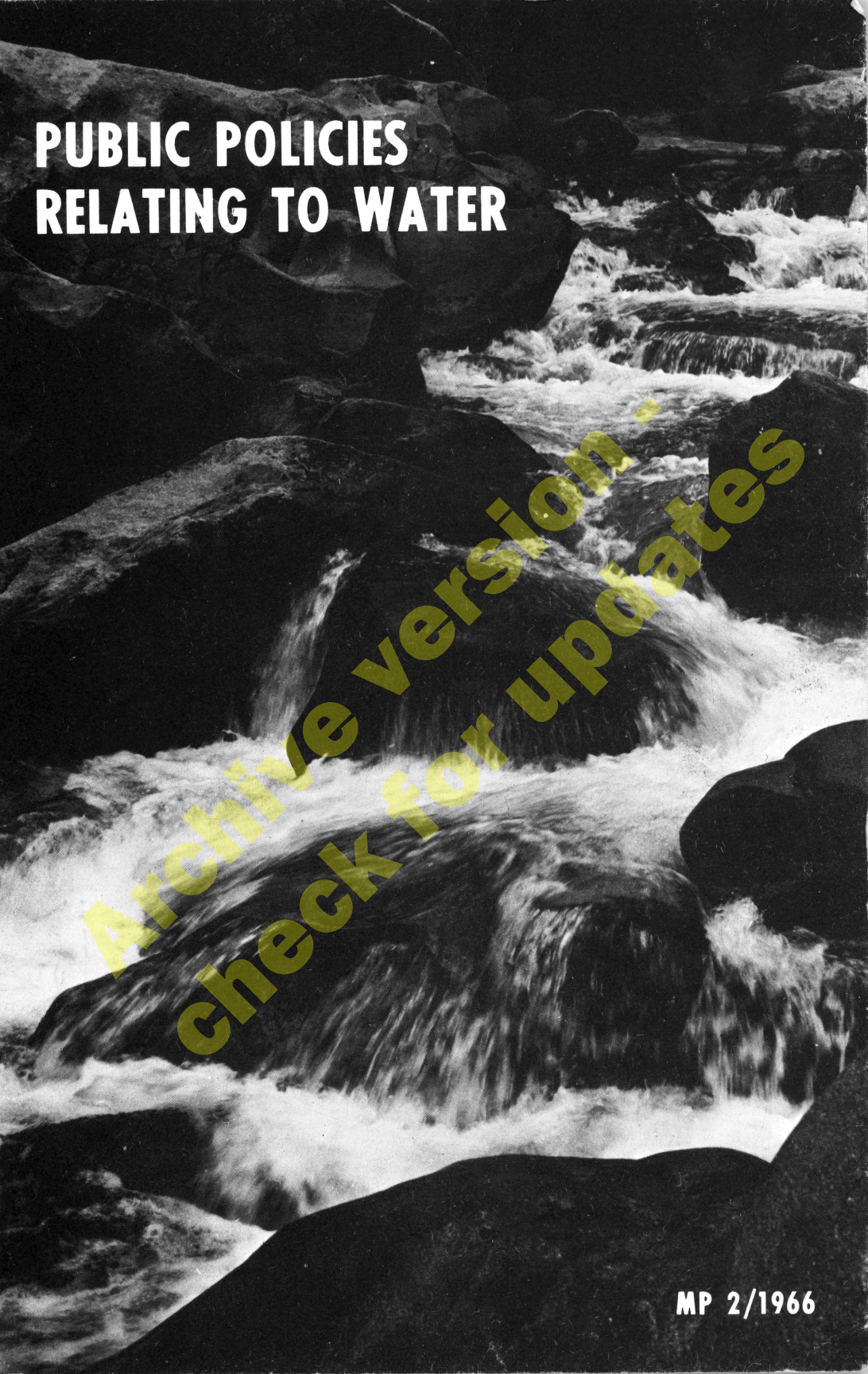
PUBLIC POLICIES RELATING TO WATER



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Public Policies Relating To Water

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F O R E W O R D

This publication includes the papers presented at the workshop on "Public Policies Relating to the Development and Use of Water Resources," held at Purdue University, November 2-5, 1965.

The conference had its beginning when members of the North Central Extension Public Affairs Committee expressed a need for an Extension educational program in the area of water resource development and use.

A subcommittee, which planned the program, had as their major audience Extension specialists in the North Central states concerned with public problems and issues relating to water. Conference speakers were from various academic disciplines and public agencies and their papers are presented here. The informal group discussions, believed to be helpful to conference participants, did not lend themselves to meaningful reproduction and consequently are not included.

Grateful acknowledgement is given to the Farm Foundation which, with funds from a Ford Foundation grant, financed the instructional staff and paid the expenses of developing the program and conducting the conference.

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ISSUES FOR EXTENSION SERVICE IN DEVELOPING A WATER RESOURCES POLICY PROGRAM

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As I recall my boyhood in Henry County, Indiana, water was just beginning to be discussed at a few County Extension meetings, along with the problems associated with urbanization. With isolated exceptions, this range of problems has not played a significant part in Extension programs across the nation. I shall not argue whether "correct" emphasis was or was not given to these areas during past years. But I do want to state my belief that Extension does have an important role to play in this field during the next 30 years. Extension cannot escape the issues in water resources and urbanization, if it wishes to remain the vital, educative force which constitutes the basis of its reputation. The purpose of this workshop is to contribute to defining the content of such a program. My particular assignment is to look at the broad issues which confront us today and about which better public understanding would be helpful.

The three points around which my comments are organized may surprise some of you. In the first instance, they do not relate to water quality, flood control, municipal water supply, recreation, irrigation, or specifically to the other concerns associated with water. Yet each point concerns all of these.

The first question must receive greater attention in terms of public understanding, as well as research and action--namely, by what institutional mechanism shall water be brought into the direct service of man. One such institution is our system of property rights. Citizens in western states have been striving for over one hundred years to develop a property system which will provide part of the answer. In addition, organizations[1] have been created for providing public goods

[1] For example, special districts, county governments, municipal departments, agencies of state governments, and large federal agencies such as the Corps of Engineers, Bureau of Reclamation, Soil Conservation Service, and the Public Health Service, all serve as organizational capacities in the West and East.

to yield other answers. In the humid Midwest, the situation is viewed somewhat differently than in the West. But the problem remains; the institutions of property and markets do not fit water so neatly as with other resources. With non-water resources, we are building upon the property-market institutions, but in the water field problems of externalities make these conventions more difficult to apply.[2] Thus, educational opportunities are defined in terms of proposed institutional approaches.

The second point grows out of the first. How can we develop systems of planning which, on the one hand, allow opportunities for a decentralized democratic decision structure, yet can handle the externalities in a fashion which will prove acceptable?

Third, how do we expand and deepen the meaning of a concept of integrated water resources management--integrated in terms of the many uses of water, but also in terms of the general environment. Parenthetically, points two and three could be held to be inconsistent, if extreme positions are taken. I prefer to blend the two.

Each of these three points will be discussed to see why they constitute issues we must face and around which I feel Extension can define a useful role.

I.

During the last ten years, a few midwestern economists and lawyers have begun to build a foundation for an institutional structure for dealing with water. Of course, institutions of this type are not built by academicians, but academicians can give direction and purpose. It is in this role that Extension can be most effective.

Midwestern courts and legislatures have been called upon to sanction a system for managing water in a way which is acceptable to the private economy. Yet water allocation and management systems which build from the base of our property institutions have been faced with many problems which need not detain us today. On the other hand, I am not so naive as to think the property base can be or should be ignored. As the social theory of property implies, this base is to be developed and

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[2] Emery Castle, "The Market Mechanism, Externalities, and Land Economics," Journal of Farm Economics, Volume 47, No. 3, August 1965, pp. 542-556.

molded to meet today's and tomorrow's problems. Let me note that concepts drawn from the fields of public utilities and contracts may be suggestive as avenues for achieving the appropriate balance between security and flexibility of water service. Thus the formal rights may be held by large management organizations which provide the secure but flexible water service.

You are probably asking--is institution-building for large water management systems a broad issue in the United States? I think it is, for the direction of movement is toward large, managed water systems. Let me call your attention to the water resources map published by the U.S. Geological Survey. This map shows the location of major reservoirs throughout the United States. A most striking observation is the extent to which the major river systems are managed today. Flows are controlled to a degree. Or more accurately, we are taking the second step toward controlled flow systems. Major rivers and tributaries are coming into this category. Thus, the institutional structure managing these water flows, the inputs, the diversions, the quality and the quantity, as well as the adjacent land uses become crucial. In this context the effect of urbanization is most significant. In fact, it provides one of the biggest aggregate changes which is just beginning to be noted and which must be integrated into water system management. The impact of this force needs wider understanding. At this point water and land management join as significant policy issues.

The integration of the diverse aspects of water management is a relatively recent concept in terms of attempted institutional implementation. This problem will be discussed more fully under point three; my main purpose for mentioning it now is to note that the external effects from water use are of such an order to magnitude that they demand special attention in organizing governmental activities from federal to local. In emphasizing the importance of this issue, I do not argue for a single centralized approach. On the other hand, the organization must be large enough to encompass major interests, be responsible enough to negotiate and make contracts, and provide a service with both, security and flexibility.[3]

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[3]Stephen C. Smith, "New Approaches in Organizing for Land and Water Use," Journal of Farm Economics, Vol. XLIV, No. 5, December 1962, pp. 1684-1694.

Emphasis is given to the service rendered by water, taking into account the externalities. With the service emphasis, the property right, permit, license, or even the organization managing the flood control structure take on new meaning as new ways of supplying the service are envisioned. The real issue is to look at these services demanded with inventive minds. If this is done, we soon realize "the water problem" has large segments of emotional involvement. This involvement may not be bad per se--but as clearly as possible, it should be identified. (Parenthetically, this identification is part of the role of the Extension Service). With such identification, an organization can be structured around the service complex with the ability to manage the total supply of the service within the area and in turn relate it to external forces. In this way, both surface and ground water may be brought into the picture, as well as the service interdependencies. Many organizational forms are available. The public district and state could assume greater roles while the federal agencies should broaden their perspective.

The "organizational approach" to providing water services should emphasize other issues than just economic evaluation. Evaluation is important, but emphasizing it to the exclusion of other criteria has resulted in lesser attention being given to the other issues--particularly the question of repayment and pricing. Wantrup noted this some ten years ago.[4] Of course, a reason these issues are important is the tendency to over invest if the "price" incidence is spread too broadly. Some flood control works may be in this category, as well as investments in low flow augmentation. On such issues the organizational structure is important--for example, the cost-sharing rules in federal programs.

I am not advocating a particular institutional approach to water problems; there are many. But I do urge Extension's involvement in assisting the water publics in finding one to fit <u>their</u> situation. Also, the expertise of a "third neutral party" is often badly

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[4] S. V. Ciriacy-Wantrup, "Cost Allocation in Relation to Western Water Policies," in <u>Economics and Public Policy in Water Resource Development</u>, Ed. Stephen C. Smith and Emery N. Castle. Ames, Iowa, Iowa State University Press, 1964, pp. 189-208.

needed. Extension is in a position to explore alternatives in a way which may not be open to other agencies. This role is all the more important with the passage of the Water Resources Planning Act of 1965.[5] State, regional and federal water resources planning takes on a new dimension under this law. In addition, the Water Quality Act of 1965[6] is being implemented. These two pieces of legislation, plus laws of an earlier vintage create an educational job of major proportions. The issue is for Extension to take on the task of water resources institution-building among the "eddies and swirls of a fast moving stream."

II.

The second issue for Extension is to define its role in the complex problem of water resources planning which is proliferating at a rapid pace. As with the previous point, this affects all phases of water management and use.

For some time a national program of river basin planning has been proceeding. It now takes on a new dimension with the passage of the Planning Act of 1965 previously mentioned. These efforts are added onto existing agency procedures of long standing for project planning. This is not the time nor the place to criticize this planning process, but the role of public understanding in this field has left something to be desired.

I say this with full knowledge of the general requirements for local sponsorship, state government review, and public hearings, as well as the necessity for political support. The importance of these procedures is recognized, but they are organized within the context of making a decision and of frequent conflicting value orientation. In this structure, two points should be noted. First, in the cross claim of protagonists, the process of "sifting and winnowing" is difficult and at times impossible. Second, prime attention is too frequently focused on "a plan" which has been prepared and is presented within a rather rigid set of value constraints.

In both instances, planning would have been improved had public participation been introduced at an earlier date and had the full array of alternative procedures for

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[5]Public Law 89-80, 89th Congress, S. 21, July 22, 1965.

[6]Public Law 89-234, 89th Congress, S. 4, October 2, 1965.

action been explored. Of course, this statement shows my own value position, as intended. However, the statement could be formulated as a hypothesis for testing--until tested, however, I shall hold it as my position.

On the first point of early participation, problems do arise. For example, the discussion of possible courses of action may cause fears and doubts which form rigidities early and thus forestall future action. But discussion under the leadership of non-action agencies may present an opportunity too long neglected.

The second point follows, that a non-action agency can explore alternatives in a context not so readily open to others. Questions of flood proofing, open space utilization of flood plains, and other opportunities enter the discourse as a normal part of an educational planning program.

As previously stated, the comprehensive river basin planning program is beginning to turn out published reports. Some of these reports go under the widely used label of "economic base studies." One point at which an educational program might start is to prepare popular summaries of these detailed analyses and relate them to issues of water quality and quantity management. The League of Women Voters has already prepared a very interesting brochure outlining water management problems in the Ohio River Valley. This type of general educational background can greatly affect the intelligence of citizen participation in water resources planning and investment discussions. This is important, since many water issues must pass several political tests, by vote of the citizens or their elected representatives.

Education for water resources planning must tie into the alternative programs for dealing with water problems. It is at heart a public affairs educational activity, since so much of the "water problem" is handled as public business. Because of this characteristic, the educator must have both, an analytical approach to the possible water management systems and to the politics of water. In the latter case, questions of incidence of benefits and costs are particularly important.

III.

As an underlying notion in both institution building and planning, I would like to introduce the concept of integrated water resources management. This approach calls for a dual approach to problems of providing water services. On the one hand, each service must be approached

singly in order to identify all of its ramifications over time. But concomitantly, the interrelationships of the whole of water services must be envisaged and dealt with. To handle the externalities, the management of the services must be integrated through some form of institutional structure. We need both approaches. I would be the first to point out that "water is not water." Namely, the water we drink is not the water in our effluent, nor the water with which we irrigate, nor the water in which we swim. An yet, the water in which we swim, and which carries our effluent, and which returns from irrigation, may be the water we drink. Because of these relationships, a concept of integrated management is useful.

The traditional institutional setting for attacking these water problems has been to approach them singly. Thus we have single function agencies dealing with floods, supply, pollution, etc. This approach has had it merits, yet I am suggesting that even using this approach, each of the agencies should view its task within the total context. In our analytical, planning, and institution-building efforts we need to focus on integrated water resources management, rather than just the individual services per se. In this way, greater meaning can be given to the individual services. Also, this approach will aid in sorting out the contribution of water development to economic development. In this way, by this focus, we can understand better the conflicting and complementary roles water must serve.

Again, this focus can be within the provence of Extension, as it can have an interest in all of the water services without pushing one interest for agency reasons. Clearly, the performance of such a task is not easy and requires skill in threading ones way in a "jungle" of agency interests.

The word jungle is used for emphasis, for we have seen great progress during the past ten years in inter-agency coordination and cooperation. Let me point out, there are many ways in which integration may take place. Having every service within one agency does not solve all of the problems. In fact, separate agencies may be the desirable integrating technique in order to give focus and thrust to an activity and to force their dealings with each other into the open. On the other hand, in adopting the pluralistic approach, we must continually be alert that important issues do not go unsolved because of excessive fragmentation of interest. Frankly, it is at this point that "non-interest" but interested agencies can be most helpful. Quietly raising

questions from a sound analytical base can be very productive.

Of course, a reason an integrated approach to water resources is important is the significance of externalities, as previously mentioned, or to put it differently, the high degree interdependence of actions of water management. For example, many institutions in the West have been built around the independence of surface and ground water. Clearly, they have different characteristics. But with heavy pressure for use, their interdependence as sources of supply is of prime interest. With the exception of closed basins, the problem is that they have not been fully integrated, although notable progress has been made in recent years. And even closed basins have been integrated with the advent of long distance water transport.

Extension could make an impact, if it could aid in bringing about this conceptual approach to water resources. As a concept, it can serve as a central idea for all agencies in approaching <u>their</u> problem and adjusting themselves to the many services which water provides.

WATER ISSUES IN THE GREAT LAKES AREA*

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A casual look at the map of North America or of the world shows that the Great Lakes area enjoys a unique position with respect to water resources. No other area in the world has access to so large a reservoir of fresh water. Aside from this characteristic, however, the water issues and problems of the Great Lakes area have much in common with those experienced throughout most of the eastern half of the United States.

From a technical point of view, the Great Lakes area may be defined as including all the land and water resources found in the upper portion of the watershed of the St. Lawrence river. It includes the watersheds of Lakes Superior, Michigan, Huron, St. Clair, Erie, and Ontario. On its southern side, it involves all but a tiny fraction of Michigan plus substantial acreages in Minnesota, Wisconsin, Illinois, Indiana, Ohio, Pennsylvania, and New York. The entire northern portion of the watershed lies within the province of Ontario.

Over-all, the watershed of the Great Lakes occupies the surprisingly small area of only 295,000 square miles, of which 95,000 square miles are covered by waters of the Great Lakes. This ratio of only slightly over two acres of watershed land surface for each acre of lake surface provides a small base for the world's largest reservoir of fresh water supplies. Because of the small size of its watershed, the Great Lakes are served by virtually no large streams. Small, relatively short tributaries drain a host of small watersheds around each of the lakes.

Despite its large expanse of lake surface, the Great Lakes watershed does not provide a hugh volume of water, as does the Columbia river basin. The area lies within a humid region and normally receives between 28 and 36 inches of precipitation each year, about 20 inches of which comes during the warmer months of the year. But this is the least humid portion of the eastern states, and the average supply of precipitation is definitely less than that received by areas farther east or farther

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*Paper presented with slide illustrations.

south. Cool weather conditions with lower attendant evaporation rates compensate somewhat for precipitation shortages and permits some stretching of the water supplies available within the region.

Water levels on the Great Lakes and water supplies in the watershed vary considerably from year to year. Heavy rains and local floods are reported in most years while local drouths also are common. Observations made during the last 90 years show that the average annual elevations of Lake Ontario have varied within a 6.6 foot range while those of Michigan-Huron have varied within a 6.3 foot range, Erie within a 5.3 foot range, and Superior within a 4.1 foot range. In 1951, Lakes Michigan and Huron were near their maximum heights and high lake waters washed away beaches, engulfed summer homes, and undermined bluffs which supported mature trees. Thirteen years later in 1964, the levels of these same lakes were at a historic low and public action programs were demanded as a means of stabilizing lake levels.

Major Water Resource Problems

The major water resource problem that must be faced in the Lake States in the years to come is that of providing adequate supplies of clean water for an expanding population. Current population estimates indicate that the Great Lakes area can expect around 20 percent more people by 1980. Meanwhile, it is argued that average per capita demands for water may well double in the next 25 years. Provision of the water resources needed to satisfy the growing demands of this increasing population will require far more emphasis on the issues of water quantity, or adequacy of water supplies, and water quality.

Problems already have arisen because water is not as freely available when and where it is desired as some people might wish. Shortages of water supplies have had their impact on economic developments. They have stimulated discussions and sometimes legal and legislative actions concerning water rights. With the increasing use of water, serious problems also are arising with respect to water quality. These problems along with those of adequate water supplies are bound to become more and more serious as population pressures cause greater competition and more conflicts of interest over the uses of water.

Looking ahead, we must assume greater demands for use of the waters of the Great Lakes area than ever before and little if any increase in the volume of water

available for use. Programs can be anticipated that will store surplus waters for later use and that will move surplus water supplies to areas of need. Comparable developments will be used to protect water supplies from pollution and to change water quality so that more of this resource is available for reuse. The direction of these expected developments indicates that the major emphasis in water policy will center around (1) attempts to better allocate our available water supplies, (2) the maintenance and improvement of water quality, and (3) management of water resources for social ends.

Major Uses of Water Within the Great Lakes Basin

Any programs advanced for the management of the water resources of the Great Lakes area must recognize the multiple use nature of the water resource in this area. The more important of these uses involve the utilization of the waters of the Great Lakes, its tributaries, inland lakes and ponds, and the ground waters of the area for such varied purposes as navigation, power, agriculture, residential, commercial and industrial, fishing, and recreational and scenic purposes.

Historically, navigation is one of the oldest uses of water in the Great Lakes area. Fur traders used the lakes and streams as a highway during the 16th, 17th, and 18th centuries as they established contact with the Indians and tapped the fur-production resources of the region. Lakes and streams were used in similar ways by the first missionaries and settlers.

Ships of various types operated on the lakes at an early date. Admiral Perry fought a major naval battle on Lake Erie during the War of 1812. In later years and particularly after the opening of the Erie Canal in 1825, boats carried supplies and settlers to the northwestern territories and hauled surplus products back to the East. Other canals soon connected Lake Erie with tributaries of the Ohio river and Lake Michigan with the Illinois river. With the rise of lumbering, streams were used for the floating of logs and timber.

Completion of the Sault Sainte Marie locks in 1855 and Canada's action in building the Welland Ship Canal in 1824 and in greatly improving this canal in 1874 opened the whole lake system to commercial ship navigation. The St. Lawrence Seaway today permits navigation of the Great Lakes by foreign ocean-going vessels. Ore boats, however, are still the navigation work horses of the Lakes.

Except for the lands bordering Lake Ontario, most of the watershed of the Great Lakes lies within an elevation range of 600 to 1,000 feet above sea level. The terrain is generally rolling to flat. Mountains are a rarity; natural reservoir sites are scarce; and while the area does boast several scenic waterfalls, hydroelectric power sites are few and far between. Nevertheless, power and gristmill sites were settled and developed by the early settlers. Major power facilities have been developed at Niagara Falls and hydro-power sites of some importance have been constructed at other locations. Most of these facilities operate for brief periods each day and are tied in with other thermal and hydro-facilities controlled by large power companies. A major use of water for power in the region is now associated with its need as a cooling agent both with thermal and atomic power facilities.

From the first days of settlement, the waters of the Great Lakes area have been widely used for agricultural purposes. Domestic use and the watering of livestock became important with land settlement. Supplemental irrigation was tried on some farms during the 1800's. But, the major adoption of supplemental irrigation practices came after World War II with the development of portable aluminum pipes and fixtures. Supplemental irrigation is now used on many Lake States farms, particularly for the production of potatoes and truck crops and as a late spring frost prevention measure with strawberries. Important as supplemental irrigation has become with farming, however, it should be recognized that the area of golf courses, cemeteries, and urban lawns which are irrigated in the Great Lakes area far exceeds the irrigated farm area.

Urban and municipal uses of water rate high in importance and also in the volume of water utilized. Tremendous volumes of water are pumped from surface and ground water sources for use in homes, factories, and commercial establishments. Most of this water is filtered and treated before use, and most of it finds its way back into lakes and streams. A major use for this water is the dilution and movement of wastes.

In earlier periods, it was practicable to dump raw organic wastes into streams and expect streams to repurify themselves before there was occasion for reuse of the water. Population pressures have changed this situation. Sanitary, public health, and esthetic considerations now require treatment of wastes; but the

problem of water pollution is far from solved. Partially treated or untreated wastes are degrading many lakes and streams while creating esthetic nuisances.

Commercial fishing has rated in years past as an important use of the Great Lakes. This industry has suffered serious reversals in the last two decades as a result of the invasion of the lakes by sea lamphreys. A lamphrey control program is now in operation which may permit a revival of commercial fishing if the lake populations of whitefish, lake trout, and perch again increase. Meanwhile, another problem has developed with the booming population of the alewife, another migrant from the sea which has no commercial or sports value and which has now taken over the lakes to such an extent that it represents around 90 percent of the weight of fish in the Great Lakes.

Recreation and scenic values are attracting increasing public attention as high priority uses of water. These uses have been enjoyed by some people for many years, but new emphasis has been given to them by the spiralling of public interest in outdoor recreation and by the growing interest the public is showing in natural beauty. Recreation and scenic values are associated with a wide variety of water activities such as fishing, waterfowl hunting, swimming, boating, waterskiing, and the simple enjoyment of scenery.

Too Much Water

Future water policies will be concerned in most instances with the problem of stretching normal supplies to care for emerging demands. Unfortunately, however, administrators of water programs must deal with wide variations in water supplies. In some seasons and some years, accommodations must be made for excessive supplies of water, while on other occasions water may be in extremely short supply. Some of the leading issues in water policy accordingly deal with the problems of too much water and too little water.

Reference has been made earlier to the damage to riparian properties caused by high water levels on Lakes Michigan and Huron in 1951. Other examples of problems stemming from too much water are provided by the seasonal floods experienced along many streams. High waters pose few problems when they occur in forested or open undeveloped areas. But they create serious problems when they engulf farms, cover or wash out highways, or inundate residential, commercial or industrial areas.

The problem of disposing of excess waters has given rise to tiling operations on farm lands, the digging of deep drainage ditches, and the organization of drainage programs that affect millions of acres in the Great Lakes region. Levies and flood control works have been developed along many streams. Plans are being pushed for integrated watershed development programs which involve the storage of surplus waters in upstream reservoirs for discharge in periods when low flow augmentation is desired. Other adjustments for periodic flooding call for the flood proofing of properties located on flood plains and for flood plain planning and zoning measures that prevent the location of developments susceptable to flood damage in areas where floods may be expected.

Too Little Water

Along with its occasional problems with too much water, the Great Lakes area suffers from occasional drouths. Drouth periods pose problems for farmers and home owners and sometimes lead to crop failures. Prolonged drouths or periods of below average rainfall can also cause low lake levels, the drying up of streams, and lower ground water levels. Inadequate water supplies require the hauling of water to farmers in some areas. They have brought losses in the recreational values of lakes and streams. Low stream flows provide inadequate supplies of water to properly dilute and float away the effluent of some sewerage disposal plants. Undependable supplies coupled with population growth also have forced inland cities to go to the Great Lakes for additional water supplies.

Water shortages and low lake levels have been experienced in the Great Lakes region during the past decade. Four principal factors -- below average precipitation, increased consumption, the dredging of deeper navigation channels, and diversions of water from the Great Lakes -- explain this situation.

Hydrographic data on the levels of the Great Lakes during the past century show that Lakes Michigan and Huron have tended to be below average in more years than they were above average in the last half century. These data indicate numerous years of below average precipitation. Meanwhile, the number of people served by the Great Lakes watershed has increased and the volume of water used for irrigation, lawn watering, human transpiration, and other consumptive uses has greatly increased. One recent statistic on consumptive use indicates that

approximately a fifth of the water provided by municipal water plants is not returned as waste water to their waste disposal plants.

Navigation considerations have called for the dredging of ship channels and the building of locks and canals. These developments, and the dredging of a 27-foot channel for St. Lawrence Seaway traffic in particular, have speeded the flow of water between some of the lakes. Dredging activities undoubtedly have had some effect in lowering lake levels. This situation is somewhat paradoxical since navigation companies need deep water and deep channels to operate their ships at full load capacity; yet the dredging of channels tends to lower lake levels. Dams with locks could be provided at the mouths of the rivers that connect the various lakes, but this approach is unacceptable to shippers because of the added inconvenience it would entail.

The principal diversion of nonreturning waters from the Great Lakes takes place at Chicago. Prior to 1900, Chicago secured its water supplies from Lake Michigan, wells, and the Chicago river and returned its waste waters to the lake. A typhoid epidemic in the late 1890's caused the city to embark on a new program under which the waste waters of the city were discharged into the Des Plaines river which runs into the Illinois and Mississippi rivers.

At present, the Chicago metropolitan sanitary district takes approximately 3,100 cubic feet of water per second from Lake Michigan and nearby wells which is not returned to the lake. This is the equivalent of two billion gallons of water per day or enough water to fill a trench ten feet deep and ten feet wide for a distance of 507 miles. The Chicago lake diversion is credited with lowering the level of Lakes Michigan and Huron by 2-1/2 inches. This diversion, however, has been more than offset by action to reverse the flows of the Ogoki River and Long Lake in the Lake Nipagon region north of Lake Superior.

Numerous proposals have been made for ways and means of countering the problem of inadequate water supplies. Individual cities are going farther and deeper for their water supplies. Numerous land owners are building ponds for recreation and water storage purposes. Small and larger watershed programs are being pushed that incorporate plans for water impoundments that can be used for low stream flow augmentation pur-

poses. State legislation has been passed to authorize and encourage watershed management programs. Riparian owners are able to establish minimum lake levels, and consideration has been given to the specifying of minimum stream levels below which diversions for consumptive uses cannot be made.

Grandiose plans also have been suggested. One of the more imaginative of these is the so-called Parsons or NAWAPA (for North American Water and Power Alliance) plan which would harness waters from the Yukon, Mackenzie, and Peace rivers in western Canada and send them south and east for use in Canada, the Great Plains, the Rocky Mountain states, California, Mexico, and the Great Lakes area. One phase of this proposal would reverse the flow of a Quebec river that now flows to Hudson Bay and send it south into the Georgian Bay of Lake Huron. This project would provide hydroelectric power plus additional water for the Great Lakes but would pose problems concerning the handling of surplus waters in years of high lake levels.

The Parsons Plan has a suggested price tag of $100 billion and would take 30 years to build. Bold and imaginative thinking of this order must be expected in the future. For the time being, however, we must look to less expensive and more pedestrian programs for solutions to the water supply problem. We must also remember that water supply problems in the Lake States appear small in comparison with the problems of more arid regions.

One area in which very definite programs can be expected is that of waste treatment and pollution control. Much of the water of the area is currently unsuitable for use or is of lower quality than that desired for the simple reason that inadequate measures have been taken to treat wastes or unreasonable liberties have been taken in polluting public waters. More thorough treatment programs and stronger controls affecting pollution practices can be expected in the years ahead. These measures will add to water costs, but they will add to the esthetic values associated with water and will permit quicker and more frequent reuse of the water supplies available.

Public Interests in Water

A final area of major concern involves expansion and preservation of the public interests in water resources. The several states have an inherent responsi-

bility to watch over the public waters within their boundaries and make certain that they are used in the public interest. In times past, the public interest has often been enhanced by encouraging private enterprise and initiative in the use of water resources. With increasing demands and more competition for approximately the same amount of water, public policy can be expected to play an increasingly important role in water resource development, use and management decisions.

Public concern over the use of water resources will take various forms. More emphasis will be given to the development of state water policies. The riparian water rights doctrines accepted in the various states will probably be modified to provide greater measures of public control over diversions of water from lakes and streams. Stronger police power measures will be exercised over pollution practices.

More action can be expected in the acquisition of public access to public waters. The undesirable aspects of this policy in opening up some waters for unlimited public use may be offset by zoning or other regulations that limit the number of public users at any one time, specify acceptable uses, or provide hours during which particular water uses may take place.

Another significant area of public concern involves protection of public waters against encroachments and possible despoilation. Dredging and filling operations can have desirable results from the standpoint of individual operators, but controls are needed to prevent the destruction of wildlife and fish spawning areas, the blocking of navigation, or the creation of undesired backwaters and 'eye-sores.' Similar controls are needed over the use riparians are allowed to make of bottomlands they may hold under public waters. These controls may call for removal of abandoned piers and limitations on the extent to which piers may project into streams. With the growing public interest in the preservation of natural beauty, action programs also may be expected that will enhance and maintain the scenic qualities of lakes and streams.

WATER ISSUES TO BE FACED IN THE GREAT PLAINS

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The conventional view has long been that the water problems of the sub-humid Great Plains are those of deficient quantity; whereas the problems of the more humid areas to the east are those of water pollution. However, this classification of problems is not tenable with respect to either area. The Plains has, and will have even more in the future, problems of water quality. Conversely the Midwest and East have, and will have even more in the future, problems of inadequate supplies of water. In fact under most conditions water problems of deficiencies in quantity and quality are inseparable. Most problems of water quality would not arise or would be easily solved if the volume of water were adequate.

Water Consumption

A common misconception as to what constitutes consumption of water has contributed to misapprehension concerning water problems, and to defects in water law. Conventionally, consumptive use of water has been defined in literature and law as the diversion of water from a source so as to make that water physically unavailable for an alternative use. Water continues to be available from that same source only as it is replenished through the hydrologic cycle.

By this definition of consumptive use, irrigation is virtually the sole consumer of water. Whereas food processing plants incorporate a little water into their product and some water evaporates from cooling towers, such consumption is nominal. For each gallon of water that is pumped for industrial or domestic purposes very nearly a gallon of effluent is discharged. Prodigious water users such as hydroelectric generating plants and barge lines divert no water from streams; and therefore do not, according to the accepted definition, consume water.

However from an economic standpoint, the conventional definition of consumptive use is not only invalid but seriously misleading. Furthermore, the origin and persistence of the definition is somewhat puzzling. The Riparian doctrine from English common law limited the

use of flowing water to those activities which left the stream "undiminished in quantity and quality." This doctrine, strictly applied, virtually eliminated all uses except the water wheel, fishing, swimming and boating. However, the doctrine did properly recognize that the ability of water resources to contribute to the production of goods and services was a function not only of the amount of water available but also of the kind and quantity of materials dissolved or suspended in the water.

From an economic standpoint, water is consumed whenever it is made either unavailable or unfit for an alternative use. Whether or not the water is diverted from a watercourse by a particular use may not be germane in an economic analysis. Water which floats a barge from Omaha to New Orleans is more completely consumed by that use than if diverted in the upper watershed for irrigation. The net benefits to society of utilizing a given volume of water in the Missouri-Mississippi basin for irrigation or for barge transportation may be open to question. However, that water used to float a barge to New Orleans is unavailable for irrigation in the Plains is not disputable. To designate irrigation as "consumptive" and transportation as "non-consumptive" is illogical.

Water Pollution

In another situation, a packing plant obtaining water from wells may actually augment, rather than deplete, the flow of a stream by discharging effluent into it. But if this stream is, as a consequence, rendered unfit for subsequent users (e.g. municipal water supply, recreation, etc.) then the water originally in the stream and the water pumped from wells, has been consumed by the packing plant.

The conclusion to be drawn from the foregoing is that the paper mill, packing plant, refinery or steel mill which pollutes a stream so as to make the water in that stream unfit for further use has, in fact, consumed that water. Water even in large quantities is a resource only if it is so located and of such quality as to be capable of yielding goods or services with values in excess of the cost of utilization. In fact, polluted water may actually have negative value as a result of hazards to health or offensive odor, taste or appearance. In some cases, the only costs of using water for waste disposal are losses of esthetic values; but, depending on the political power and value structures of the people

whose sensibilities are being offended such costs may be substantial indeed.

Obviously, activities are not necessarily undesirable or unjustified simply because they pollute water. Waste disposal, biologically, domestically and industrially, has been a legitimate function of water from the beginning of time. Without this service from water man could not exist. We need merely to recognize that man's right to pollute water must be subject to restrictions and controls as are his rights to "consume" water in the conventional sense. Public policy must be concerned not with water per se, but with the services which water is capable of performing for mankind.

The use of water as a vehicle for the disposal of waste should be subjected to the same kind of economic scrutiny as any other use. Activities which pollute water are justified only if they generate benefits in excess of (1) the benefits obtainable from alternative uses requiring unpolluted water, or (2) the cost of restoring the water to a condition which meets the minimum requirements of alternative uses. Even if these conditions are met, pollution should not be allowed if alternative methods of waste disposal cost less than the benefits lost or costs incurred because of the pollution.

This discussion of the problems of water quality has a two-fold purpose. The intent is to establish that (1) the problems of water quality and those of water quantity are inseparable and (2) problems of water pollution are not restricted to the densely populated areas of the country. Water becomes polluted whenever the kind and concentration of materials in solution or suspension reduce its capability to yield benefits to those who would use it. Concentrations of pollutants rise from tolerable to unacceptable levels as a result of either (1) the introduction of additional pollutants or (2) a reduction in the quantity of water. For the latter reason, areas of low rainfall such as the Plains may, in the long run, face more serious problems of pollution than do areas of higher rainfall.

Furthermore, in the long run pollutants from crop and livestock production may pose a much more difficult problem than do those of municipal or industrial origin. Wastes from non-agricultural sources are often in large volume and heavily concentrated but are relatively easy to locate and capture for treatment. Also marginal value productivities of water used for industrial and

municipal purposes are high and thus justify substantial expenditures for pollution abatement and control.

On the other hand, the wastes from crop and livestock production are widely dispersed. These wastes include not only the runoff and seepage from barnyards but also highly toxic pesticides and fertilizers; which are dispersed over wide areas. Nitrate and phosphate ions are appearing with increasing frequency in both ground and surface waters in concentrations which are detrimental to the health of wildlife, farm animals, and people. And perhaps even more serious, pesticides of high toxicity have on occasion appeared in lakes and streams in sufficient concentrations to kill fish. Such concentrations would likely be deleterious to the health of farm animals and humans.

Farmers rapidly increase their use of chemicals each year. The number of different chemicals, the purposes for which they are used, their toxicity, the total quantity applied and the extent of the area covered, all are increasing at an increasing rate. Furthermore, irrigation, which is also increasing provides a means by which the chemicals can be carried into surface and ground water supplies. Of course, heavy rains, which often occur in the Plains, will also move the chemicals from their point of application. The principal additional danger posed by irrigation is the substantially heavier application of fertilizers and pesticides which accompanies irrigation. Careless or excessive application of irrigation water is almost certain to wash dissolved chemicals out of the field or flush them down through the soil profile to below the root zone. These chemicals, unless they break down or degrade into non-toxic substances, (and some are exceedingly stable) will eventually appear in either ground or surface water.

Recently, two long-range projects designed to attack water pollution problems in the Midwest and Far West areas have been approved by the Public Health Services. The projects will investigate water pollution problems resulting from intensive farming operations.

The projects will cost an estimated seven million dollars and take about seven years to complete. Headquarters for one - the Missouri-Red River Basins project - will be in Kansas City, Missouri. The project includes part or all of several states in the North Central Region: Minnesota, Iowa, Missouri, Kansas, Nebraska, North Dakota and South Dakota.

Improved Efficiency in the Use of Water

As the demand for services from water increases, two courses of action are available to provide these services. We can either develop additional sources of water or use the available water more efficiently. East of the Missouri River people have traditionally viewed water as a limitless resource. Each individual has felt that he has had the right to use all the water he wanted without consideration for others. Although we in the Plains have long recognized surface water as a "scarce" resource, we have typically had no feeling of scarcity with respect to ground water. Whereas each of the Plains states has developed and utilized mechanisms for allocating surface water, we have few such means for rationing ground water. An immediate problem in each of the Plains states is to develop a general realization that (1) ground water is not limitless, (2) surface water and ground water supplies are often closely interrelated, and (3) appropriate allocative mechanisms must be developed, adopted and enforced with respect to ground water. Unless such mechanisms are developed and applied before ground water sources are overdeveloped severe distress will be experienced by competing users and by communities at large.

Physical Efficiency

Traditionally, public reaction to any scarcity of water has been substantial expenditures to develop additional water supplies. The second alternative listed above of utilizing existing supplies more effectively and efficiently has received relatively little attention. On the contrary, distribution of water has been on bases which do not provide incentives for water conservation but instead encourage excessive water use. For instance, a large proportion of all water used in the United States is provided to the users virtually free or at prices substantially below cost. Where charges are made, they are often on a flat fee basis; or when water is metered to users the price per unit declines with quantity used. Little wonder that water is often utilized in a wasteful manner.

These practices, which encourage prolifigate use of water would be sensible only if the quantity of water were unlimited or at least adequate to meet all demands. Placed among the inalienable rights of man seems to be the right to prodigious quantities of water of acceptable quality.

The perpetuation of these methods of distributing rights to water into an era of water scarcity seems also

to reflect the erroneous view that the demand for water is perfectly inelastic. In other words, the view seems to be that water users will consume a given quantity of water irrespective of the price, up to some point where they can no longer afford to use any water. Or stated differently, the marginal value productivity of water in any use is considered to be constant irrespective of the quantity of water allocated to that use.

The views stated above are, of course, untenable since they fly in the face of the immutable principle of "diminishing marginal productivity." Particularly spectacular examples of practical methods of conserving water can be found in industry. The most common examples involve the use of towers for the recirculation of water used in heat transfer. More recently, shortages of water and/or pollution control measures have induced companies to install water treatment facilities which permit plants to recirculate water used for a variety of purposes. By this means a plant may cut consumption to as little as one percent of previous levels. In some cases, the process of treatment recovers materials of sufficient value from the effluent to pay for the cost of treatment. Given possibilities such as these for water conservation, modest charges for either water or the discharge of effluent could be expected to result in drastic reductions in the amount of water taken in and effluent discharged. Other water users, including irrigators do not have possibilities for such spectacular reductions in water consumption. However, all will likely respond to restrictions on water supply, or increased costs for water for waste disposal, by improving their efficiency in the use of water.

Allocative Efficiency

The concept of efficiency in water use does, of course, encompass more than the maximization of product from a given quantity of water in each of a number of uses. Of equal importance is the allocation of water among competing users in such a pattern as to maximize the net value product of the water. Estimates made by researchers in New Mexico assigned gross value products per acre foot of water of approximately $1 million to $3 million to municipal and industrial uses.[1] Recreational uses were estimated to yield from $200 to $300

[1] Wollman, et. al., The Value of Water in Alternative Uses - With Special Application to Water Use in the San Juan and Rio Grande Basins of New Mexico, University of New Mexico Press, 1962. pp. 39 and 125.

per acre foot of water. By comparison, irrigation produced a gross value product of about $20 to $60 per acre foot of water.

The magnitude of these differences is interesting but may not be of general significance. Even with such large differences of gross productivities, no decision can be made concerning the appropriate allocation of a given volume of water. Only net value productivites are of relevance in determining appropriate allocation. No use, irrespective of the size of the gross value product, can lay claim to water, unless the cost of the other necessary inputs is less than the value of what is produced. For a long time no serious competitor is likely to come forward to compete with agriculture for water in much of the Plains.

Agriculture is, however, a prodigious user of water. For instance, the production of a ton of sugar or of corn may consume 1000 tons of water. Perhaps only river navigation, among major water users, requires greater quantities of water for a given value of product. Given this heavy consumption of water, agriculture would be well advised to seek means to improve the efficiency of water use.

Certainly the largest potential for saving water in agriculture is in the raising of crop yields under both dryland and irrigation. Improved varieties of plants and improved cultural practices have a continuing potential for improving water use efficiency. But more impressive results can presently be achieved with fertilizer. In a study conducted by the USDA at Tucson, Arizona, unfertilized barley, yielding 18 bushels per acre, used 80 percent as much water as fertilized barley, yielding 81 bushels per acre.

Other methods of increasing agricultural output from a given amount of water would include:

1. Reduction of evapotranspiration losses by cultural practices, such as limited tillage or chemical fallow;

2. Use of more of the plant (e.g. silage or green chop vs. grain harvest); and

3. Optimization of timing and rates of application of water in irrigation.

In the same way that agriculture should exploit possibilities in dryland farming as an alternative to

increased irrigation, other goods and services might be provided at a lower cost by alternative means. For instance, electricity can be generated by steam plants using coal or atomic energy. Also, until existing railways running adjacent to the river approach their capacity to move freight, the heavy public subsidies which permit barge transportation on the Missouri River must be viewed with skepticism. Under no circumstances can any water use claim benefits in excess of the cost of providing the same good or service by an alternative means. By this standard not one gallon of water would be allocated for navigation on the Missouri River either now or in the forseeable future. The cost of such transportation to date would compare favorably only with air freight.

Summary

The primary issue facing the Plains with respect to water is the need to make the people aware that water, including ground water, is a scarce resource. Alternative users and uses will compete with increasing vigor for both ground and surface water. As a result of the low productivities of water in irrigation and navigation, these uses will not likely compete on economic bases with alternative uses when such are feasible. On the other hand, with careful use, substantial quantities of water will be available for irrigation in the Plains for a long time, and perhaps indefinitely. But even where irrigation rights to water are preempted by industry or municipalities, the prior rights of irrigators should be protected.

Although agriculture is legally in a favored position in most of the Plains states, such a preferential position cannot be maintained in the face of overriding economic considerations. Efforts need to be made in all of the Plains states, particularly with respect to ground water, to develop appropriate water law and administrative procedures to reconcile the claims of those who compete for the water. Particular attention needs to be given to the problems of allocating rights to "non-consumptive" users, as that term is currently defined. As indicated, any use which makes water unavailable or unfit for an alternative use has, in fact, "used up" that water in an economic sense. Claims to the services of water should be evaluated in that light.

The use of chemicals in agriculture must be scrutinized in terms of the dangers of pollution of surface and ground water. Those who manufacture and distribute, as

well as the farmers who apply fertilizer and chemicals, must become aware of the potential hazards and take steps to mitigate the problem. The alternative will likely be the imposition of stringent regulations and restrictions on the sale and use of such chemicals. Such restrictions could be most onerous to an agriculture which is becoming increasingly dependent on chemicals.

As the patterns of demand and supply change for the various goods and services which utilize water for their production, the patterns of water use should be free to shift in a corresponding fashion. Of prime importance to the effective allocation of water over time is the development and maintenance of a legal framework which will permit water to shift among uses and users in response to changing demands. Included in such a framework would be means whereby holders of water rights could sell those rights to users with greater potential.

Of equal importance to the allocative mechanism is a framework of private rights and public controls which encourages efficient use of water by all those who acquire rights to it. Vast opportunities exist to improve the effectiveness of water use. Great potential also exists for the development of additional supplies of water; although efforts to improve the use of what is available would appear to be currently more productive. We who reside, gain our livelihood, and engage in our leisure activities in the often parched Plains have a special interest in seeing that water is well used. The concept of "beneficial" use must be refined and enlarged to encompass consideration of the relative productivity of water in competing uses, as well as the productive efficiency within particular uses. The concept of "opportunity cost" should gain preeminence in the determination of the appropriate allocation of rights to water among competing users. Ideally, water would not be considered "beneficially used" if additional net benefits could be achieved either (1) by improved efficiency within the existing pattern of use or (2) by a different allocation of rights among users.

NATURE AND IMPORTANCE OF WATER QUALITY IN THE USE AND CONTROL OF WATER

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Current usage of water in the United States is estimated to exceed 320 billion gallons per day.[1] By 1980, within 15 years, this demand may well double. This would mean an annual increase of around 6 per cent. This increase would represent an annual allowance for a population growth of around 1½ per cent per year and a per capita increase of around 4½ per cent per year. However, such aggregate estimates must be redefined in terms of water quality since particular uses of water require specific quality characteristics.

Elements of Water Quality

The nature of the water quality problem may be stated in terms of three elements. First, wastes or pollution emanating from a particular use may foreclose other uses with an equal or even higher value. Costs of removing or remedying quality pollutants may be prohibitive to the other use or uses.

Second, quality pollutants dumped as a side effect or discharged as a treated waste of one use may increase the cost of (or correspondingly decrease the benefits to) another use. And further, if these costs (included decreased benefits) affecting the second use were assessed back to the first cost, the resulting costs to the first use would exceed the benefits to the second use. Or, the benefits from a second use could be obtained in another manner at a lower cost. For example, a municipality with primary and secondary treatment leaves the water at a quality level inferior to use for downstream recreation, i.e. swimming. However, an offstream impoundment which would provide the recreational use, could be constructed at a cost less than the tertiary or third order treatment by the municipality.

Third, future extension of a particular use to meet increasing future demands may be prevented by excessive costs or permitted only by higher costs involved

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[1] H. A. Swenson and H. L. Baldwin, A Primer on Water Quality. U. S. Government Printing Office. Washington, D. C. 1965. p. 22.

lake shore site planning? Should the state employ such a site planner?

2. Are present plumbing and subdivision code requirements of the State Board of Health adequate as applied to lake or stream shore land? Are the policing and enforcement of these restrictions adequate? If not, what should be done?

3. What are the possibilities of protecting shallow water habitat and shoreside wetlands from filling and development? By zoning? By purchase of easements? By so-called conpensable regulations? By other measures? At what level of government?

4. What should be the criteria that should govern the State Board of Health in deciding whether or not to require public sewage treatment facilities for clusters of lake side settlement? Should public health be the sole criterion?

5. Should the state's power, through the Public Service Commission to approve or disapprove locally proposed bulkhead lines, be strengthened?

6. Do we need some general guides to help us protect our lakes and streams from misuse of shorelands? If so, who is to prepare them? How are they to be implemented?

7. In general, how can we better assure compliance at the local level with present state level lagooning, grading, subdivision and other shoreland controls?

8. Should the Public Service Commission or some other state agency be authorized to bring summary proceedings to enjoin proposed shoreland activities which may be harmful? If so, how should this be phrased?

9. What can we do in Wisconsin to finally move from the talking to the action stage in the field of flood plain regulation? Should the state be authorized to institute these controls? If not, which level

of government? Should the state regulate the primary floodway, local units the secondary flood plain?

Water Quality Management in General

I do not have the time to explore the complexities of water quality management with you. I want merely to make a few general points.

First, we have treated water as a free good in the mid-west. We have permitted industries, municipalites, institutions and individual householders to make free use of our water courses for waste disposal. We have been blase about the "externalities" which upstream polluters have dumped on downstream users. We have only recently begun to tackle water pollution problems on a problem shed basis. But now we are aroused. The stench of Lake Erie has become a rallying point.

Long ago we pushed the courts into the background so far as concerns water pollution. We were dissatisfied by their inexpertise and their doctrines about a "right" to pollute so long as the water was still of "reasonable" quality. We turned to agencies staffed by engineers. But we have found that the engineers are not sufficiently concerned with total regional impact of pollution, with the real economic and amenity costs of it. Instead they put on blinders, look at each polluter's individual situation and then make ad hoc judgments of what he can afford in the way of improved treatment. There has been little or no economic analysis, and the pitiful plight of the downstream recipient of all the "goop" has been lost in the shuffle of individually focussed administrative orders. And these "orders" have been treated like fourth class junk mail by some polluters.

The setting of stream standards has often been a facade to hide inactivity and to create the misimpression that the pollution control agency was really taking the comprehensive view.

All of this is understandable; there has been but a small constituency to back rigorous pollution control. Even today in many places industrial expansion, regardless of consequences to watercourses, receives the support of those who count in the local economy. But things are changing; millions are demanding that something be done and soon. Again, the agenda quoted above may have in it some ideas which you will find helpful as we look ahead to the implications of these demands:

1. Should greater local participation in water pollution control be encouraged by:

   a. Possible legislation authorizing employment of sanitarians by counties acting singly or jointly. Door County has hired a sanitarian who is doing effective educational work in explaining State Board of Health private sewage disposal system requirements. Should counties be clearly authorized to employ such personnel? Should such county sanitarians be given enforcement powers?

   b. Should legislation authorizing the creation of Regional Water Quality Boards - one for each major river basin in the state - be adopted? There would be technical membership representing the State Board of Health, Conservation Department and the Agricultural Extension Service. Citizen members would represent industry, agriculture, municipalities, recreation and conservation interests. The board would sponsor educational meetings, would receive complaints and suggestions and would serve as a liaison between local people and localities and the state water pollution control agencies.

2. Should there be legislation authorizing new sanctions, procedures, and incentives?

   a. Are new sanctions required? Should interim fines be authorized for failure to meet the requirements of one stage of a multiple stage pollution order?

   b. Would it be better to concentrate all water pollution enforcement (injunction) actions in the Dane County Circuit Court so as to build a base of judicial expertise in this complicated field? Should private pollution abatement actions also be restricted to this court? Should the burden of proof in private plaintiffs be lessened? Should there

be provision authorizing the court to call on the state pollution agency as a master in chancery in such private cases?

c. Should there be at least one attorney from the attorney general's staff assigned full time to water pollution work?

d. What about so-called effluent charges - should the legislature authorize their use, at least on an experimental basis? The idea here is to charge the polluter for the privilege of using public waters for the discharge of his wastes. The more harmful the pollutants, the higher the charge. How should such charges be fixed, and how and by whom administered?

e. What about quick tax write-offs and other subsidies? Should Wisconsin move further in this direction? If so, what should be the criteria? And, what educational program and what procedures do we need to assure that such subsidies will work more successfully in the future, than have past tax write-offs and partial exemptions?

f. Should there be special procedures for fixing of stream quality criteria required by the Water Quality Control Act of 1965?

g. What, if anything, can be done to improve "follow through" to achieve compliance with pollution orders? Would it help to establish a procedure to convert such orders into court injunctions as a matter of course?

Conclusion

In both these areas of Shoreland Uses and of Water Quality Management, I see challenges for people engaged in extension and adult education activities. In my own state we are hoping extension personnel will be the principal liaison between the state and local units so far as concerns shoreland and flood plain regulation. A major job of education needs to be done to get people to accept the kinds of shoreland controls I have mentioned, to get people to respect and protect shoreland

amenities. And, in the field of water pollution generally people are in great need of information and help. Public support behind pollution control orders will in the long run prove to be the most effective "sanction."

How will extension people respond to the challenges which are implicit in the demands of our people for water based recreation and for a decent and attractive environment in which to live?

WATER DEVELOPMENT POLICIES - CORPS OF ENGINEERS

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The water development policies applicable to the Corps of Engineers' civil works program have evolved over many years but the most significant and controlling aspects of present policies are of very recent origin. The shift from a predominantly navigation orientation began in the late 1920's with the initiation of the "308" reports which outlined the possibilities for development of the nation's rivers for flood control, hydro-power and irrigation as well as for navigation. Following the major flood control and multiple purpose legislation of 1936, 1938 and 1944, there was intensive reexamination in Congress and in the Executive Branch of Federal water policies. The inter-relations of many water and other resource uses were increasingly recognized in the Fish and Wildlife Coordination Acts of 1946 and 1958, in water pollution control legislation in 1948, 1956, 1961 and 1965, in the Water Supply Act of 1958, in the recreation and conservation legislation of 1963, 1964 and 1965.

The net effect of the major legislative and administrative actions of recent years has been to produce an aggregation of Federal water and related land use policies which is fairly complete and definitive but is not entirely coordinated and consistent.

The attached reading list contains references to recent reviews of the evolution of Federal water policies (Items 1, 2 and 3). The purpose of this paper is to summarize the current Federal policies governing the water resource planning activities of the Corps of Engineers and to discuss policies applicable to development of water and related land resources for various purposes that may be served or affected by Corps of Engineers' projects.

The most significant, and most recent, water policy development is the Water Resources Planning Act of 1965 (Public Law 89-80). Under this act, there has been established a Water Resources Council, consisting of the Secretaries of Agriculture, Army, Health, Education and Welfare and Interior and the Chairman of the

Federal Power Commission.

The Council has the two principal duties of formulating the policies to be followed by Federal agencies in planning and developing water and related land resources and of reviewing the plans developed regionally for those purposes.

The act recognizes the need for plans that encompass the possible actions by all levels of government and private initiative in the management of water resources. It provides for financial assistance to improve the states' potential for water planning and for the establishment of river basin planning commissions composed of State and Federal regional representatives.

The new Water Resources Council provides an important new opportunity for improving the formulation and implementation of Federal water policies. This is illustrated in the policies, standards and procedures which have been printed in Senate Document 97, 87th Congress (Reading List Item 4). The S. 97 policies were jointly recommended by the Secretaries of Agriculture, Army, HEW, and Interior as an ad hoc council before passage of the Water Resources Planning Act. The policies were approved by the President on May 15, 1962.

The S. 97 policies and standards now provide a common basis for Federal agencies in the formulation, evaluation and review of plans for development of water and related land resources. This tends to reduce differences in practices which were possible under the various legislative authorities which evolved at different times for different purposes and permitted a wide range of interpretation and application by the agencies on similar problems.

The new standards call for a comprehensive and long-range viewpoint in planning with full consideration of all types of water demands and development possibilities.

The standards are generally consistent with the "Green Book" originally developed in 1950 (Reading List Item 5). Initial plan formulation and evaluation are to follow precise principles based on tangible values. The extent of departure from optimization of monetary values necessary to give weight to intangible or unevaluated factors is to be clearly outlined.

The standards also stress the need for outlining and presenting to decision-makers alternative solutions in order that variations in objectives, policies, timing

and other factors may be considered in adopting plans for action.

Thus, a much improved basis for plan formulation has been officially adopted and is becoming increasingly reflected in the plans currently being presented by the Corps of Engineers for consideration by the Congress.

Policies for cost allocation and cost sharing were not covered in detail in the S. 97 statement. These matters are scheduled for intensive future analysis under the Water Resources Council. Since the issuance of the original "Green Book" in 1950, it has been the practice in the Corps to allocate costs among the purposes of a multiple-purpose project in accordance with the "Separable Costs--Remaining Benefits" method except in special cases where it is considered that more equitable results are obtainable by some other method. In the remainder of this statement, the current cost sharing and related policies applicable to the various water uses in the Corps of Engineers' program are outlined.

Commercial Navigation

The Federal Government generally bears the entire construction costs of commercial navigation projects and operates and maintains the projects. Aids to navigation are fully Federal.

Non-Federal interests are generally required to provide terminal facilities, dredging in bathing areas, and the necessary lands, easements, rights-of-way and spoil disposal areas with retaining dikes, therefore, make necessary alternations or relocations of utilities; participate in bridge changes under the Truman-Hobbs Act of 1941 as amended; and make a cash contribution for special benefits, as in "single-user" cases, or for land enhancement due to fill from dredged spoil from project areas.

Recreational Navigation

The Federal Government will assume not more than 50 per cent of the construction costs of the general navigation facilities (breakwater, entrance and main access channels, and public anchorage basins) serving recreational craft, and 50 per cent of minimum basic on-shore recreational facilities, such as parking, picnicking, safety and sanitary facilities. Operation and maintenance of the project structures and areas, and provision and maintenance of navigation aids may be entirely at Federal expense but non-Federal interests

are encouraged to take over maintenance and operation of shore facilities whenever possible.

Non-Federal interests are required to provide 50 per cent of the construction costs allocated to recreational navigation and on-shore recreational facilities, and all lands, easements, rights-of-way, a public wharf open to all on equal terms, and all servicing and self-liquidating facilities, including dredging in bathing areas, and necessary policing and other services.

Flood Control

Current flood control cost-sharing is based on the provisions of the 1936 Flood Control Act as amended by the Acts of 1938 and 1941.

The Federal Government generally assumes the entire cost allocable to flood control in reservoir projects and the construction cost of local protection projects.

The general Federal policy on local cooperation for flood control, repeated in each of the authorization Acts since 1936, provides that construction of local protection projects shall not be undertaken until States, political subdivisions thereof, or other responsible local agencies have given assurances satisfactory to the Secretary of the Army that they will (a) provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction of the project, except as otherwise provided herein; (b) hold and save the United States free from damages due to the construction works; (c) maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army. These are known as the "a-b-c" provisions.

A special cash contribution may be required of non-Federal interests in cases where appreciable enhancement (increased land utilization) benefits of a windfall nature are expected with the project. This contribution is generally 50 per cent of the project allocable to such enhanced use.

Small Flood Control Reservoirs

When small reservoirs serve in lieu of other types of local protection measures or the benefits are concentrated in one locality, consideration is given, on a case by case basis, to requiring non-Federal interests to share in the costs to an extent similar to the requirements for local protection projects.

Major Drainage

Construction costs, including lands, allocated to major drainage are shared on a 50-50 basis, with non-Federal interests required generally to contribute their share in cash or equivalent work, as well as providing the rest of the usual "a-b-c" provisions of local co-operation.

Irrigation

When irrigation is a function of a Corps reservoir, costs allocated to irrigation are recovered by the Bureau of Reclamation in accordance with Reclamation Law.

Hurricane, Tidal and Lake Flood Protection

The Flood Control Act of 1958 authorized several hurricane flood protection projects, with the Federal Government to bear 70 per cent, and non-Federal interests to bear 30 per cent of the total first costs of projects for this purpose. The total first costs for cost-sharing include all construction, lands, easements, rights-of-way, and relocations. When the cost of land, easements and rights-of-way amount to less than 30 per cent of total first costs, non-Federal interests provide these items plus a cash contribution; when they exceed 30 per cent, they become the minimum requirements. Depending on the nature of the works involved, part or all of certain items of operation and maintenance, which would normally be borne by non-Federal interests, may preferably be performed by the Federal Government (such as operation of navigation gates in hurricane barriers.) In such cases, non-Federal interests may be required to contribute additional costs equivalent to their responsibility for future operation and maintenance costs.

Hydroelectric Power

The costs allocated to the hydroelectric power function in Corps of Engineers' multiple-purpose projects are repaid by the beneficiaries through the medium of the rates set by the Federal power-marketing agencies with the approval of the Federal Power Commission for sale of power. The marketing agencies of the Department of the Interior and the Tennessee Valley Authority are consulted on the marketability of project power during investigations.

Water Supply Storage

Where storage for municipal and industrial water

supply is made available by multiple-purpose projects, water users are required to pay the cost allocated to such storage. The Water Supply Act of 1958 (Title III, Public Law 85-500), approved 3 July 1958, provided that State or local interests contract, or give assurances that they will contract, for the use of such storage on a basis which will permit paying out the costs allocated to water supply within the life of the project and within 50 years after the water supply storage is first used. Water supply costs to be repaid by non-Federal interests include interest at a rate prescribed annually by the Secretary of Treasury. Where water is not used immediately for water supply, no interest on the investment is charged until use up to a period of 10 years.

Water Conveyance Facilities

Costs allocated to water conveyance are assigned to non-Federal interests except for such portions as may equitably be assigned to the Federal Government, as, for example, where a Federal installation would be served, or for that portion used for widespread water quality control. Reimbursement provisions are same as for water supply storage except that there is no waiver of interest awaiting future use. Maintenance and operation are the responsibility of the non-Federal interests.

Water Quality Control

The Federal Water Pollution Control Act of 1961 (P.L. 87-88) amended P.L. 660-84th Congress to include storage in Federal projects for regulation of stream flow for water quality control under certain criteria, with Federal assumption of the costs if the benefits are widespread or national in scope. These conditions include interstate and geographical considerations, type of pollutants, availability of alternative solutions, distribution and costs of pollution abatement measures for which stream-flow regulation is a necessary supplement, number and diversity of beneficiaries, and special Federal interest areas.

Outdoor Recreation at Reservoirs and Navigation Projects

The Federal Water Project Recreation Act of 1965 (P.L. 89-72) provides, subject to a statement of intent by non-Federal interests to cooperate in an agreed-upon plan for development of recreational facilities at a reservoir and navigation projects, that the Federal Government may assume not more than 50 per cent of the separable costs of including recreation and fish and

wildlife enhancement as a project purpose, plus all of any joint costs allocated thereto. Non-Federal interests must also agree to administer the recreation facilities. In the absence of local expression of intent to cooperate as above, no recreation facilities would be provided except incidental to other purposes or as a minimum for public health and safety at pre-existing access points.

Fish and Wildlife Conservation

The costs of remedial measures that are economically justified for the mitigation of project-caused damages to fish and wildlife are allocated to the project functions involved, and borne in an equitable manner by the interests concerned with those functions. The allocated costs of justified measures for the conservation and enhancement of fish and wildlife may be borne by the Federal Government when they are parts of a national or basin program for fish and wildlife development in accordance with the Fish and Wildlife Coordination Act of 1958 (P.L. 85-624) as determined by the Federal and State conservation agencies.

Beach and Shore Protection

Federal assumption of costs in shore and beach protection may be recommended in accordance with the following:

Shore Category[1]	Maximum level of Federal Aid	
	Construction	Maintenance
I Federally owned	100%	100%
II Publicly owned, non-Federal parks and conservation areas[1]	70%[1]	None
III Publicly owned, non-Federal other than parks and conservation areas	50%[1]	None
IV Privately owned, where protection will result in public benefits	50% Multiplied by the ratio of public benefits along Cat. IV shore to total benefits along Cat. IV shore.	
V Privately owned, protection will not result in public benefits susceptible of evaluation	None	None

[1]Cost-sharing percentages do not apply to lands, easements and rights-of-way.

Interest Rate Practices

When evaluating benefits in terms of the costs of the alternative that would be used to realize the benefit in the absence of the water project, the interest rate (private or public) this would be relevant to the alternative is used. (Paragraph V-D-2, Senate Document 97, 87th Congress).

In discounting future or projected costs and benefits, for inclusion in plan formulation and evaluation, the discount rate used is that prescribed annually by the Treasury and is based on the average rate of interest payable by the Treasury on the interest-bearing marketable securities of the United States outstanding at the end of the fiscal year preceding such computation, which, upon original issue, had terms to maturity of 15 years or more. The computed average rate is rounded to the next lower 1/8 per cent. (Paragraph 7-2, Senate Document 97, 87th Congress). For water supply reimbursement the same formula is used but the computed average is not rounded.

The current prescribed interest rates for Fiscal Year 1966 are:

For plan formulation	3 1/8%
For reimbursement of water supply costs	3.222%

Period of Analysis

Current Corps policy in project formulation and evaluation is to analyze reservoirs and mainline levee protection on the basis of a 100 year useful life and all other water resource purposes on a 50-year basis, or less if appropriate.

Reading List

Schad, T. M. 1962, "Perspective on National Water Resources Planning." J. Hydraulics Div., Proc. Am. Soc. Civ. Engrs. 88 (HY4): 17-41.

Weber, E. W., and M. M. Hufschmidt. 1963. "River Basin Planning in the United States." In Science, Technology, and Development--United States papers prepared for the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas: Volume I, Natural Resources: Energy, Water and River Basin Development. pp. 299-312. U.S. Govt. Printing Office, Washington, D. C.

Weber, E. W. 1964. "Comprehensive River Basin Planning--Development of a Concept." Journal of Soil and Water Conservation, July-August, 1964. pp. 133-138.

President's Water Resources Council. 1962. "Policies, Standards, and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources." Senate Doc. No. 97, 87th Congress, 2d Session. U.S. Govt. Printing Office, Washington, D. C. 13 pp.

Federal Inter-Agency River Basin Committee, Subcommittee on Benefits and Costs. 1950. "Proposed Practices for Economic Analysis of River Basin Projects." U.S. Govt. Printing Office, Washington, D. C. 85 pp. (A revised version under the same title was published in 1958 by the Subcommittee on Evaluation Standards, Inter-Agency Committee on Water Resources. Commonly referred to as the "Green Book" and available from the U.S. Govt. Printing Office, Washington, D. C., it was 56 pages in length.)

PRESENT WATER DEVELOPMENT POLICIES

DEPARTMENT OF THE INTERIOR

Robert W. Nelson
Deputy Assistant Secretary of the Interior
Water and Power Development

You asked that my discussion here today on water policy include such things as a reconciliation of conflicts in the use of water, cost-sharing policies of the Federal Government, and repayment. In reviewing the program schedule, I noted that I was to follow Eugene Weber representing the Corps of Engineers. In order to avoid unnecessary duplication, Gene and I agreed to divide the subject between us. It seemed logical to us that since he was first on the program, and since the first stage in water resource development is the formulation and justification of a project, that he should discuss these subjects with you, and that I should cover those matters relating to cost allocation and repayment.

Before doing so, however, I should like to make two observations. First, the problem of reconciling conflicts for the use of scarce resources, which Mr. Weber has discussed, is most difficult. I suspect it may be even more difficult for the Department of the Interior than in other agencies. This is because Interior is responsible for a number of programs which sometimes find themselves in sharp conflict. These are the programs of the Bureau of Reclamation, the Fish and Wildlife Service, the National Park Service and the Bureau of Outdoor Recreation. Where conflicts are encountered in the development of water resources, particularly among these agencies, it is the Secretary's responsibility to harmonize the competing uses in the optimum manner. This obviously is a most difficult job. It is impossible to completely satisfy all interests. And they may be the subject of debate on occasion in the press and elsewhere. There are many cases, however, and I might add by far the majority, where such functions as water conservation, flood control, fish and wildlife, and recreation are harmoniously combined. Unfortunately, however, these are not the ones which are generally brought to the attention of the public at large.

My second point is that Assistant Secretary Holum, who is my immediate supervisor, is responsible for the policy supervision of five agencies in the Department.

These include the Bureau of Reclamation, which I have previously referred to, the Bonneville Power Administration, the Southeastern Power Administration, the Southwestern Power Administration, and the Office of Saline Water. The responsibilities of these agencies may be roughly grouped into three categories. These would include the development and conservation of our water resources, the marketing of hydroelectric power, and the development of the science and technology of desalting water.

The Bonneville Power Administration, the Southeastern Power Administration, and the Southwestern Power Administration are all power marketing agencies. The Bureau of Reclamation, which is the primary water resource development agency of the Department, also markets power in most of the 17 Western states. The northwestern states, which are served by the Bonneville Power Administration, is the major exception.

By congressional direction, the Department of the Interior markets all power produced at all Federal projects, except in the TVA area. It also markets irrigation water in the 17 Western states produced at its own projects as well as those of the Corps of Engineers. The Corps of Engineers and the Bureau of Reclamation both market water for municipal and industrial purposes. Also, both of these agencies are responsible for securing reimbursement as required under the Federal Water Project Recreation Act which was approved by the President in July of this year.

I believe this background is important so that you understand that the Corps and Interior agencies are deeply involved in matters of repayment of Federal projects.

Repayment requirements for the various functions included in Federal projects vary from one function to another. Municipal and industrial water, as well as commercial power, are reimbursable with interest while irrigation is reimbursable without interest. Part of the costs for fish and wildlife and recreation are reimbursable with interest. To the extent the beneficiaries can be identified, the function of water quality control is subject to reimbursement. Flood control has traditionally been considered to be nonreimbursable. However, I should point out that some repayment in the form of cost-sharing is required for local protective works.

Cost Allocation

Because of the variation among functions in the

reimbursable requirements, or the cost-sharing arrangements as many people now refer to them, it is necessary to allocate the construction costs of multiple-purpose projects. Much has been written on the subject and some people are prone to despair that there is no prospect of ever devising a procedure which will result in an equitable sharing of both the cost and savings resulting from multiple-purpose construction. The initial efforts in this direction were based upon the use of physical criteria such as use of space or use of water. However, it soon became obvious that there was little if any relationship between such physical criteria and the actual benefits derived from the functions involved. For instance, flood control space may be held vacant in a reservoir in anticipation of a flood for many years before it is actually used. On the other hand, irrigation water from a reservoir might be used every year. Also, the physical criteria approach did not provide a common denominator for all functions. Some required empty storage space, some required a full reservoir, and some were served by water as it was withdrawn. It was because of the difficulty associated with the use of physical approaches that attention was subsequently turned to the possibility of allocating costs on the basis of economic criteria or benefits. However, experiments with the procedure soon revealed that the benefit approach might be secured in alternative ways more economically, and also, in spite of efforts to develop uniform procedures for the evaluation of benefits among functions, there are still some substantial differences.

After having experimented with both of these procedures, attention was given to the possibility of using a method which involved a combination of physical and economic criteria. The procedure now in use by most Federal agencies involves such an approach. It is referred to as the Separable Costs Remaining Benefits method, and I confess, is as complicated as the name suggests. I will not attempt to explain it in detail except to note that under the procedure the maximum allocation to any function is limited by the lesser of the benefits or the alternative cost of serving that function. On the other hand, the minimum allocation to any function is based upon the separable costs or the amount of cost that could be eliminated from the project if the particular function were eliminated. The application of this procedure, if done correctly, is complicated and time-consuming. Many people have suggested that the detail involved is not warranted by the accuracy of the data used, particularly in the benefit eval-

uation. Others have suggested that even more precise allocations could be secured. These would even be more detailed and time-consuming than the present procedures. In general, I believe refinement can be made in the area of cost allocation but even so the procedure could even then not be referred to as an exact science.

Since the Department of the Interior is responsible for marketing the services of certain functions provided by the Corps of Engineers projects, namely, power and irrigation water, questions have been raised from time to time about who should be responsible for preparing the cost allocations. At the present time it is generally agreed that the construction agency is responsible for allocating the costs on its own projects. With general agreement on procedures, this question of responsibility is not as important as it once was. It should be recognized, however, that even though there is now agreement on general methods, there are variations among the agencies in detail of application.

Repayment

Having made the allocations the question of repayment is then involved. Since the reimbursable requirements vary considerably from function to function, I shall explain these in some detail.

Let us take irrigation first. In general, irrigation costs are reimbursable in 40 years without interest. Some of the more recent authorizing acts have provided for reimbursement in 50 years. The Reclamation Project Act of 1939 provides that charges to water users shall be based upon their payment capacity. This involves a determination as to how much the irrigators could logically be expected to pay after taking into account their prospective income and expenses, including family living. In those cases where the prospective payment capacity is not adequate to assure repayment within the number of years allowed by the Congress, other sources of revenue may be used if they are available. The 1939 Reclamation Project Act, for instance, provided that after payout of the power and municipal and industrial water investments, revenues from those sources may be used to assist in the repayment of other functions including irrigation.

Also, in connection with irrigation repayment it should be noted that the 1939 Reclamation Project Act provided for the use of both repayment and water service contracts. A service contract is comparable to a telephone service charge. An annual payment is made for a

specific service. The repayment contract on the other hand involves the repayment of the total reimbursable construction cost. In general, water service contracts are used where we are only supplying water and not constructing distribution works. On the other hand, the repayment contracts are generally used in those instances where we have built distribution works to serve specific pieces of land. In these cases, it is necessary to have a repayment contract prior to the initiation of construction to protect Government investment. After construction is initiated, the Government finds itself in a poor bargaining position.

Perhaps a word or two about contracting organizations would be of interest to you. Initially, the irrigation repayment contracts were negotiated with individuals. However, our efforts now are to negotiate such contracts with large, legally established organizations representing the water users. These organizations take the form of irrigation districts, conservancy districts, or in some cases irrigation associations. Contracting with such an organization simplifies the administration associated with the contract and consolidates management of the completed irrigation facilities in a large, efficient organization.

Next, let us look at commercial power. Compared to irrigation, the law provides very little guidance for repayment of the commercial power investment. Except in the case of a few specific projects, there is no general requirement of law which establishes the number of years allowed for the repayment of the power investment, nor is there any general over-all criteria which establishes the interest rates to be used in amortization of that investment. In the absence of such specific criteria, we are guided by recent authorizations in which the Congress has indicated that it desires the investment in commercial power be repaid within 50 years and at an interest rate specified in the Water Supply Act of 1958. This interest rate is "the computed average interest rate payable by the Treasury upon its outstanding marketable public obligations, which are neither due nor callable for redemption for fiteen years from the date of issue." This rate has been going steadily upward. In 1950 it was 2.551%. It is currently 3.222% and appears to be on the rise over the next several years.

In the early years of Federal participation in the power program, repayment contracts similar to those used for irrigation were used. In other words, after

repayment, the power projects were turned over to the users and the revenues from that project were available for any purpose the owners wished to make of them. However, this policy was changed some time ago and now power is marketed on a service contract basis. The right to the continued output rests with the United States. Under the service contract approach, after the initial costs are returned, the revenues which continue to be available can be used to finance the development of other power projects or other functions of related projects, such as irrigation. This change from a repayment to a service contract constituted an important step in the development of Federal power policy. As you may know, the law requires that preference be given to public bodies and cooperatives in the marketing of power produced at Federal projects.

Perhaps I should point out that the time will soon arrive when most of the base power loads are met from steam generation, including both fossil and atomic-fired plants. This has let some to believe that a continuing requirement for hydroelectric power no longer exists. However, it should be noted that steam generating plants are most efficient when operated on a continuous basis. They are not suited to meeting loads of short durations or what we call "peaking power" requirements. Hydroelectric powerplants which can be turned on and off at a moment's notice are best suited for this. Therefore, the development of atomic-fired steam generating plants will in the long run, we believe, create a growing demand for more hydroelectric power generating capacity. One example of this is, of course, the pumped back storage projects that are being constructed by the private utilities.

In recent years much consideration has been given to the possibility of interconnecting major Federal power systems to take advantage of hydraulic and electrical diversity in those systems. In 1964 the Congress authorized an enormous extra high voltage intertie between the Bonneville Power Administration system and Federal, private and public systems in California and the Pacific Southwest areas. This interconnection adds considerably to the ability to meet peak loads and make possible much fuller utilization of all the power resources in the Pacific Northwest - Pacific Southwest area.

The third item is municipal and industrial water. Here once again Congress has not established specific rules for reimbursement, so as in the case of hydro power

we are guided by certain authorizations. As a general rule, investments in M&I water are scheduled for repayment in 50 years with interest, and the same interest formula is used as that for commercial power.

The Water Supply Act of 1958 provided authority to add capacity in storage reservoirs for anticipated future use and also to forego interest on 30% of the cost of the project for a period of 10 years. The law is not clear on whether or not the total allocation to municipal and industrial water should be repaid within 50 years after the water service becomes available, or in 50 years after the extra capacity built in anticipation of future needs is put to use. To date, Interior contracts have been based on the assumption that even where extra capacity is provided, it is necessary to accomplish repayment in a 50-year period after service becomes available.

Both repayment and water service contracts are used for M&I water. However, we are now considering the possibility of using only service contracts similar to the practice with commercial power.

An interesting aspect of M&I water is the changing use that occurs over time. Many projects that start out as irrigation are subdivided and become suburban areas. Water originally provided for irrigation at rates based upon ability to pay is thus converted to municipal use. Continued repayment of these costs without interest is, we believe, inconsistent with the repayment policies applicable to municipal and industrial water. Procedures to eliminate this inconsistency are currently under study.

The last repayment category is Recreation and Fish and Wildlife. The Federal Water Project Recreation Act passed July 9 of this year provided that one-half of the separable costs in addition to all of the operation and maintenance costs on such facilities, be repaid within 50 years at interest rates applicable to other functions. The Act provided several ways in which the repayment could be accomplished, including contributions of land and land rights, complete repayment at the time of construction, or an operating agreement by which the operating entity agrees to charge user or entrance fees and dedicate a portion of that fee to the amortization of the capital costs. Where this is done, the Federal Government will provide, on a nonreimbursable basis, the other half of the separable costs and all of the costs of the joint facilities which are allocated to recreation and fish and wildlife. This act is so new

that we do not as yet have any experience in its application.

The Federal agencies have been working for the past 10 or 15 years in the development of uniform procedures for use by all the agencies in carrying out the Federal water resource program. In this regard, it should be noted that the Federal Water Resources Planning Act, which was enacted on July 22 of this year, established a Water Resources Council, which is composed of the Secretaries of Agriculture; Health, Education, and Welfare; the Army, and the Interior; and the Chairman of the Federal Power Commission. One of the responsibilities of this Council is the further development of uniform standards and procedures for use by the agencies.

The water resource policies of the Federal Government have been subject to a continuous evaluation as the nature and scope of those programs have changed. As we look into the future and contemplate the possibility of large-scale, inter-regional movements of water, dual-purpose desalting and powerplants, reclamation and reuse of sewage waters, more extensive use of ground water, weather modification, and increased requirement for aquatic oriented recreation, there may be many other changes in Federal water policy.

PRESENT WATER DEVELOPMENT POLICIES - SOIL CONSERVATION SERVICE

Gladwin E. Young
Associate Administrator
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U. S. Department of Agriculture

It is a pleasure for me to return to the Purdue Campus where I registered as a student 46 years ago this fall. During the 16 years here as a student and as a member of the staff of the Agricultural Experiment Station, I cannot recall any attention directed toward water problems. Certainly there was no concern then with public policies related to water.

This is not difficult to explain and certainly needs no defense. We had some pretty big floods on the Wabash and its tributaries, but in those days nothing could be done about that. But, now something is being done about it. This institution and the two cities dumped their raw sewage into the Wabash, like all other urban communities. Now something is being done about that, too.

The big woods and swamp that provided summer flow for the swimming hole on a tributary of the Wabash where my brothers and I learned to swim was drained and cleared during that period and the swimming hole has long since silted full. Now something is being done about erosion control and water storage in small watersheds all over the Nation.

Until about the last two decades the Department of Agriculture and the Land-Grant Universities had not included water resource planning and development as a subject for their concern. Now it is a subject of major concern.

Protection and Development of Water Resources-- A Public Problem

Freedoms have always been related to abundance of natural resources. Limit those resources and you limit freedoms.

The truth of this is made clear whenever problems of water supply confront more and more communities.

The shortage of usable water in the Northeastern

states in recent months provides dramatic demonstration of regulations imposed on freedoms to use water.

The water shortage in that area, as in most areas, is due to failure to make investments in planning for storage of adequate water and failure to make the necessary investments for pollution control. A few years of sub-normal rainfall put many cities in trouble.

The available supply of fresh water in the United States is adequate to meet foreseeable demands from the expanding population--but not without great investments in water resource planning and tremendous increases in surface water storage, in major distribution systems and certainly in pollution abatement.[1]

We have long considered water as a "free good." As "free as the air." All we had to do was to pump it or pipe it. Our rivers have been city sewers and at the same time a principal source of water.

But from now on the costs of having water at the right place, at the right time in the right amounts, and of usable quality, are going to rise--perhaps as much as 10 to 20 times for some communities.

The Nation's Water Problems Begin on the Land

The nature of water problems frequently transcends solution by the individuals, by the communities, or by State governments.

This does not argue that, therefore, the solution to the nation's water problems rests with the Federal government. There is no one national water problem, unless it is stated as a general problem of managing the supply we've got. Our fresh water supply falls first on the land--our farms, fields, and forests that make up the watershed lands.

You can't manage water resources without managing land. If a program for water resources development begins only after water runs off into the rivers and reservoirs, much of the opportunity to make productive use of it has already been lost and much of the needed controls have already been bypassed.

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[1]Senate Report No. 29, 87th Congress, 1st Session, January 30, 1961. Report of the Senate Select Committee on National Water Resources.

Only a small proportion of the water that falls as rain and snow ever reaches the rivers and reservoirs.

Since the middle 1930's, landowners throughout the country have received assistance from the Department of Agriculture in carrying out programs of soil and water conservation. The nationwide program began with a focus on erosion control. These controls took the form of interrelated measures, including engineering and vegetative controls as well as shifting land to adapted uses.

For many years, landowners and professional agricultural workers have observed, and in some cases measured, the effects of such soil and water conservation practices on water leaving the farm.

Some early advocates had hoped that such measures would reduce flood damage significantly. While land damage from torrential storms was reduced, it was obvious to all that if floods even on the little tributaries were to be prevented, detention dams would have to be used, in addition to soil conservation practices, to control excess runoff.

Thus, 20 years after the nationwide soil conservation program was authorized, a nationwide program of Watershed Protection and Flood Prevention was authorized. The legislative history of the Act[2] explained that it was authorizing a program to fill the gap between the program of soil and water conservation on individual farms and the flood control program being carried out on the major rivers by the Department of the Army.

The Weather Bureau calculates the annual precipitation at 30 inches a year, if spread evenly over the surface of the 48 states. This amounts to about 4,300 billion gallons a day. The Geological Survey calculates that streamflow is the equivalent of about 8.5 inches a year, or about 1,200 billion gallons a day. This means that roughly 70 per cent of the total precipitation is used by crops, trees, and other vegetation, or is lost through evaporation or seeps into deep underground water. Only 30 per cent runs off into rivers and reservoirs.

Not only does management of surface water through management of land and vegetation have an effect on the nation's total available water, it also affects water quality and flood damage.

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[2]Watershed Protection and Flood Prevention Act, Public Law 566, 83rd Congress, as amended.

Sediment from soil erosion is still a principal source of pollution of water supplies. In volume it is greater than all other pollutants combined.[3]

Flood damage in the upper tributaries and small watersheds, while not as spectacular, is calculated to be as great as all the flood damage combined on the major rivers.[4]

As students of the evolution of public policies and public programs, you will want more perspective and background for these nationwide programs than I have given here. You will want to read two new books coming out of Resources for the Future.[5]

The Act, as it was passed in 1954, authorized essentially a flood protection program for tributary streams. To minimize conflicting authority for flood control already vested in the Department of the Army, the Department of Agriculture program was limited to watersheds of 250,000 acres or less in size, and dams with flood storage of 5,000 acre-feet or less. The Act very appropriately placed first importance on soil conservation measures on watershed lands. It recognized that sediment from eroding lands was a major hazard to water supplies and reservoir capacity.

Since its enactment in 1954, the Watershed Act has been amended eight times. None of the proponents of the Act in 1954, either professional people or Congressmen, would have risked his reputation to propose that Federal funds be authorized for storing water for recreation, and for fish and wildlife on farms.

Events in our national way of life, however, have since placed recreation, fish and wildlife, and now beauty of the countryside on a higher scale of values for more and more people.

While each watershed project must still meet economic criteria, including a favorable benefit-cost

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[3]Committee Print No. 9, Water Resources Activities in the United States, "Pollution Abatement," Select Committee on National Water Resources.

[4]PA-337, "Water Facts."

[5]"Soil Conservation in Perspective," by R. Burnell Held and Marion Clawson; and "Governing Soil Conservation," by Robert J. Morgan, published by John Hopkins Press.

ratio, the law now provides for sharing Federal and local costs on a 50-50 basis to build additional storage in watershed project reservoirs for recreation and for fish and wildlife purposes. Loans at favorable interest rates to local sponsoring organizations are available for all purposes of the watershed projects, including water for recreation and for municipal and industrial water supplies.

Recreational Use of Water

I do not want to bore you with a lot of figures, but I would like to point out that there are now 706 watershed projects approved for operation throughout the country. In these projects approximately 4,500 dams will be built or are already constructed, most of which will store water which will have limited recreational use. But of this number 160 dams are making provision for additional storage specifically for recreational uses.

This is a pretty small proportion with special provision for recreational purposes, however, it must be kept in mind that authorization to share costs for recreational purposes became effective only 1962. There is no doubt in my mind that the local sponsors will soon be asking themselves why they were not farsighted enough to include storage for recreational purposes, including fish and wildlife in all of these projects.

Out of the 706 small watershed projects, provision has been made for municipal and industrial water supplies in only 78 projects. In several of these cases, the communities almost passed up completely an opportunity to build into their projects additional storage for water supplies. Some projects have been amended at the last moment, and in every case the community is more than pleased with the benefits that are accruing from this additional investment.

In 150 rural communities, one or more rural industries have been brought in because of assured water supply and freedom from floods made possible by watershed projects. These communities have found that water resource developments and flood prevention provide a common denominator and an opportunity to join hands of rural and urban interests to bring about effective community development.

Without going into details of procedure for obtaining approval of watershed projects, or the organization of the Department of Agriculture to carry out

this program, I want to explain that watershed projects are sponsored by local units of government and are owned and operated by such sponsors. Eligible local sponsors are state governments or their subdivisions such as soil conservation districts, county governments, cities, or special districts. The Department of Agriculture assists the local sponsor to plan the project. Funds to install the project are made available to the sponsors on a cost sharing basis, or as loans made by the Farmers Home Administration. Decisions about including recreation or wildlife or industrial water must be decisions of local sponsors. The Federal Government cannot dictate this.

The Soil Conservation Service has the delegated responsibility within the Department of Agriculture for the watershed program. The Forest Service, the Economic Research Service, and Farmers Home Administration have assigned functions in their fields. In each state, the SCS State Conservationist has full administrative authority and responsibility for the watershed program in that state under policies laid down by the Administrator of the Soil Conservation Service.

The Extension Services in nearly every state have given significant help to local communities in getting organized, finding necessary community leaders and holding information meetings. After all, a lot of people have to make up their minds at the same time, or a project doesn't move.

River Basin Planning

The Department of Agriculture has been a major participant in river basin planning since this approach to water resource planning was initiated in 1943. Since that time the Federal Water Resource agencies have maintained an interagency coordinating committee at the Federal level, and river basin committees have been organized on many of the principal river basins with Federal and State membership.

Last July, the Water Resources Planning Act was signed by the President. In effect, this Act gives a statutory basis for continuing planning that was underway through voluntary agreements between Federal agencies and state governments.

I shall not attempt to give a digest of this Act, but from the standpoint of state participation, these provisions are pertinent:

When river basin planning commissions are formed, the governor of each affected state is to appoint a representative of his state government as a member of the Commission.

A sum of $5 million annually for 10 years is authorized to be made available to state governments to assist with preparation of state water resource plans and for training personnel.

River basin planning already underway will no doubt be continued either as now organized, or under the new organizational arrangement which provides for a chairman appointed by the President, a representative from each concerned Federal agency, and a representative from each state in the river basin.

Continued participation of the Department of Agriculture in river basin planning is expected to be guided by the same general policies and objectives that have guided past participation.

It is the intention of the SCS to continue emphasis on the interrelationship of land and water in comprehensive planning and in the development of watershed projects. The new Water Resources Planning Act makes full provision for this policy in wording of its purpose "to provide for the optimum development of the Nation's natural resources through the coordinated planning of water and related land resources....."

Problems Ahead for River Basin Planning

How comprehensive should river basin plans be is a question not yet defined in general policy statements or actual experience. However, general guidelines for river basin planning have been established by Presidential action and are published in Senate Document 97, 87th Congress. As we study that document we are convinced that the intended core of river basin planning is the determination of how the water and related land resources in all parts of a river basin shall be managed to serve the needs of all the people. Those needs include the reduction of flood and sediment damages, provision of water supply for municipal, industrial and agricultural uses, water quality control, fish and wildlife development, recreation, hydro-electric power, navigation, preservation of areas of unique beauty and the conservation and effective use of water from the time it falls on watershed lands until it reaches the oceans.

A comprehensive basin plan is not necessarily an appropriate focus around which all other resource developments or economic developments should be planned. The river basin plan should not be conceived as the master plan for all human activities for a geographic area. Of course, the impacts of water resource development on the total economy of a basin and on total national needs for goods and services are important. These impacts are analyzed and projections made for industrial development, agricultural production and economic growth in each region. Yet, each river basin plan is inherently a "piecemeal" plan from a national viewpoint. Comprehensive river basin plans do not necessarily represent the best over-all economic development plan for the Nation when added together. This is not to argue against river basin planning in favor of some super-planning device. We merely seek to establish recognition of the limits of river basin planning.

River basin plans should be formulated with appropriate consideration of the uses of land and the effects of management of both public and private land on water quality and quantity. Quantities and costs of soil and water conservation practices need not be estimated and presented in detail in river basin plans. But conservation of land and water should be set forth as a prerequisite for those phases of water management which would be adversely affected by improper land use.

Since a high proportion of the land is in private ownership, decisions about its use and management will be made by the millions of individuals who own it--not by public agencies. But public programs of education, technical assistance, cost sharing, credit and research need to be continued to help influence significant decisions.

By the same token, special efforts are needed to make certain that private interests are properly represented in the river basin planning process and in subsequent developments. Perhaps this can best be done by organized groups like the Wabash Valley Association here in Indiana and Illinois. The Extension Services can be effective in helping local interests to organize and effectively express their interests.

For what period of time should river basin development be planned is another pertinent question as efforts in river basin planning are expanded.

It is not realistic to attempt to prepare a blueprint for development for all time to come. "One shot"

comprehensive blueprint plans begin to be obsolete the day they are printed. No group of planners can reliably forecast needs, nor can they anticipate technological changes very far ahead. River basin planning must be a continuous process during the decades over which developments must actually extend. River basin plans must be flexible guides which are continually revised. Provisions must be made for periodic reviews by all interests, including the Congress.

How should competing purposes of water uses be decided?

Any realistic procedure for river basin planning must make provision for compromising conflicts of interests. Competing uses for water inevitably demand decisions about kinds of developments and these decisions must be based mostly on judgments. These judgments need to be expressed about the purposes or objectives of water resource developments before they are planned, during the time they are being planned and before they are finally built.

For example, judgment decisions are required to determine if flood control should be aimed at protecting the greatest number of acres, or the greatest number of people, or the greatest amount of property value, the greatest scenic values or some other predetermined goals. Levels of protection that should be provided for urban or agricultural areas require answers that must be largely based on judgment values. Judgment is required to make an appraisal between zoning the flood plain or protecting it for development. Such judgments involve more than strictly monetary considerations. A formula for maximizing monetary net benefits cannot supplant informed judgments in river basin planing, but can be a useful component of judgments.

Another example is the growing nationwide demand for water-based outdoor recreation. Is this demand best served in any river basin by one or more large reservoirs each with thousands of acres of water surface, by many smaller reservoirs each with 100 or so acres of water surface within a radius of 10 to 15 miles of every point in a river basin--or by some combination of such reservoirs.

Should an optimum plan provide a basis for more widespread dispersal of people and industry in contrast with fostering further concentration in metropolitan areas?

The concept of maximizing net monetary benefits from the national viewpoint does not give the answer as to whether the nation wants to retain one river in a wild status and one watershed as a wilderness, or to develop another river almost totally for industrial uses or another watershed for home sites or open space.

These are objectives dictated by judgments. Lay people are just as well equipped--or even better--to render judgments in these matters as are the "expert" water resource planners and developers.

The new Water Resources Planning Act authorizes Federal funds to be allocated to state governments to make water resource plans for each state.

This will give an opportunity for soil conservation districts, state soil conservation committees, extension services, and state agencies administering programs for parks, fish and wildlife, recreation, water resources, and for associations of special interests to participate directly in the planning process.

Under the provision made for water resource planning by river basin commissions, interest groups must reflect their positions either through their representative of state government, through one of the Federal agencies, or to the Commission as a whole.

This in no sense means that interest groups will not be heard or heeded. No public agency exists very long if it fails to tune in on public opinion. Specific provision is made in the new Act that minority views shall be made a part of planning reports. This means that Congress will arbitrate any conflicts that the Commissions may not be able to.

While river basin planning is probably still in a trial and error stage, the Federal government, with support of state governments, has decided to continue and expand the efforts to develop plans for all major river basins.

In summary, I should like to re-emphasize these points: The Department of Agriculture will continue to see to it that the interests of rural communities be kept in proper perspective in the Nation's programs of water resource development.

The two million stock ponds and small watershed dams on farms and ranches throughout the Nation are as much a part of effective water resource development as are the few hundred spectacular large reservoirs. One

does not replace the functions of the other. Both are needed. The Nation's program of water resource development must begin on the land.

To make full use of our water resource we must use it over and over from the time it falls on watershed lands until it reaches the oceans. Since the quality of water and rates of runoff are affected by the way land and vegetation is managed, water resource development must be participated in by millions of private owners of land--not just by State and Federal governments and public agencies.

Increased demands for use of water for recreation and for fish and wildlife are very real and are generally not incompatible with other uses. To meet these demands will require specific provisions for these kinds of developments in the thousands of impoundments in watershed projects throughout the country. Local interests who must put up part of the costs will continue to be guided by relatively short-time direct benefits.

River basins provide a logical unit for over-all planning for water resource development, but the planning process has not yet reached a high degree of perfection. Greater involvement is needed of more and more informed people in judgment decisions about objectives and purposes of public programs for water resource developments.

The Department of Agriculture will continue to look to the Agricultural Extension Services for contributions to these objectives.

PRESENT WATER DEVELOPMENT POLICIES - PUBLIC HEALTH SERVICE

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The development of water resources as an aid to the economy has been advocated and practiced from the earliest times of the Nation. The first manifestation of the practice concerned the improvement of the waterways for navigation to open the country for settlement and for trade as well as for military reasons and to unify the Nation through more effective communication. The expected favorable effect on the "economy" was regarded as the convincing factor in these navigational undertakings.

A detailed historical account of governmental activity in this realm will not be given here. It will be sufficient to sketch the long evolution of water resource development policy. Debate and controversy over the nature and extent of governmental activity in water resources, particularly Federal government activity are recorded at every step in the policy evolution. The earlier forms of the debate concerned the constitutionality of Federal activity in "internal improvements"; that is, in roads, canals and waterways.

For instance, President James Monroe vetoed the Cumberland Road Bill in 1822. He did not question the economic validity of the Road; he doubted whether the U. S. Constitution permitted the Federal Government to perform the tasks ordered by the Congress.

A multiple series of events including westward expansion, emigration, wars, the transcontinental railroads, the growth of large cities, economic depressions, the advent of the automobile and the highway, industrial growth, and technological change interacted to produce conditions which required more skills, adjustments and organization to assure the well-being and orderliness of society. The scope and direction of government were

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greatly affected by these events. New constitutional interpretation facilitated the insistence of many groups that action by the Federal government was necessary. Consequently, there was increased Federal participation in navigation projects, and new activities were begun, such as irrigation under the Reclamation Act of 1902 and the various flood control measures resulting from the vast floods of the late 1920's along the Mississippi and Ohio Rivers.

The increase and expansion of Federal activity did not diminish State authority for the new laws required participation of the States in both the planning and financing of the efforts. Indeed, the pattern of Federal-State collaboration that was begun in the navigational efforts of the early 19th Century was continued and expanded by these new Acts. A prominent example of the early Federal-State relationship is recorded in the construction of the canal through the Great Dismal Swamp of Virginia to Albermarle Sound in North Carolina in the 1820's. Explicit economic arguments were used in justifying the effort; that is, the proponents asserted that the canal would facilitate commercial development and in time pay for itself in tolls.

Private interests began the canal in 1818 but had insufficient capital, and so the Commonwealth of Virginia and later, the Federal government provided financial aid. Technical assistance in planning, construction, and management was provided by the U. S. Army, Corps of Engineers. This pattern of Federal-State relations is referred to by students of constitutional law and government as "cooperative Federalism." It was incorporated in the statutes authorizing the new activities and expanding the older ones.

The wider scope of Federal activity in navigation, irrigation, and flood control provided impetus for new views of the situation. The logic and technical feasibility of considering the several objectives together led to multiple-purpose project development on the basis of entire river systems or drainage basins. In other words, account was taken of the hydrologic and physical unity of the major river systems and other drainage basins such as lakes and bays. It was recognized that these could be managed as units to offset problem conditions and to produce deliberately chosen results. The concept became known as comprehensive development because of its wide geographic view and inclusion of the complete range of water-related problems.

This comprehensive frame of reference led to additional legislation which permitted the waterways to be developed in the ways the public planning and decision processes found to be desirable. The new legislation, accumulating over a period of more than 30 years, authorized development for electric power, for municipal and industrial water supply, for fish and wildlife enhancement and recreation, for small watershed management, and for water pollution control. Each of the statutes and programs constituted a renewal of the expression of faith that man can cope with nature and control its furies and direct its energies to his desires. Put another way, the legislation indicates that the rivers are viewed as natural resource assets similar to coal, iron, and uranium. They await man's ingenuity, skills and conviction as to the form and manner in which they will be developed.

Much of the direction and momentum that produced this legislation and the programs adopted under its authority was provided as the result of the findings and recommendations of several major studies and numerous smaller ones. The water and land studies of the National Resources Planning Board and its predecessor planning agencies of the mid-1930's, the 1950 report of the President's Water Policy Commission, the 1955 report of the President's Advisory Committee on Water Resources Policy, the individual reports on major drainage basins such as the Arkansas-White-Red, the Missouri, the New York-New England, and the Delaware, and the recently concluded commission studies of the South-Eastern and Texas basins, as well as the 1960 report of Senator Kerr's select committee on national water policy, each emphasized the necessity and desirability of development and management of the water bodies, not only for man's present activities, but with explicit regard for the future.

Especially noteworthy in each of these reports is the fact that they state or suggest in one way or another that the water resources must be developed not only to accompany or to facilitate changes in the economy but that they also can shape or influence the economy.

This viewpoint was reiterated most recently in the program proposed to improve the economy of the Appalachian region. That program urged the development of the water resources as a major impetus to growth. The viewpoint has also been incorporated expressly in the official standards for planning Federal water resources. The standards require consideration of

national, regional, state, and local viewpoints for full resource development by major river basins, blending the hydrologic and physical situations with the economic and with all feasible purposes being evaluated and included for development according to how they fare under benefit-cost analysis.

Therefore, with the establishment of this comprehensive frame of reference, the questions to be raised in regard to water resources involve how the resources should be developed, in which basins or rivers, for what purposes, at what rate, at what scale, by whom, at what cost, and who will pay, and in what manner. The questions are not solely economic in nature; they are basically economic, however, but as is apparent, the economics of the situation becomes the politics of the situation.

The process of answering these questions begins with an appraisal of the physical and hydrologic capabilities of the waterways in relation to the existing pattern of economic activities in the basin. Though the basin is a distinctive hydrologic and geographic unit, it is not a distinctive economic unit. Basin economics diffuse into and are a part of the national economy. That is, the volume of economic activity in a basin is influenced strongly by the demand for goods and services throughout the Nation, for the basin economic activity contributes to and participates with economy. This basin-nation economic interrelationship applies to agricultural production, mineral and timber production, manufactured goods, to recreation, and indeed to every phase, for the mail-order catalog brings even retail sales within this scene. Conceived in another way, the basin economy is involved in the exchange of goods and services with places and regions beyond its boundaries. The problem confronting the public decision-making agencies, therefore, is to see the place of the basin economy in this wider regional or national economy and to see in what manner the water resources can be used to enhance the basin's position in this respect.

For instance, if the basin has strong water-related recreational advantages, the river may be developed to attract recreation visitors. The condition of the waters to achieve the most from this objective must be sufficient to permit not only swimming, boating, and camping, but also to support fish and wildlife. A high quality of water must be maintained from a sanitary and visual standpoint. The decision to use the waters in

this manner may require the prohibition of all liquid waste discharges to the river. Or the decision may require that wastes be so highly treated that their effects on the stream will be negligible. Either requirement imposes a restriction on some kinds of economic activity in the area either by preventing their operation in the usual manner or by making their operation more costly than if conducted elsewhere. On the other hand, it may be possible to use the river to enhance industrial development as well as recreation. In this instance, the decision would be made to seek manufacturing plants requiring large volumes of water. It would be necessary to provide reservoir storage to meet the water supply demands of these plants and for the water supply of the municipalities whose population would increase due to the new employment opportunities. The reservoirs then could also be adapted for recreational use. The manufacturing plants, however, would be required to locate where their treated wastes would be discharged below the reservoirs. The adverse effect on the stream from the discharge of the treated wastes could be offset by scheduled releases of water from the reservoirs to augment and otherwise regulate the flow of the stream. The flow regulation will dilute wastes and increase the oxidation capacity of the stream. Thus, the waters stored in the reservoirs and the water released from the reservoirs would serve several purposes and some of the purposes simultaneously. The attainment of more than one objective as in the example here requires the adjustment and modification of apparently conflicting uses and purposes. Such adjustments are necessary to achieve optimum multiple-purpose effects.

Since each purpose and function relates to human activities and needs, the magnitude of the projects and the portions of a project designated for each purpose must reflect both a conception of the dimension of the future economy and an estimate of the costs and gains of each unit of the project. The conception of the future is developed through analysis of the probable economy of the area in relation to the probable national situation for the next 20-25 years and for the 50-year mark. That is, the projects are sized or scaled to reflect the size of the activity to be served or the size of the problem to be overcome. For instance, the scale and the number of the reservoirs will depend on the amount of water needed for cities and industry, for recreation, and for releases for pollution control and for flood control storage, and perhaps for hydro-power.

The size and number will be influenced also by the benefits to be gained from each purpose in relation to the costs for each purpose. Now economists often indulge in formidable words and phrases and complicated mathematics to describe their calculations and conclusions. No matter how they express themselves, the questions they should be required to answer are: "How much does it cost, and what do we get for the money?" Another question should accompany this one: "What do we lose if we don't undertake the project and what will the future situation be if no development takes place or if partial or delayed development becomes the choice?"

The answers to these questions will permit both the decision-makers and his public constituents to judge whether the proposals are satisfactory--even more--whether they are desirable or worth it; that is, whether the program should be undertaken.

Now there is no absolutely convincing development proposal nor is there any single absolutely "right" or "best" way to develop a basin.

The public must make some deliberate, explicit choices of what they want to do with the waterways. The studies will reveal the range of feasible choices and will analyze the probable consequences of each in costs and benefits and in influences on the well-being of people and on the environment. Therefore, the public must be concerned, must be consulted, must reflect on the situation, ask questions and pass judgment. In other words, the public must participate in the planning process to permit the planners to do their best work. Participation includes not only Federal, State, and local government agencies but citizen groups, industry, and individuals.

Summary

In summary and to conclude, it is evident that there has been widespread acceptance of the idea that the Nation's water resources can be developed and manage to advance economic and other deliberate objectives. The development of each basin and river requires appraisal of the physical and economic situation to reveal the feasible choices and their consequences. Though the choices may be numerous in most instances, choice is not unlimited, for the physical and economic situation are important limiting factors. No method of economic analysis absolutely assures the best choice because the analysis rests on the preferences and value systems of

the publics involved. Economic analysis can reveal the costs and benefits to various preferences. It can also reveal the costs and benefits for incremental changes in preferences. Thus, implicitly the results of the economic analysis say the basin can be developed in this manner, to serve these purposes, to provide these services, to eliminate or reduce these problems or hazards to the extent indicated. It will cost this much money and it will produce this much benefit. The benefit will accrue in these particular ways, in these sub-regions and nationally, and to these sectors of the economy. If the development does not take place, these benefits will not accrue, and the following order of economic and physical events will transpire. Therefore, the choices are deliberate. The studies reveal the possibilities and probabilities. The public chooses.

In order to insure that there will be an adequate supply of water of satisfactory quality for all our needs, both present and future, the Congress has enacted and the President signed Public Law 89-234, "The Water Quality Act of 1965." On the occasion of the signing of this bill, President Johnson said, "This moment marks a very proud beginning for the United States of America. Today, we proclaim our refusal to be strangled by the wastes of civilization. Today, we begin to be masters of our environment ..... The clear fresh waters that were our national heritage have become dumping grounds for garbage and filth. They poison our fish, they breed disease, they despoil our landscapes." He concluded with this statement, "The ultimate victory of reclaiming this portion of our national heritage really rests in the hands of all the people of America, not just the Government here in Washington. Much of the money, and some of the imagination, much of the effort, must be generated at the local level. Then, and really only then, will this blueprint for victory become victory in fact."

I am sure the following sections of this law will be of interest to you:

First, the new act creates a Water Pollution Control Administration which reports directly to an Assistant Secretary of the Department of Health, Education, and Welfare. This places the responsibility for water pollution control at a level several echelons above the position it previously occupied. It gives additional stature to this very important activity and insures that it will receive the constant attention at

the highest level within the Department of Health, Education, and Welfare. It is an indication of the increasing importance which Congress and the Administration attach to this very serious social problem.

Second, the Act singles out the pollution contributed from urban storm runoff and from overflowing combined sewers by providing for research and demonstration grants into new or improved methods for controlling such wastes. These problems are common in metropolitan areas throughout the United States and in many smaller communities. The sum of $20 million annually was authorized for this activity. Funds for the current fiscal year were contained in a supplemental appropriation act.

Third, the Act increases the size of construction grants for a single project from $600 thousand to $1,200 thousand and for multiple projects from $2,400 thousand to $4,800 thousand. It also increases the authorization for appropriations for construction grants from $100 million to $150 million for fiscal years ending June 30, 1966 and 1967. Toward this end, the Congress appropriated $130 million for distribution this fiscal year.

Finally, the bill provides for the establishment of water quality standards. It describes procedures by which the states can establish such standards subject to review by the Secretary of Health, Education, and Welfare. If the states do not act in establishing such standards or if such standards are considered unsatisfactory by the Secretary of Health, Education, and Welfare, procedures are outlined under which the Secretary may establish such standards.

The Water Quality Act of 1965 greatly strengthens the Water Pollution Control Program and, as President Johnson pointed out, "This bill will not complete the assurance of absolute success. Additional bolder legislation will be needed in the years ahead." His statements clearly express the determination of the Administration to control and eliminate pollution and to enhance the quality of the waters of America for the beneficial uses to which they can and should be put.

ECONOMIC CONSIDERATIONS IN ALLOCATING WATER RESOURCES

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The problem of how best to allocate water resources should be viewed as part of the over-all management problem in the use and development of water resources. We are not just concerned with the allocation of water resources between competing uses. The problem of allocation needs to be considered within a management framework which is capable of comprehending the major technological, hydrologic and economic relationships of water resource management. In a real sense, the allocation of water resources involves wise use of water in all of its uses and also the wise use of all complementary resources which are intimately related to water resource development and regional economic growth. It is now becoming increasingly clear that the economics of water resource management must be given greater consideration.

Water Crisis As a Managerial Crisis

In some respects, the widespread concern about water shortages appears greatly exaggerated and unwarranted. Careful studies of prospective water demands and water supplies in the United States indicate that water supplies appear more than adequate, in a physical sense, to support anticipated levels of economic growth.[1]

On the other hand, there are signs that the needs for more effective management of our water resources are rapidly approaching a "crisis" stage. Yes, there are enough water supplies to meet most regional and national growth projections providing we manage our water resources in sensible fashion and providing we begin to make use of economic principles in allocating existing supplies and in the development of new supplies.

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[1]See Landsberg, Fischman, and Fisher, Resources in America's Future, (Baltimore: John Hopkins Press, 1963), Chapter 19; Nathaniel Wollman, Water Supply and Demand, U.S. Senate Select Committees on Water Resources, Committee Print #32 (Washington; Government Printing Office, 1960).

Some of the signs of the "management crisis" can be found in the growing deterioration and degradation of water quality in most of our lakes, rivers, and underground waters. In addition, we are seeing that rapid urban growth is bringing water "shortages" to many cities. I have argued elsewhere, for example, that the case threshold for municipal water supply in many of our growing urban areas will probably double in the next generation.[2]

However, a study of the public press and some of our leading periodicals reveals that the current concern for these sorts of problems is not likely to lead to better processes of management and to greater use of economic principles in dealing with water problems. Instead of concern for new or improved institutions and procedures for management of our resources, the emphasis is often upon massive crash-spending programs to meet so-called needs or requirements. In New York City, for example, it is easier to talk about building nuclear desalting plants for new supplies instead of installing meters, stopping leaks, and making more efficient use of existing supplies. In our polluted river basins our political leaders are considering banning waste disposal or instituting large construction programs instead of establishing basin management procedures to balance benefits and costs from alternative uses of rivers among up-stream and down-stream users.

Underlying all of our water problems is the simple fact that there is competition for the use of water resources; this competition will increase and become more intense in the future. But why do we have water problems which are seemingly more pervasive and more difficult to solve compared to the use of most of our other natural resources.[3]

The answer lies in the fact that existing processes, institutions and procedures for managing our water resources do not lead to results which can be considered satisfactory. We have not yet developed institutions for sensible management of our water resources. Second, we have not, for the most part, applied economic principles to water allocation and water investment. The

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[2]J.W. Milliman, "Policy Horizons for Future Urban Water Supply," Land Economics, May 1963, p. 112.

[3]As an aside, I would emphasize that the problems of air pollution and effective management of our urban airspace are quite similar in nature to water resource management.

water problem, then, is not primarily one of water but instead is one of institutions, management, and of economic principles.

New Management and Institutional Processes

The roots of the management problem in water resources go back to the fact that water is usually a fugitive, migratory resource which is variable in distribution over time and space. These features here made it very difficult to develop property rights in water. There is no such thing as federal water law; federal powers over river basins and inland navigation are derived instead from the commerce and proprietary powers. Each state has been permitted to adopt its own system of water law.

The situation has two important features which are responsible in large part for the current poor management of water resources. First, existing water laws usually fail to deal with the obvious externalities which develop from multiple use of common interrelated supplies across state boundaries and even within individual states. Serial uses of river flows and the mining of ground water are inadequately taken into account by existing water law and by existing federal and state agencies. Second, the operation of water law in most states has prevented the development of a market system for water resources which might help with the problem of transferring water supplies to new uses in response to changing economic relationships. In some states water rights are actually tied to specific lands. This means that the transport of water to new uses, particularly to growing urban areas, is sharply restricted.

It seems to me that our concern should be with devising institutions to provide efficient management of water resources which are used in common, which have to be subject to a balancing of gains and costs as the demand for water grows in the future. I suspect that two different sorts of solutions need to be followed in different combinations in different sections of the United States.

(1) One procedure is to establish regional systems of water management; (2) the other solution lies in the development of systems of water law applicable across state boundaries to establish property rights in water so that water markets can help allocate water to its most productive uses. Most clearly, these two solutions are at opposite poles. One involves centralized decision-making by private individuals and groups. Yet,

I believe that a set of efficient institutions and process for the management, allocation, and development of our water resources will involve some combination of both kinds of solutions.

Systems of Regional Water Management

The need to develop regional systems of water management is probably best argued by Allen Kneese in connection with his study of regional water quality problems.[4] Kneese argues, quite convincingly, that regional authorities should be established to internalize the major off-site costs of water pollution. Such authorities would supply the long-needed coordination between up-stream and down-stream users and be instrumental in devising means to obtain a balancing of gains and costs between various water users on our major streams and tributaries. Kneese has argued that charges be levied upon waste disposal to motivate firms and cities to cut back on discharge. The schedule of effluent charges would presumably be based upon external costs on other users of the stream and, therefore, would vary with stream flow conditions and outfall locations. In addition, the river basin authority would be able to undertake large-scale treatment measures which might not be economical or available to individual firms or cities. The authority might also consider many different kinds of treatment alternatives, other than low-flow augmentation, such as artificial reaeration of streams, in-stream treatment and collective treatment of diverse wastes from diverse sources.

Although Kneese's work is primarily directed toward regional water quality management, it is clear that he thinks that water quality management should be directly related to the total management of the hydrologic unit, including use of water for hydro-power, recreation, navigation, flood control and related uses. Water quality in its broadest sense is another dimension to the over-all problem of competition between various uses and users. Apparently, in the United States, only the Delaware River Basin Commission has this sort of broad authority to combine water quality management and water resources development in a single regional authority.

Water Law and Market Allocation of Water Resources

At the other end of the spectrum is the need to

[4]Allen V. Kneese, The Economics of Regional Water Quality Management (Baltimore: John Hopkins Press, 1964).

revise our water laws so that the market system can be used to a greater extent to allocate water resources. I have argued elsewhere that much of the present misuse of water can be traced to imperfections in water law and its administration.[5] This occurs primarily because water rights are not clearly defined, do not have the necessary legal certainty, and cannot be transferred with ease as are rights to other types of property. As a consequence, the market processes that ordinarily direct resources to uses that maximize their productivity are severely limited in the case of water. Individuals and local organizations do not have the proper incentives to invest in water when tenure is uncertain. Moreover, economically desirable transfers of water between higher and lower valued uses and among regions, to the mutual advantage of all parties, are discouraged by these imperfections in rights and by the lack of a clear legal basis under which such transfers can be consumated.

The establishment of clear property rights to water does pose difficulties. Water is a fleeting resource. It exists partly as a store and partly as a flow. The development of water law occurred when very little was understood about the phases of the hydrologic cycle from which our supplies are obtained. Then, too, water, until fairly recently, has been in a position of surplus supply in relation to demand, so that it has been a free good or at least a very cheap one. Therefore, little consideration had to be given to its efficient allocation or to the laws governing its use and ownership. With increasing demand, however, even the humid regions have begun to recognize the inadequacy of their doctrines of water law. I believe the wrong direction is being taken in modifying present law, as represented by drafts of "model" state water codes and the recent actions of several states in this connection. These actions tend to attenuate the already weak fabric of property rights in water. The tendency is to arrange matters so that allocation of water can take place only through grants or permits to users by central administrative commissions or by cumbersome court procedures, based on fuzzy criteria of

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[5] J.W. Milliman, "Water Law and Private Decision Making: A Critique," Journal of Law and Economics, Oct. 1959, pp. 41-63; also in Chapter IX of Water Supply: Economics, Technology and Policy (co-authored with Jack Hirshleifer and James DeHaven), University of Chicago Press, 1960.

"reasonable" or "beneficial" use. In these circumstances, tenure of water rights becomes uncertain, dependent upon the changing wills of the commissions or courts. This line of legal development, I suspect, may lead to serious misallocations of water among competing users; it will, unless revised, seriously weaken or stop altogether the exercise of local and private initiative in the development of water resources.

In my opinion it is justifiable, however, for a state to assume ownership of unappropriated water. Rights to this water could then be distributed by auction among the competing claimants against the reservation price representing the value of the state's own public uses. This procedure would allow the state, and ultimately the individual citizen-taxpayer of the state, to receive compensation from the fees paid for the rights to use these unappropriated but potentially valuable water resources.

I believe that the law of prior appropriation as developed in some western states has most of the elements required to make this kind of system work. This type of water law needs to be strengthened primarily in its provisions for the transfer of rights. Under this system the courts would function, as they do for other real property, to adjudicate disputes as to the ownership and extent of the property right and to hear pleas relating to breach of contract in transfers or from parties who consider themselves injured by the actions of the owners of the water rights. The judicial system would be freed of its present inappropriate administrative-economic function of issuing and revising rights to use water on the basis of criteria like "reasonable beneficial use."

What, then, is the place for government entities in a system of water law based on property rights in water? Briefly, that they could perform the same functions for water as they do for other resources. These functions, paralleling those provided by governments for resources such as land, minerals, and petroleum, may be briefly listed as follows:

1. Establish a system of law that permits a clear definition of the extent of property rights in water, particularly adapted to eliminate commonality problems which may pertain with particular force in the case of water.

2. Provide certainty of tenure for these rights and establish a clear basis for

their transfer between individuals and private or public agencies under voluntary contractual agreements of purchase and sale.

3. Provide a procedure whereby rights to yet-unowned water may be secured by individuals, private or public agencies, or political entities.

4. Establish rules and procedures for the protection of outside parties against the spillover effects caused by the actions of water-right owners. These rules would be similar to zoning in the case of land use and would protect against harmful effects such as pollution, flooding, and the creation of drainage problems by water-right owners. Alternatively, procedures could be set up whereby injured parties can obtain compensation for damages.

5. Develop and provide information regarding the extent and quality of water resources and the technical and economic factors relating to the various possible sources of supply.

Economic Principles of Water Allocation

The economic effects of any proposed policy can be decided under two headings: effects on efficiency and effects on distribution of income and wealth. Much of what the existing body of economic thought has to say concerns efficiency effects.[6]

There is, of course, a sense in which greater efficiency--meaning a larger national income--benefits everyone in that it is possible to distribute the gains in such a way that everyone benefits. However, economics alone, cannot give us answers to distributional policy problems. It can show us how to attain efficiency and what the distributional consequences are of attaining efficiency in alternative ways. But it cannot tell us how to distribute gains from increased efficiency. It is also true that any particular change in the direction of efficiency will involve a certain intrinsic distribution of gains and losses. In practice it may not be

[6]For a critique of this point of view see Michael F. Brewer, "The Economics of Water Transfer, "Natural Resources Journal, January, 1965.

feasible to affect a redistribution such that everyone gain. Nevertheless, I tend to argue for increased efficiency in the management water resource whenever possible and presume generally that the matters of desirable income transfers between groups in our society are best handled by general fiscal tools.

It is generally agreed that there are two major economic principles which are applicable to the problem of resource allocation. The principle of equalizing marginal values in uses and the principles of marginal cost pricing. I will discuss each of these principles briefly.[7] Although these principles are well understood by economists, nothing is more frustrating to me than to see that public discussion of water resource problems is seemingly carried on without knowledge or appreciation of these basic economic principles.

If we wish to allocate a flow of water on an annual basis among competing uses, economic theory asserts an almost universal principle: the total value or product is maximized by equalizing the value of the marginal product of water, as defined by its demand schedule, in all of alternative uses. Another name for this principle is "equi-marginal value in use." The value in use of any unit of water, whether purchased by an ultimate consumer or by an intermediate consumer, is essentially measured by the maximum amount of resources (dollars) which the consumer would be willing to pay for that unit. Marginal value in use is the value in use of the incremental units consumed and will usually decline as the quantity of water consumed in any period increases. The principle, then, is that a resource should be allocated so that all users or consumers derive equal marginal values in use. In other words, when the marginal product of alternative uses of water are set equal, no amount of water can be transferred to a higher valued use.

When the uses of a stream are complementary instead of competing it is necessary to calculate the joint marginal product of the group of complementary uses. Then the joint marginal product of a group of complementary uses can be evaluated in comparison with

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[7] The reader can find extended references to these principles in the items listed in the bibliography at the end of this paper. My discussion here draws heavily on Chapter III of Water Supply book by Hirshleifer, DeHaven, and Milliman.

groups of competing users. Water reserved up-stream will result differentially higher values for water delivered to locations down-stream because of losses from evaporation and seepage enroute. The value of the marginal product in the first use plus the value of the marginal product from each succeeding return flow should be made equal for all uses and all points of use.[8]

As I suggested above, these optimizing procedures can be accomplished either through the device of centralized decision making in the context of a river basin authority or through the greater development of markets for water resources. In either context, however, the rule would still hold and point toward procedures for maximizing the total use value of our water resources.

Of course, this does not deny that there are important measurement problems related to water uses which are not normally allocated by the price system. It is difficult to compute willingness to pay or marginal benefits, for example, for outdoor recreation use of water, for environmental aesthetics and for many public health aspects. Nevertheless, even if data are very crude, I would argue that considerable improvement in the allocation of water resources can be achieved by the use of this economic principle. Furthermore, our measurements in these matters are likely to get better over time as more research is carried on with respect to benefit-cost analysis of attaining these sorts of intangible values in alternative ways.

The second economic principle which would promote efficiency allocation of water supplies is the principle of marginal cost pricing. That is to say, on efficiency grounds, consumers or water users should be charged (directly or indirectly) prices which are equal to additional or marginal costs of extra supplies including values in use foregone in alternative water uses. To meet the criterion of equi-marginal value in use, however, the price should be made equal to all consumers. So the combined rule would be to make prices equal to marginal costs for all users. Where water is allocated

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[8]For excellent discussions of these points see: G.S. Tolley and V.S. Hastings, "Optional Water Allocation: The North Platte River," Quarterly Journal of Economics, May, 1960; L.M. Hartman and D.S. Seastone, "Efficiency Criteria for Market Transfers of Water," Water Resources Research, Second Quarter, 1965.

to users at differing locations with differing use patterns and thus differing marginal costs, the rule says that customers having identical or similar cost conditions should be charged equal prices. When the marginal costs of service differ, then marginal cost prices should differ in corresponding fashion.

There are, of course, a number of problems connected with the determination of marginal costs. One defficiency is that conventional accounting systems do not usually provide direct information with respect to marginal costs. By and large, accountants attempt to work with averages. They attempt to distribute all costs to various classes of output so that it usually requires a careful reassessment of cost data to make meaningful estimates of extra costs of extra water supplies. Furthermore, these conventional accounting practices are sanctioned and usually enforced by the common time-honored procedures followed by various federal agencies and most public utility commissions. In addition, marginal cost, correctly viewed, should take into account social costs of external or off-site effects as well as correctly counting the real costs of capital and other resources used in the construction of facilities and river works. For example, even if funds are provided from public sources we cannot escape the fact that the cost of capital in water supply projects must take into account the loss of alternative values foregone, as well as an appropriate adjustment for risk and uncertainty. Failure to correctly assess marginal costs has undoubtedly led to premature investment in new facilities and also to widespread failure to make better use of existing supplies.

Conclusion

Our water problems are largely ones of inadequate institutional arrangements for management of water resources and failure to use economic principles. I have suggested two alternatives which should be given consideration in the choice of decision-making framework: (1) The regional basin authority; and (2) greater use of the market system through improvement in water law. Each of these institutions has a different set of strengths and weaknesses; each has merit. It would seem that some combination of the two kinds of institutions would be desirable and feasible for greatly improving the management of our water resources.

The essence of the economic principles to be followed in the allocation of water resources can be summarized in two rules:

1. Total product of water can be maximized by equating the value of the marginal products for all alternative uses of water.

2. Water prices (explicit or implicit) should be made equal to marginal costs. If marginal costs differ among various uses, then prices should differ in corresponding fashion.

It seems fair to observe that public officials, intelligent laymen and the water industry itself (broadly viewed) have not given sufficient thought either to the employment of proper economic principles or to the development of efficient management institutions for the use of our water resources. The challenge of future, in my opinion, lies in increased recognition of these twin needs.

Selected Readings

Anderson, Raymond L., "The Irrigation Water Rental Market: A Case Study" Agricultural Economics Research, Vol. XIII, No. 2, April, 1961.

Brewer, Michael F., "The Economics of Water Transfer" Natural Resources Journal, Vol. 4, No. 3, January, 1965.

Brewer, Michael F., Economics of Public Water Pricing, Giannini Foundation Research No. 244, Division of Agricultural Sciences, University of California, May, 1961.

Brewer, Michael F., Water Pricing and Allocation with Particular Reference to California Irrigation Districts, Mimeographed Report No. 235, Giannini Foundation of Agricultural Economics, Division of Agricultural Sciences, University of California, October, 1960.

Castle, Emery N., and Lindeborg, Karl H., "The Economics of Ground Water Allocation: A Case Study," Journal of Farm Economics, Vol. XLII, No. 1, February, 1960.

Gaffney, M. Mason, "Comparison of Market Pricing and Other Means of Allocating Water Resources" Water Law and Policy in the Southeast, Athens, Georgia, Institute of Law and Government, School of Law, The University of Georgia.

Gaffney, M. Mason, "Land and Rent in Welfare Economics" Land Economics Research, edited by Joseph Ackerman, Marion Clawson, and Marshall Harris, Baltimore - The John Hopkins Press, 1962, Published for Farm Foundation, Resources for the Future, Inc.

Hartman, L.M., Seastone, D.A., "Alternative Institutions for Water Transfers: The Experience in Colorado and New Mexico," Land Economics, Vol. XXXIX, No. 1, February, 1963.

Hartman, L.M., Seastone, D.A., "Efficiency Criteria for Market Transfers of Water" Water Resources Research, Vol. 1, No. 2, Second Quarter, 1965.

Hartman, L.M., Seastone, D.A., "Welfare Goals and Organization of Decision-Making for the Allocation of Water Resources" Land Economics, Vol. XLI, No. 1, February, 1965.

Hastings, V. Stevens, Water Rationing: The North Platte River, A Dissertation submitted to the University of Chicago, 1963.

Hirshleifer, Jack, DeHaven, James C., and Milliman, Jerome W., Water Supply: Economics, Technology, and Policy, University of Chicago Press, 1960.

Kelso, Maurice M., "The Stock Resource Value of Water," Journal of Farm Economics, Proceedings Issue, Vol. XLIII, No. 5, December 1961.

Kneese, Allen V., The Economics of Regional Water Quality Management, Baltimore: The John Hopkins Press, 1964, Published for Resources for the Future, Inc.

McQuire, Joseph W., Etcheson, Warren W., Methodology for Evaluating Uses of Water in the Pacific Northwest, Part Two, Monograph published by Northwest Pulpand Paper Association, Seattle, Washington, October, 1963.

Milliman, Jerome W., "Commonality, The Price System, and Use of Water Supplies" The Southern Economic Journal, Vol. XXII, No. 4, April 1956.

Milliman, Jerome W., "Policy Horizons for Future Urban Water Supply" Land Economics, May 1963.

Milliman, Jerome W., "Water Law and Private Decision-Making: A Critique" The Journal of Law and Economics, Vol. II, October 1959.

Moore, Charles V., "Economics of Water Demand in Commercialized Agriculture" Journal American Water Works Association, Vol. 54, No. 8, August 1962.

Rawn, A.M., Bowerman, F.R., "Planned Water Reclamation" Sewage and Industrial Wastes, Vol. 29, No. 10, October 1957.

Renshaw, Edward F., "Value of an Acre-Foot of Water" Journal American Water Works Association, Vol. 50, No. 3, March 1958.

Smith, Stephen C., "The Rural-Urban Transfer of Water in California" Natural Resources Journal, Vol. 1, No. 1, March 1961.

Trelease, Frank J., "Policies for Water Law: Property Rights, Economic Forces and Public Regulation" Natural Resources Journal, Vol. 5, No. 1, May 1965.

Wollman, Nathaniel (editor) The Value of Water in Alternative Uses, Albuquerque, New Mexico: The University of New Mexico Press, 1962.

WATER - ITS INDUSTRIAL USE AS AN ECONOMIC FACTOR IN REGIONAL DEVELOPMENT

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I have interpreted the subject as involving two major facets:

First, water as a factor in the location decisions of industry; and

Second, the utilization of water by industry in relation to regional water resources development.

In the following discussion I have attempted to provide some general evidence with respect to water as an industrial location factor, some detailed information with respect to why water is a relatively unimportant factor in the location decisions of industry, and finally some observations regarding the interrelationship between decisions made by industiral water users and decisions made by regional agencies responsible for water resources development (and management).

Water as an Industrial Location Factor

For a discussion of water as a factor in industrial plant location, industry can be divided into non-heavy water using and/or polluting industries and heavy water using and/or polluting industries. The latter category includes petroleum refining, chemical manufacturing, pulp and paper, steel, canning, meat packing and steam power.

For the non-heavy water using and/or water polluting industries, water is not a factor in interregional or intraregional location decisions. Management attitudes with respect to water supply and waste disposal can be characterized essentially as taking these factors for granted. The desideratum is the quantity and quality of water necessary for plant sanitary and fire protection purposes at a reasonable price, reflecting a well run water and waste disposal system, whether public or private. Well run also means no adverse impacts on tax and fire insurance rates. The attitude toward water with respect to location decisions is the same as toward other services and utilities, such as power, telephone, and fuel.

With respect to the heavy water using and/or polluting industries, water as a factor in location decisions includes not only water as an input to the production

process, i.e., water at the intake(s) of the plant, but also the waste water which is an output of the production process and which requires disposal. Thus, water includes not only the availability of water at the intake---quantity and quality, but also the availability of water at the effluent point(s) of the plant to assimilate and/or carry off the wastes from the plant, and the related effluent controls. It is perhaps relevant to note at this point that waste disposal problems are often more difficult, both technologically and economically, than problems of intake water for the heavy water using and water polluting industries.

Given this definition of the factor "water", the contentions of these remarks are: (1) water is of only marginal importance in interregional location decisions, and (2) water may be, but is not necessarily, of significance in intraregional location decisions for the heavy water using and/or polluting industries. Admittedly it is difficult to specify the areal extent involved in the above definitions, i.e., what is interregional and what is intraregional. In terms of areal extent, the Maumee or Mahoning basins are not in the same category as the Colorado Basin. Water utilization costs will not determine whether or not a plant will locate in the Colorado Basin rather than in Northern Ohio, but may determine the location inside or outside of the Maumee Basin in the latter area.

Various types of evidence can be cited to support these two contentions. The evidence includes: (1) general surveys of factors influencing or determining location decisions in industry; (2) empirical evidence with respect to actual locations of heavy water using and/or polluting plants; (3) statements made by industry representatives and (4) the impact of factors or constraints other than water on location decisions.

Surveys of Plant Location Factors

A survey of plant site decisions was made among subscribers to Business Week.[1] The question asked was: "If your company were selecting a new plant site, which of the following considerations would be of significant importance to you in selecting the specific area or site." It appears that the implicit assumption in the survey was that location with respect to general geographic regions, i.e., interregional location, is determined by what might

[1] T. E. McMillan, "Why Manufacturers Choose Plant Location vs. Determinants of Plant Location, " Land Economics, Volume 41, No. 3, 1965, pp. 239-246.

be called the basic prerequisites of the productive activity---markets, availability of raw materials, and transportation. In relation to intraregional location decisions, the following factors were cited by the indicated percentages of the respondents: trucking---76%; reasonable cost of property---67%; reasonable or low taxes---65%; ample area for expansion---63%; favorable labor climate---62%; water supply---22%; waste disposal---21%; and water transport---8%.

A survey cited by Pope[2] involved an investigation of the criteria used by industrialists in locating a new plant. The criteria in order of importance were: (1) transportation; (2) labor market; (3) land availability; (4) market proximity; (5) raw material availability; (6) state and local tax structures; (7) leasing and financing arrangements; (8) abundant water supply; (9) nearness to related industries; (10) availability of a building at the desired site; (11) community cultural and recreational assets; and (12) nearby vocational training facilities. Again it appears that the survey related to intraregional location decisions.

A third and similar survey was conducted under the auspices of the Economic Development Committee of the Illinois State Chamber of Commerce by a firm of consulting engineers.[3] The survey was primarily oriented to plant site, i.e., intraregional decisions. Approximately twenty-five per cent of the respondents replied "yes" to the question: "Was the availability of an adequate municipal water supply a prime factor in choosing the site." Approximately twenty-five per cent of the respondents also replied "yes" to the question: "Was the availability of adequate municipal sewers, storm drainage, and waste disposal facilities a prime factor in selecting this site."

The surveys cited above clearly suggest that water supply and waste disposal have been relatively unimportant even in relation to intraregional location decisions of the heavy water using and/or water polluting industries.

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[2] R. M. Pope, "Water for Industrial Growth," Water Works Engineering, No. 116, 1963, p. 11.

[3] Warren and Van Praag, Consulting Engineers, Pipelines to Sound Industrial Growth, 1963, 11 pp.

Actual Plant Locations

A second source of evidence consists of empirical location decisions with respect to plants of various heavy water using and/or polluting industries. That is, plants in this category have located where water supply and/or waste disposal problems have been relatively acute, in terms of physical scarcity and/or high water costs. For example, Kaiser located a steel plant at Fontana, California; petroleum refineries were located at Big Spring and Amarillo, Texas; a petrochemical plant was located at Odessa, Texas; and a major steam power plant was located in the Four Corners area of New Mexico. All of these specific locations have difficult water utilization problems of one kind or another. The location of the Bethlehem Steel Plant at Sparrows Point, Maryland is another example. There was insufficient fresh water at a reasonable cost at this site, but the location was determined on the basis of market considerations and accessability to foreign ores by water transport. Sewage effluent was then used as a major source of plant water supply.

The reverse of course has occurred. This is exemplified by petroleum refining in the Pacific Northwest. No refining capacity was constructed in that region until the late 1950's, despite the availability of large quantities of water, as well as low cost power. Until the demand for petroleum products within the region was sufficient to enable constructing refineries of sufficient size to yield economies of scale, no refining capacity was established in the region.

The Upper Peninsula of Michigan is ideal from a water standpoint. Water supplies are cool, clear, colorless, and of unlimited quantity. However, distance from the market, inadequate labor supply, and transportation problems have precluded much industrial development. As a Vice-President of Dow Chemical Company expressed it, "The Upper Peninsula has a fabulous supply of good water but little industry."[4]

Statements by Industry Representatives

Additional evidence with respect to water as a factor in the location of plants in the heavy using

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[4] W. H. Schuette, "The Need for Water Conservation for the Viewpoint of Industry, in Industrial Water Conservation," Continued Education Series No. 83, School of Public Health, University of Michigan, 1959, p. 19.

and/or water polluting industries exists in statements by industry representatives who have been involved in the design and location of such plants. For example, a survey of chemical manufacturing in the Ohio River Valley resulted in a consensus that any available water can be treated to a quality level adequate for use in the manufacturing process. The locations of chemical manufacturing plants were based on such economic factors as raw material availability, labor availability, transportation, nearness to markets, and the tax environment. Water availability is only one of a great many variables in plant site selection and in the ultimate profitable operation of a chemical processing plant. Where location is dictated by other factors, and such location is in an area where water is relatively scarce, air cooling can be substituted for water cooling for virtually all uses in the manufacturing process.

Petroleum refineries represent another example. Thus, "Water availability, as to both quantity and quality, has been only a minor factor in site selection. Factors other than water availability will undoubtedly continue to control future refinery locations."[5]

According to one of the leading petroleum refinery design and construction firms, water availability---with respect to both supply and waste water disposal, does not determine interregional location and has been only a minor factor in intraregional location decisions. In designing a petroleum refinery, the regional area is first selected. Then the size of the plant, product mix, and the various processes to be used are determined, in relation to the crudes to be used and the product mix. Once the processes are determined the water utilization system is then designed relation to whatever constraints may exist with respect to the plant site. Generally the water utilization system is designed to minimize water utilization costs and/or total production costs. Such design may mean air cooling, even with locations on sea water; extensive recirculation; incineration of wastes; and even the use of salt water cooling towers.

Other Constraints on Plant Locations

Plant location, both interregional and intraregional, may be constrained by various factors. For example, in the mining, canning, and steam power industry, the sources

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[5] H. F. Elkin and R. J. Austine, "Petroleum in Gurnham," Industrial Wastewater Control, Academic Press, 1965, p. 301.

of raw materials as inputs to the production processes may well determine specific locations. In such instances plant location occurs despite whatever water problems may exist in the particular locations. For example, in a study of copper processing operations in Arizona, the cost of intake water was found to vary from $.01 per thousand gallons to $1.00 per thousand gallons.[6] At the same time the quoted price for crude copper in New York was identical for all producers. Obviously the disparity in water costs did not preclude exploitation of the various copper deposits within the state.

With respect to canning, there may be a constraint on the permitted time from the field where the raw product is produced until the final product emerges in the can. This time constraint is on the order of two hours for canned products such as corn and peas. In addition, there are only certain climatic areas which are suitable for the production of these products. Consequently, location is constrained by these factors, regardless of the availability or unavailability of water supply.

Steam power plants using coal as a fuel may be located far from water because of the availability of an inexpensive source of coal. For example, the Naughton Steam Plant at Kemmerer, Wyoming is located nineteen miles from its water supply. The location of the plant at this point required the construction of a reservoir for water storage, diversion works from which the water is pumped to a settling basin, and a long pipeline from the water diversion to the plan itself.[7]

The general evidence suggested above can be summarized in two statements.

> First, water---including both water supply and waste disposal, may become significant in plant location decisions only at the intraregional level. With respect to such decisions, total water utilization costs from intake to outlet are determined for various alternatives and evaluated in the same manner as any of the other major engineering factors in relation

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[6] M. M. Gilkey and R. T. Beckman, "Water Requirements and Uses in Arizona Mineral Industries," Bureau of Mines Information Circular 8162, 1963, 97 pp.

[7] Anon., "Plant Takes Special Coal-Water Systems," Electrical World, Volume 161, No. 12, 1964, p. 128.

to a particular site---cost of land, site preparation (grading, drainage, and so on), power supply, foundation conditions, and construction cost differential. Some potential plant sites are rejected because of high water utilization costs; other sites have been utilized even though extensive investment in water utilization facilities has been necessary.

Second, water costs for the heavy water using and/or water polluting industries have only a very marginal effect on interregional location decisions. For example, with respect to petroleum refining, if location of a refinery in the Puget Sound area is calculated to be profitable, water utilization costs might influence the choice between two sites thirty to fifty miles apart. Water costs will not determine the choice in location between Puget Sound and the Los Angeles or San Francisco Bay area.

Why Water Is Not An Important Factor In Location Decisions

There are two basic reasons why water is not an important factor in interregional locational decisions of industry and is only a minor factor in most cases in intraregional location decisions.

First, because of the inherent flexibility in industrial water utilization systems.

Second, because the ratio of total water utilization costs to total production costs is relatively low, even for the heavy water using and/or polluting industries.

Flexibility in Industrial Water Utilization

Flexibility in industrial water utilization systems means that there are many alternative ways of meeting the requirements for water used in the production process. To put it another way, there are many substitution possibilities among the components of industrial water utilization systems.[8] There is probably greater flexibility with respect to water as a factor input in the production process than with respect to other factor inputs.

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[8] B. T. Bower, "Industrial Water Utilization: Substitution Possibilities and Regional Water Resources Development," Proceedings Western Section Regional Science Association, Urban Systems Report No. 1, Arizona State University, Tempe, 1964, pp. 119-142.

The general nature of an industrial water system is depicted in Figure 1. Such a system can be thought of in simple terms as consisting of several subsystems--- the intake water subsystem, the water treatment subsystem, the production process water subsystem, the waste treatment subsystem, and the discharge subsystem. Substitution possibilities exist among the subsystems of the water utilization system as well as among the components of any particular subsystem.

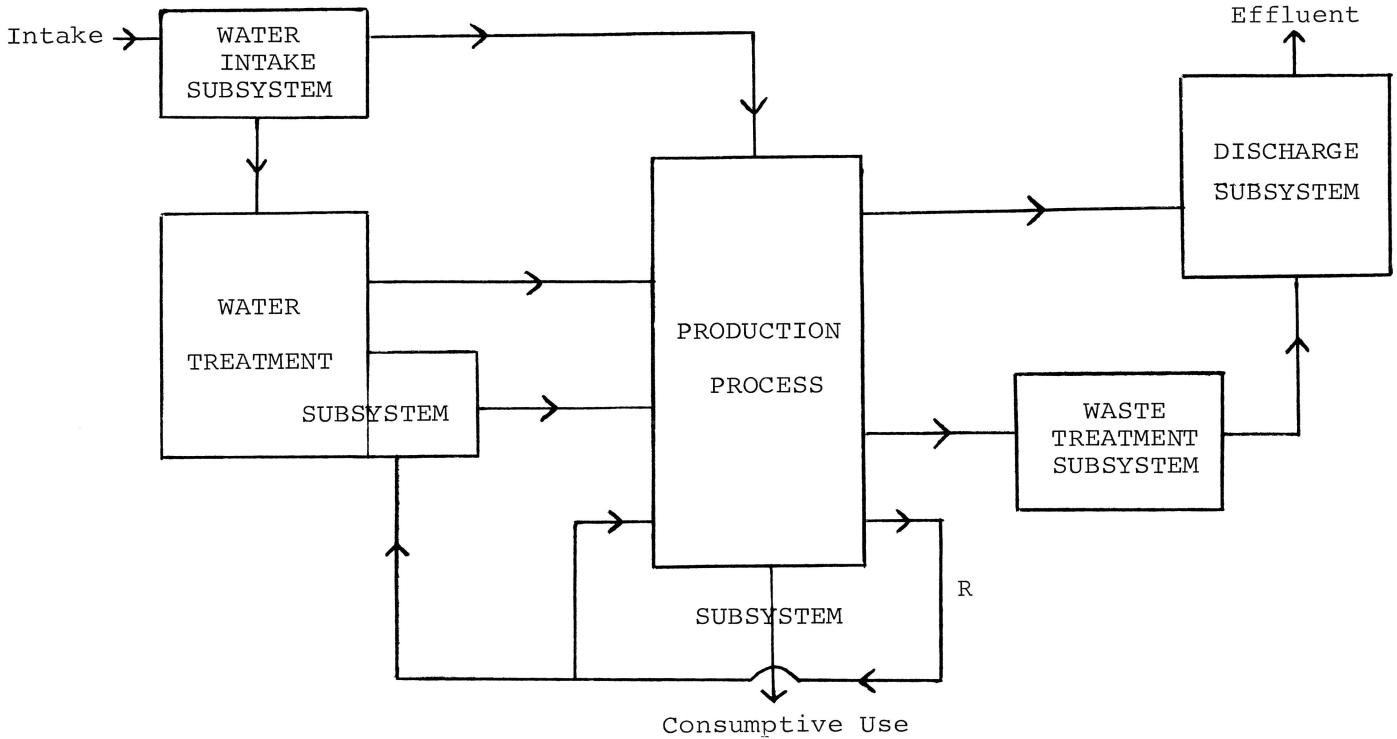
The final design of a water utilization system of a plant at a particular location is reflected particularly in the water intake per unit of product processed or per unit of final output, and in the waste load per unit. These variables, and the final design of the system, are a function of the quantity and quality of water at the intake(s), the nature of the production process, the spatial layout of the plant, the operating rate, the controls on air pollution, the controls on waste water effluents, the quantity and quality of water available at the effluent end for assimilation or conveyance of the final waste discharges, and the possible locations for disposal of the final waste effluents.

To illustrate the interrelationships among the various subsystems, consider the most common response to a relative scarcity of water in terms of price, at the intake and/or at the discharge. Price at the discharge point or points is reflected directly in terms of effluent charges and indirectly in effluent controls in physical terms. The common response to increases in intake water costs and/or increases in effluent charges is to increase the extent of recirculation within the plant. Economically it may well be preferable to increase the degree of recirculation rather than to provide more extensive waste treatment. This is particularly true since the waste water treatment generally costs from two to four times intake water treatment for the heavy water using and/or water polluting industries.

Increasing the degree of recirculation decreases the quantity of intake water per unit. For example, at the Kaiser Steel Plant at Fontana, the water intake is about 1,500 gallons per ton in contrast to the industry average of about 20,000 gallons per ton. Increased recirculation also means a reduction in the quantity of waste effluent. The latter enables less expensive treatment to meet whatever effluent standrads may exist. By-product recovery also becomes more feasible as the concentration of the effluent increases.

FIGURE 1

GENERALIZED INDUSTRIAL WATER UTILIZATION SYSTEM



Notes: R = recirculated water.
Only some of the many possible water circuits are shown.

It should be noted that closed water systems may be more economical than open water systems, i.e., those with little or no recirculation, even with no increase in intake water costs and/or in effluent controls. Closed water systems generally enable better control of water quality in relation to the production process, less total pumping, a reduction in total treatment costs both intake and effluent, and a reduction in the quantity of intake and effluent water to be handled.

Increasing the extent of recirculation in a plant cannot be accomplished without additional cost. The principal factors affecting the cost of recirculation appear to be: (1) the complexity of the production process with respect to the number of component steps involved; (2) the spatial layout of the plant; (3) the range of products produced (product mix); and (4) the extent of water quality degradation in the production process. Even so, the costs of recirculated water may be considerably less than the cost of new intake water. For example, Gilkey and Beckman found the cost of recirculated water to range from one cent to two cents per thousand gallons in contrast to one cent to one dollar per thousand gallons for new intake water.[9]

Total Water Utilization Costs in Proportion to Total Production Costs

The second basic reason why water is not an important factor in industry location decisions is because the proportion of total production costs represented by total water utilization costs is relatively low even for the heavy water using and/or polluting industries. Unfortunately, data on this ratio are sparse. However, general statements to this effect have been made by industry representatives and empirical location decisions substantiate such statements.

Some data are available from a study of industrial water utilization in North Carolina.[10] Estimates by Walker for the paper industry indicated water utilization costs of one to one and one-half per cent of total production costs and for the food processing industry they

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[9] Op. Cit., Gilkey and Beckman, p. 2.

[10] W. R. Walker, "Industrial Water Use in North Carolina," University of North Carolina Water Resource Paper No. 13, 1964, 70 pp.

were from two to five per cent of total production costs. Walker concluded that water costs, including expenditures for water rights, comprised in most cases a minor part of overall production costs even among the water oriented industries. Also, there were large variations in relative water costs among firms in the same industry in the same area.

Additional evidence of a similar nature was obtained in a study of California industry by Lofting & McGauhey.[11] Using the input-output table which they had developed for the California economy, the effects of increase in the price of fresh water supplies were estimated, assuming fixed technology and the likelihood that such price increases would be passed along to the final demand sector. The results of their computations are shown in Table 1. Note that for most of the heavy water using and/or polluting industries such as pulp and paper, primary metals, and electric light and power, a 50 per cent increase in the price of fresh water results in an increase in the final price of the output of less than 1 per cent. It should be emphasized that this result was obtained even with the assumption of fixed technology, i.e., not allowing for any substitution possibilities within the water utilization systems of the various industries.

Interrelationships Between Public and Private Decisions With Respect to Water Utilization

Perhaps the most important factor influencing intraregional plant location decisions is the attitude of local governmental units with respect to water supply and waste disposal, or the willingness of the governmental unit to explore alternative means of handling water supply and waste water problems in relation to industrial users. Most firms prefer not to be in the water supply and/or waste disposal business. The primary function of an industrial operation is to produce a good and to make a profit. Consequently, what industry looks for is an efficient water supply and waste disposal system and one which will not impose arbitrary effluent controls or charges or drastically increase water rates.

The attitude of the local governmental unit is of particular importance where the plant water intake and/

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[11] E. M. Lofting and P. H. McGauhey, "Economic Evaluation of Water, Part III, An Interindustry Analysis of the California Water Economy," Water Resources Center, University of California, Contribution No. 67, 1963, 83 pp.

Table 1.

EFFECTS OF INCREASE IN PRICE OF WATER

Industry	Percentage Increase in Price of Output to Final Demand, for 50% Increase in Price of Fresh Water	100% Increase in Price of Fresh Water
Meat, poultry, and dairy products	4.7	9.4
Agricultural products, except cotton	5.7	11.4
Fishing, hunting, etc.	0.1	0.2
Food and kindred products	2.1	4.1
Logging and fabricated wood products	0.4	0.7
Pulp and paper products	0.2	0.4
Chemical products	1.2	2.5
Petroleum and coke products	0.1	0.2
Primary metals	0.4	0.9
Electric light and power	0.5	1.0

Source: Lofting and McGauhey, p. 41.

or waste discharge comprises a large portion of the total withdrawals and/or waste discharges in the particular area. This is often true in small towns or cities. At the same time that the industrial plant is the major water user, it is also likely to be the primary economic base of such towns. If the local governmental unit is not willing to consider alternative possibilities for handling water supply, and waste water, there may be major impacts on the local economy because of changes in plans for plant expansion and/or plant location in the area.

To illustrate, one of the common procedures for handling industrial waste disposal problems is the development of facilities for the combined treatment of industrial and municipal wastes. Various procedures for accomplishing combined treatment have been followed. Facilities have been constructed and operated by industrial plants for the treatment of both industrial and municipal wastes, such as Union Carbide Chemical Company in South Charleston, West Virginia and West Virginia Pulp & Paper Company at Luke, Maryland. Industrial firms have also made direct lump sum contributions to local governmental agencies toward the investment costs of public waste treatment facilities. Another procedure has been the evolution of a system of sewer charges, generally based on both a quantity charge and a surcharge in relation to the quality of the waste effluent, i.e., BOD and/or suspended solids.

There are several advantages to the combined treatment of municipal and industrial wastes. First, savings in both capital and operating costs can be achieved for both the industrial plant and the public, stemming from economies of scale in waste treatment. The major limitation is that some industrial wastes cannot be treated in combination with municipal wastes. However, the difficult to treat wastes generally are of small quantity and can be segregated for separate treatment. Second, industrial wastes mixed with domestic sewage are usually more amendable to biological degredation.

A third advantage stems from the specialization which is possible through combined treatment. A large municipal plant is likely to be operated by reasonably well trained personnel. On the other hand, the operation of a complex waste treatment plant is alien to many industrial plants. It is a "sideline" to the main effort. As one industry representative phrased it, "Our speciality is the manufacture of soaps and allied products. We would

like to stick to this speciality and stay as much as possible out of the field of waste treatment."[12] Finally, combined treatment may enable the use of valuable land in crowded industrial areas for more productive purposes. The relatively large areas necessary for waste treatment plants can be utilized instead for manufacturing processes.

For combined treatment of municipal and industrial wastes to be successful there are certain prerequisities. First, all users---including industries, should be willing to pay their fair shares of the costs. In general, "Industry today realizes that there are no dark corners in which to hide and that all geographic locations are requiring waste treatment."[13] The second prerequisite is that an equitable system of sewer charges must be established so that all users can benefit from the economies of joint treatment. Third, consideration must be given to any difficult industrial waste to be handled. Where such a difficult waste cannot be treated in the joint facilities, some alternative means must be found.

In summary, probably the important factor influencing industrial location decisions on the intraregional level is the attitude of the local governmental unit in terms of willingness to consider problems of water supply and waste disposal jointly with the industrial plants involved.

A second level of interrelationship between public and private decisions relating to water resources involves what might be termed the region-wide level. Figure 2 is an attempt to indicate the context of the interrelationship between plant level decisions and region-wide decisions with respect to water resources development and management. Water resources development and management encompass all facilities and measure to regulate surface and ground water flows and dispose of waste water.

Two levels of decision-making are evident. The first is the plant or individual city level; the second is the region-wide level. Thus, the extent of in-plant

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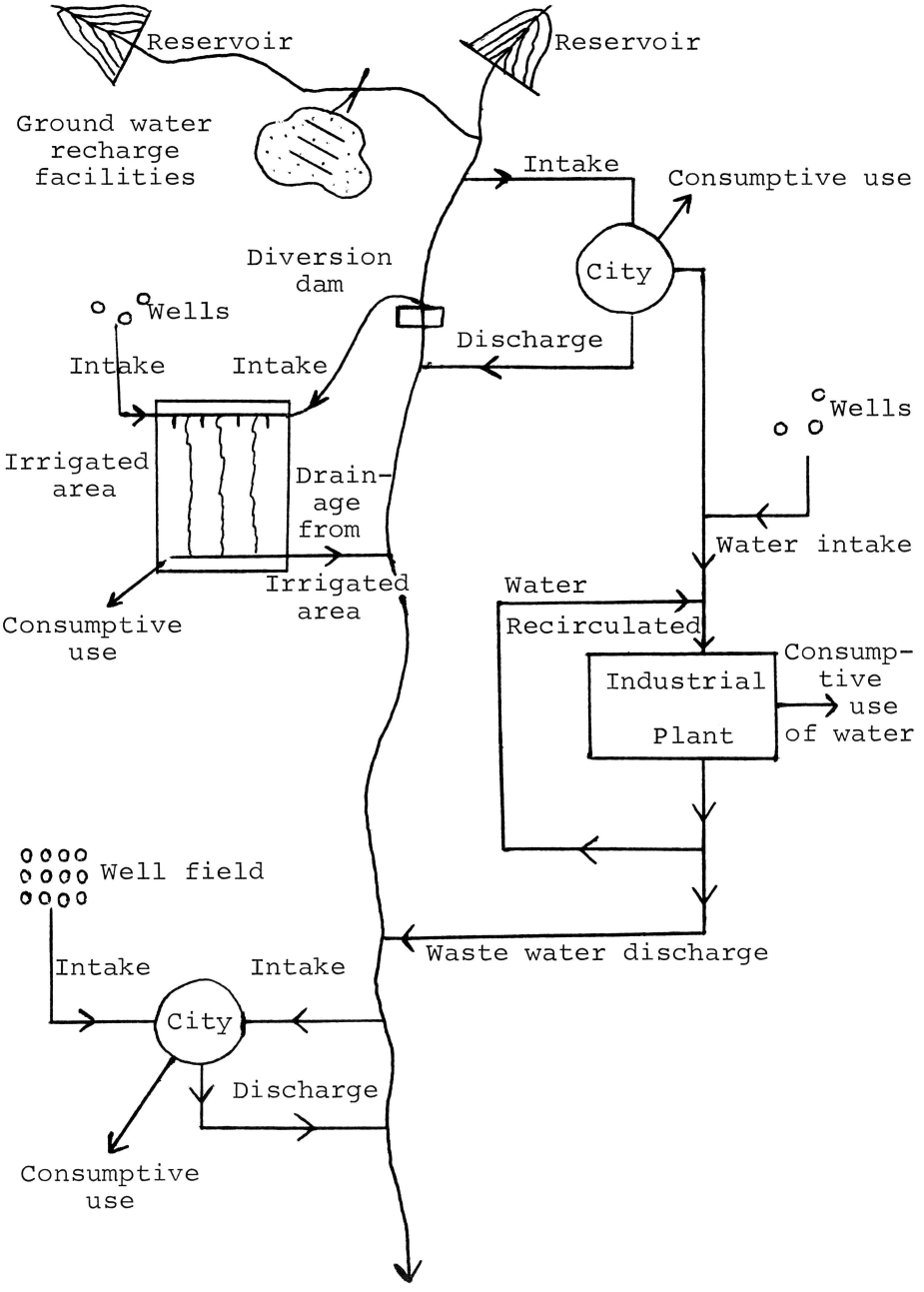
[12] J. F. Byrd, "Public Meeting on Joint Municipal-Industrial Waste Treatment," JWPCF, Vol. 36, No. 6, 1964, p. 151.

[13] H. R. Zablatzky, "Industry's Idea Clinic: Disposal of Industrial Waste Treatment Plant Sludge," JWPCF, Vol. 37, No. 4, 1965, p. 537.

FIGURE 2

ILLUSTRATION OF REGIONAL WATER
RESOURCES DEVELOPMENT AND UTILIZATION



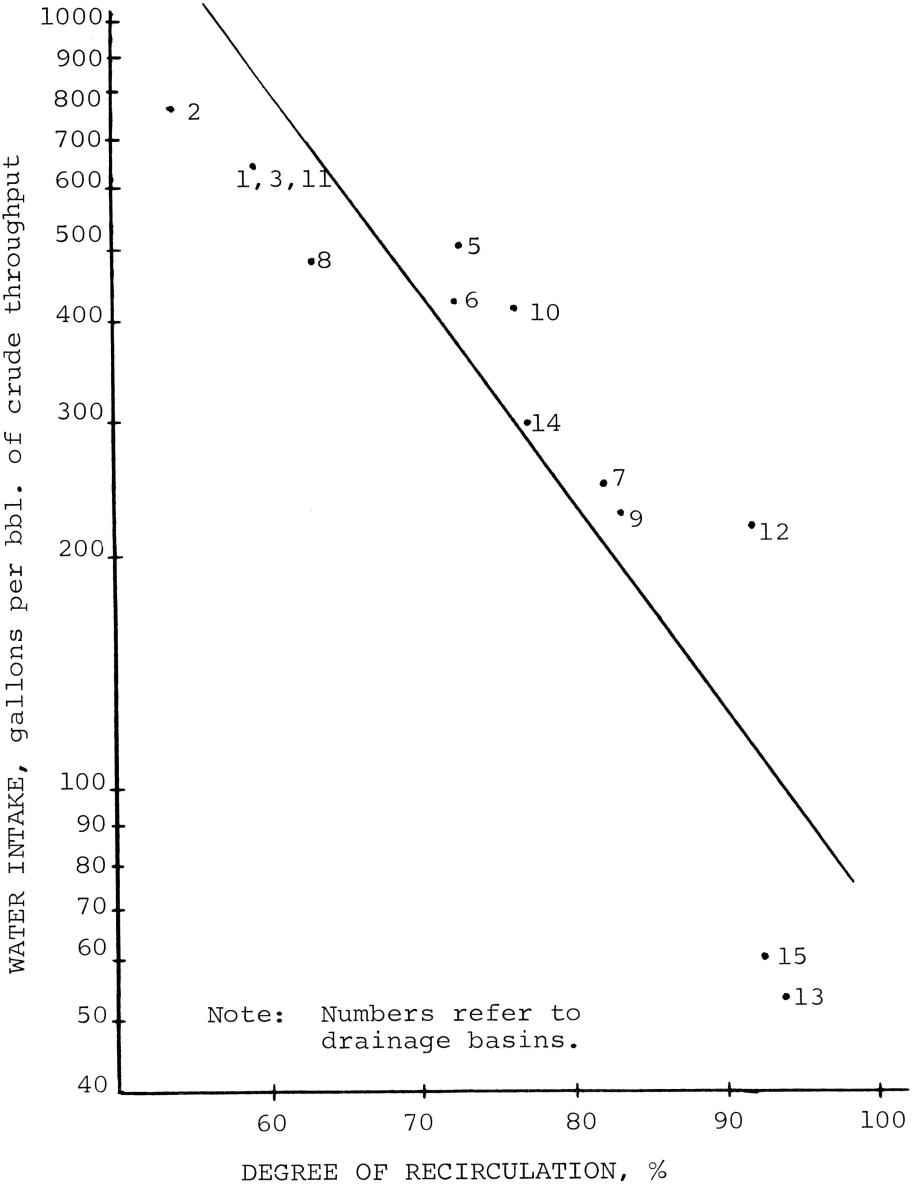
recirculation to be adopted and the level of waste treatment to be provided are decisions which are determined at the local level, either by the individual industrial plant or by the individual city. Decisions with respect to the extent of reservoir development to be undertaken are made at the region-wide level. At the same time, the extent of reservoir development necessary is of course dependent upon the decisions made at each plant and local city with respect to the degree of recirculation and the degree of waste treatment to be provided. These individual user decisions affect the amount of water required at the intakes and the amount of dilution water required for assimiliation of wastes and for the maintenance of desired water quality levels. For example, the effect of recirculation on water intake is shown in Figure 3.

Assumptions made by region-wide water resources planning agencies may or may not be in accord with the decisions of management on the local levels. As noted previously, industrial water utilization patterns are affected by various factors, such as intake water cost, effluent controls, and the amount of water available for the dilution of wastes. Investment in in-plant water systems can reduce significantly the public investment required in reservoir development and related facilities. In other words, in-plant investment can be substituted to some degree for public investment in reservoirs and related facilities, and the reverse. The optimal solution is likely to be some combination of in-plant water investment plus public development. In some cases, in-plant investment is less expensive than public investment in reservoir development; in other cases the reverse is true.

The basic problem is how to achieve the optimal solution for overall water resources development in a given region given the different decision-making centers. Two principal types of procedures can be suggested. The first is to provide some formal means of participation in the water resources planning process for local decision levels, i.e., major industrial water users and local water supply---waste disposal agencies. The second is to utilize the market system through some form of water utilization charge. Such a charge might be based on four parameters: quantity of intake water, quantity of consumption use, quantity of the waste effluent, and the quality of the final effluent.

FIGURE 3

RELATIONSHIP BETWEEN RECIRCULATION AND QUANTITY OF INTAKE WATER IN PETROLEUM REFINING, 1959



Source of data: D. H. Stormont, "Refiners Make Good Use of Fresh-Water Supplies," Oil and Gas Journal, Number 61, Volume 8, 1963, p. 86.

Concluding Comments

In the foregoing discussion an attempt was made to place the importance of water in proper perspective with respect to industrial location decisions and hence indirectly with respect to regional economic development. Several conclusions are suggested by the evidence presented.

First, water, both supply and waste water disposal, is a very marginal factor in the interregional location decisions of industry, even for the heavy water using and/or water polluting industries.

Second, water, both supply and waste water disposal, can be but is not necessarily, a significant factor in intraregional location decisions of industry. Communities with an abundant water supply will not attract industry if other factors, such as raw material availability, markets, transportation, and labor, are not adequate. Conversely, communities with relatively scarce water may attract industries if other factors are available and suggest such location. Thus,

> "In the Southwest, many communities have undertaken heavy financial burdens to provide water supplies far in excess of normal needs in the expectation that such supplies would attract industry. Too often these water supplies have to be financied by general obligation debt which pushes the tax rate above a competitive level. To accommodate 22% of the firms interested in water they have reduced their ability to attract 78% of the firms where this is not a prime consideration."[14]

The two basic reasons why water is such a minor factor in location decisions of industry are, first, because of the flexibility inherent in industrial water utilization systems, and second, because the proportion of total production costs represented by total water utilization costs is relatively low even for the heavy water using and/or water polluting industries.

Third, decisions at the plant level relating to industrial water utilization have direct and sometimes

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[14] Op. cit., McMillan, p. 246.

significant impacts on decisions concerning public investment in water resources development. The challenge to decision-makers and planners is to find mechanisms for integrating the public and private decisions involved. Many industry representatives realize that major public investments to provide a superfluity of water of zero price at the intakes of industrial plants is not economical from a regional point of view. To quote a Dow Chemical executive, "Subsidized supply of water will tend to encourage large and uneconomic usage."[15] Such uneconomic usage is undesirable from the standpoints of both private industry and the public. Thus, before a region commits itself to a large program of water resources investment based on the assumption that developed water resources are a major attraction to industry, it would seem wise to be certain just how important water as a factor is. Its importance can be assessed only in relation to other factor inputs to the production process, not in isolation.

Opportunities for water conservation and for the effective handling of wastes are so extensive in the heavy water using and/or water polluting industries that it appears the availability of water, beyond some minimal amount, has a very minor impact on industrial location decisions.

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[15] N. D. Criswold, "Water Problems in Industrial and Municipal Development," Proceedings 8th Annual Conference on Water for Texas, Texas A & M University, 1963, p. 43.

WATER - ITS RECREATIONAL USE AS AN ECONOMIC FACTOR IN REGIONAL DEVELOPMENT[1]

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Each year our expanding population is gaining more and more leisure time, more money, and more and better travel facilities. As a result, we are devoting a continually higher proportion of this leisure time in pursuit of outdoor activities.

The Outdoor Recreation Resource Review Commission reported that over 90 per cent of all Americans participated in some form of outdoor recreational activity in the summer of 1960.[2] By 2000, they anticipate that swimming will be the most popular outdoor recreational activity, even exceeding driving for pleasure, which is currently number one.[3] These forecasts may be conservative if pollution control methods are successful in cleaning up the streams, lakes, and seashores so that our outdoor activities will be more pleasant.

Clean water makes possible a variety of activities such as swimming, boating, fishing, water skiing and even hunting. Most of the migratory wildlife is found on streams and ponds. In addition, just about all of our existing wildlife seeks habitats near water.

Even when we drive for pleasure, we find that water is a prime factor influencing our excursions. In the Midwest Area, over 90 per cent of all caves, historical monuments, and pioneer trails are located along the waterways. An even higher proportion of these facilities may exist along waterways in other regions. In fact, water is either directly or indirectly associated with

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[1]Paper prepared for Extension Workshop on Public Policies Relating to Water, Purdue University, November 4, 1965. The opinions expressed are those of the author and are not necessarily those of the Economic Development Division, ERS, or the U.S. Dept. of Agriculture.

[2]Outdoor Recreation for America, Outdoor Recreation Resource Review Commission Report to the President and Congress, January, 1962, pp. 4-5.

[3]Loc. cit. p. 173.

nearly all outdoor recreational pursuits. Therefore, a measurement of the economic impact of outdoor recreation is roughly a measurement of the economic impact of the recreational usage of water.

In pursuing outdoor activities, people spend money in preparing for the activity, getting to and from the place where the activity is found and while enjoying the activity. The spending of this money becomes an important factor in area or regional development.

Catering to the needs of recreationists is big business. Various estimates of the magnitude of this business have been made. We found in Missouri that about one-fifth of the expenditures of visitors to our state are for sleeping accommodations. Other studies have verified this proportion. Assuming this is true for the nation, the expenditure for hotel and motel accommodations can be used to estimate total expenditures of visitors. For 1958 and 1963, the Bureau of Census reported that hotel and motel receipts totaled $3.9 billion and $5.0 billion respectively.[4] Therefore, expenditures of travelers visiting the various states are imputed to be $19.5 billion in 1958 and $25.0 billion in 1963.

In addition to expenditures by visitors while in the area, considerable sums are spent preparing for the trip. For 1960, it has been estimated that $2.1 billion were spent for boats and their maintenance, $3 billion by fishermen and $1.5 billion by other sportsmen for equipment.[5] It was concluded that in 1960, direct expenditures for recreational activities were over $27 billion. Excluded from these estimates are the expenditures to construct the recreational facilities and the share of the costs of the automobiles and other modes of transportation that could be attributed to recreational pursuits. These outlays are probably over $5 billion. In total, it appears that the amount spent for outdoor recreation in the United States was between $30 to $34 billion in 1960.

Based on changes in hotel and motel receipts, it appears that recreation expenditures have increased about 6 per cent a year and total at least $43 billion in 1965. A rapidly growing industry of this magnitude has an impact on the economic growth of our country.

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[4]1963 Census of Business, Selected Services, U. S. Summary, BC 63-SA-1, p. 7.

[5]Outdoor Recreation for America, p. 78.

Since water is the main ingredient sought in recreation, I believe recreational usage of water is a primary factor in the economic growth of many areas. I am interpreting economic growth in terms of increases in goods, services, employment and per capita incomes.

Most recreational waters are located in rural areas and the population in urban places. The number and quality of the highways leading to the recreational resource determines how much the facilities are used. Not only are the inter-connecting roads important, but also the access roads within the area. Much too often the recreationist drives most of the way over a four-lane highway to the recreational site and discovers the difficult task of maneuvering his valuable auto over unimproved roads unsuited for that use. Where the auto goes, so goes the vacationer. Since most recreational experiences are gained within the auto or a few hundred yards from it, the economic impact of a visitor is directly related to the quality of roads. Highway location and quality determines recreational usage of various areas.

As mentioned previously, the recreationist spends money preparing for the experience, enroute, or at the site of the experience. Some recreational expenditures are inter-area purchases whereas others represent intra-area cash flows. The economic impact of each type of purchase on an area is quite different.

Recreational purchases by local residents may be in lieu of spending for other goods and services. Thus, their purchase may have little stimulus on the local economy. However, even in this setting, it appears that recreational expenditures by local residents may result in less local cash saving and thus multiply the effect of the purchases in stimulating the local economy. More goods and services are purchased than would have been without the recreational activity. It is easy to justify in our puritanistic minds a new fishing tackle, a bowling ball, a motor boat, etc., if we feel that by using these items we may live longer. In fact, when I saw my wife purchase a new scale, I knew my life of rest had come to an abrupt end. An alarm clock and a gift of a new fishing pole soon followed. Inter-area purchases have an even greater economic impact. If a recreationist can be induced to visit another area, his spending in the area visited may have a similar effect on the local economy as a new factory. A new dollar has entered the area spending stream. More people are employed or some are more fully employed. Quite nat-

urally the visitor's home town may suffer from the dollars transferred.

To measure the economic impact that intra or inter-recreational purchase have on an area, one needs to check the cash flow. The mere presence of a recreationist in an area does not necessarily mean he is helping the local economy. To create an impact on an area, the visitor has to spend money while there. This fact is often ignored in imputing the cost and benefits from a new recreational venture such as a new lake. Much too often you see estimates derived showing the number of hunters, fishermen, campers, and boaters that have or will be visiting an area and a fantastic claim made as to the economic impact on the local economy. Completely ignored is the fact that there may be no firms or service facilities on or near the lake and none planned in the future. If the visitor is there enjoying a free good or one provided by public monies for a token fee, his presence may be a drag on the local economy. He may make most of his purchases prior to entering the area and little while there. The local economy has the expense of policing his visit, cleaning up after he is gone and reaps nothing in return. The economic impact of his visit is almost nill.

Many of our lakes in the Midwest have been developed primarily for flood control with limited recreational use. Private development is either forbidden or restricted. A few facilities are allowed to develop. As a result about the only development which occurs is a limited number of concession stands, boat docks, and a few public camp grounds and boating facilities. Fishermen and hunters are the main guests attracted, whose economic impact on the local economies are minor and sometimes negative. These restrictions may have resulted in a lower level of economic development within the area than existed prior to building of the lake.

On some lakes, regulations have been less stringent. Some areas have been restricted for public use and the rest allowed to develop under private enterprise, as on the Lake of the Ozarks in Missouri.

It was developed by a private power company in 1931. The initial cost of the lake was about $30 million. The lake is 129 miles long and has 1,375 miles shoreline. Approximately 50,000 acres are inundated. Because the primary purpose of the lake was for generation of power, the water level in the lake fluctuates annually as much as 18 feet. Spring floods carry heavy

loads of silt from the cultivated lands into the drainage basin causing muddy water a considerable part of the year. In spite of these detriments, the Lake of the Ozarks became a fishing attraction almost immediately after completion. To meet the needs of fishermen, recreational facilities were erected along the primary roads leading to the Lake. These were rustic cabins. Later as the lake became more famous as a recreation area, better facilities were added. By 1960, there were over 500 resorts and motels on the lake and 6,000 summer homes. In addition, about 1,000 other service firms are located there. A state park of 16,500 acres was located on the lake with 4,000 acres of water adjacent to camp sites. It is one of the most often visited of all state parks in Missouri.

What has recreational development of this lake meant to the economy of the counties surrounding it? Development on the lake proceeded quite slowly until after World War II, when it started to develop rapidly. For example, about $1 million was spent by vacationers in the area in 1939; by 1948 the amount had increased to $3,800,000; by 1960 it was over $15 million; and has been climbing more than 10 per cent a year since then. Today, tourists are spending over $25 million a year in the area.

Facilities have been upgraded as more people were attracted. Two years ago I met with a group of investors trying to decide whether to build a $3 million resort on the lake. On a basis of relative trends in use, it appeared that the investment would be a sound one. That facility is nearing completion. These recreational developments have affected the incomes of many persons.

Camden, a county in which much of the lake is located has had an increase of 138 per cent in median family income from 1949 to 1959, whereas the average increase in median family income in the state was 97 per cent. Population also has increased, contrary to the trend in other rural counties. If you visit the county seat, you have a feeling that this area is on the move. Many new buildings have been constructed since 1950.

I have not mentioned the impact that this building boom has had on the area. Roughly it appears that over $50 million has been spent to build the homes and resorts on the lake. Their cost alone is greater than the cost of erecting the dam.

In 1960, about 6,500,000 visitors who lived more than 50 miles from the lake visited it. Those who stayed in motels overnight spent in the area, an average of $4.30 per person per day and those who stayed overnight in the summer homes about $2.80 per person per day. Daytime visitors, who were the most numerous, and campers spent about 10 cents per person per day in the area. Some of the day visitors only stayed a few minutes; others several hours. The vast majority, however, gassed up their cars before they entered the area, and apparently either ate before they left home or carried their lunches with them. When I say within the area, I am referring to all distances within 20 miles of the lake and in most instances 40 miles. We used county boundaries in establishing the limits.

I hope you have not inferred that day visitors or campers are not welcome. A motel owner told me that these visitors were day visitors today but they would be night visitors tomorrow. He also stated he was indeed pleased to see so many campers coming to the lake. He estimated that they would have 9 out of 10 of them in a motel by the end of the week. I am quite certain that this was true because you don't camp out in 90 degrees weather when an air-conditioned motel is next door. In fact, an owner of a cabin on the lake, stated he allowed his son and daughter-in-law to have his cabin for their honeymoon night. He took their air-conditioned room in a motel adjacent to the highway. In the middle of the night they wanted to trade back.

How much recreation expenditures can increase employment and income in a rural area was verified by a study we conducted in 31 counties of the Missouri Ozarks. We found that recreation and tourism added nearly $70 million to the economy in 1959. As a result of the tourist trade, about 5,300 more employees were hired than otherwise would have been. In addition, 2,500 new firms were located in the area. If present trends continue, tourist will spend over $160 million in the area by 1975.

Although I have emphasized the economic impact of recreational activity, the sociological effect may be just as great. It is quite difficult to separate the two. A person who may have the opportunity to enjoy a recreational activity even though he may never participate, feels better. He, therefore, seeks to live where these activities are available. Since a happy labor force is very important in production, plants often are

located in areas that afford recreational activities. When IBM was considering locating a plant at Boulder, Colorado, they sought 2,500 employees. In response to their request, over 10,000 of their employees offered to move to that locality. As a result, they altered their plans and put in a plant three times as large. Many other examples could be cited on how the recreational environment influenced plant location.

We found in the Ozarks that contact between people brings about a more progressive attitude. The influx of tourists into the Ozarks made this area more receptive to change than some other areas in the state. This has occurred through a change in the attitude of the local people and by the migration of more progressive people into the area.

Land values often increase when people are attracted to a recreational area. For example, a new lake may increase the value of land several miles from the lake. Some people point to this as an undesirable situation which brings windfall profits to the land owners. Although this occurs, it may be that such action is desirable from the standpoint of society. In the Ozark area this rise in land values may have brought about more rapid farm consolidation with the relative change in the value of bottom and ridge land. Ridge lands, because of the view, increased more rapidly in value than bottom land. Ridge lands which had little value for farming were disposed of by the farmers who had fairly good size units and bottom lands were purchased from other part-time farmers who were getting only a nominal return from farming. This was done either by trading or cash transactions. As a result more economically sound farm units are being rapidly established.

In summary, recreation and especially water recreation is having and will continue to have an economic impact on our society. Some areas because of topography, climate, and location have a large proportion of their lands unsuited for the cultivation of crops. Yet, they have tremendous potential for recreational use. Water, when developed in this setting has considerable recreational appeal. The construction of highways and addition of service firms will open these areas for recreational use by urban dweller. Both the urban and rural residents will profit. Those areas which first identify this potential, develop it, advertise to attract customers, and satisfy them are the areas towards which the recreational dollar flows, and these tourists may be the most important factors in determining economic growth of an area.

WATER - ITS AGRICULTURAL USE AS A FACTOR IN REGIONAL DEVELOPMENT

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There are no neat answers concerning the role of natural resources as economic factors in national and regional development. In fact, there is a real divergence of opinion concerning the economic importance of natural resources.

In this paper I will:

(1) discuss some of the divergent concepts and points of view concerning the economic importance of natural resources,

(2) outline the criteria that characterize resources that are important in regional development, and

(3) relate some empirical work that indicate national and regional difference with respect to agricultural water resource development.

Definition of Concepts

Although a look at definitions may be elemental and considered out of place, I think it necessary that we reflect on the meaning of certain terms; at least you will know my definitions. The importance of an understanding of these concepts will be clearer as I develop my points.

Natural Resources--

First of all, instruments of production that have economic usefulness are characterized as resources. Natural resources are such non-reproducible and naturally replenished items as agricultural land, water, minerals and ores which can be depleted but cannot be reproduced in their exact form, at least with current technology.

*Helpful comments were received from Ralph Loomis, Dave Boyne, Bill Heneberry and Bill Easter on an earlier draft of this paper. Nevertheless, errors of omission and commission are the author's.

Natural Resource Conservation, Depletion and Development--

Conservation of resources, in a strict sense, involves the regulation of the use of a resource so as to extend and sustain its consumption or use over time. Resource depletion is the opposite of conservation. Resources are used at faster than current rates. Natural resource development involves the manipulation of the resource to improve its quantity or quality over time. Managing a resource to increase its utilization over time is a form of development. A resource might be depleted, then developed to restore its productivity. The possible manipulation of the resource will depend on technology available and the economic relationships involved. In either conservation, depletion or development, the spatial location of the resource does not change.

Natural Resource Substitution--

Resource substitution occurs when completely new instruments of production are used or are developed to provide almost identical goods and services. De-salting sea water for beneficial use is an example. The development of nylon and other synthetic fibres as a substitute for cotton and silk are still others. Resource substitution is usually characterized by the goods and services being produced in a different geographic setting and by different resource owners.

Economic Growth and Development--

National or regional economic growth is the added economic activity generated through the utilization of resources to provide goods and services. Professor Schultz has said that "economic growth is the development and use of resources."[1] Economic growth can occur only is there are natural resources or substitute resources (as I have defined them) in which to make additional capital investments and provide new labor incomes. The new investment comes about because of expected demand for the goods and services. Schultz states that economic growth results from a dynamic disequilibrium. As demands shift, opportunities to utilize existing resources or develop substitute resources with a high pay off come into existence. As the resources are developed and the particular demand satisfied, rates

[1] T. W. Schultz, Land in Economic Growth, Agr. Econ. Res. Paper No. 3816, University of Chicago, August 26, 1958 (mimeo), p. 27.

of return on investment decline, thereby slowing the productive investments, and deterring economic growth. To make growth a continuous positive function, new or expanding demands and new sets of resources or ample supplies of existing resources must be available for productive exploitation.

The relationship of natural resource conservation, depletion, development and man-made resource substitutes to economic growth and development should be evident. Policy decisions concerning national and regional growth will involve one or more of these concepts. Development will be facilitated if there is a timely and adequate supply of resources.

Water, as an integral part of agricultural land, is a natural resource that has had a very significant impact on the development of agricultural regions. This is a statement of the obvious. The real question concerns the role of water for agricultural development in future regional development and the public policies and educational programs that should prevail.

Role of Natural Resources in Agricultural Development

Both optimistic and pessimistic views can be found among laymen and scientists concerning the future role of natural resources. The pessimistic view obviously leads to questions about natural resource limitations on economic growth and development.

The pessimistic view is based on the Ricardian-Malthusian scarcity doctrines. According to this view, natural resource being non-reproducible, have a finite supply. As population pressures cause all the available natural resources to be brought into use, the law of variable proportions comes into effect. The marginal productivity of labor and capital diminishes as these factors expand against the fixed amount of natural resources. As output per capita declines, the economic welfare of individuals is impaired. Likewise, since economic growth is measured by the increase in output diminishing returns slow the growth rate and ultimately, as output reaches a maximum, economic growth will cease.[2]

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[2]For a discussion of these points, see Chandler Morse and Harold J. Barnett. "A Theoretical Analysis of Natural Resources Scarcity and Economic Growth Under Strict Parametric Constraints," Natural Resources and Economic Growth, compendium of papers presented at conferences of Committee on Economic Growth of the Social Science Research Council; Joseph J. Spengler, April 1960, p. 23.

The new concept of resources is that at any given time the supply of a particular material or group of resources may be limited, but over the long run the total supply of resources can be expanded. The technology and knowledge springing from science, in effect, can expand the supply of the resources either in developing the same resource or providing a substitute.

The new concept of resources is a dynamic view. As science improves and man's knowledge grows, increasing proportions of our total environment can be used to provide food, shelter, clothing, tools, energy, etc.[3] At the present time, only a small portion of our total environment is used for these purposes. Likewise, if we accept the view that there is an infinite amount of matter in total space, then the horizons are unlimited. Furthermore, if matter is never destroyed merely by being used, and only its current arrangement into useful resources is destroyed, then man can use his scientific knowledge to develop some new (and perhaps improved) replacement or substitute resources.

The implications of this view for economic growth and welfare are profound. There would be no lasting resource limitation on growth. As pressures on resource mount and as the marginal productivity of labor and capitol diminish, forces would be set off in either the private or public sector to develop substitute resources. Economic welfare need not decline because of resource scarcity as long as the forces of science and technology can be controlled and directed to this end.

There are many empirical studies representing attempts to validate both the pessimistic and optimistic views concerning resource scarcity.

The very fact that two-thirds of the world population is undernourished and that large regions of the world are depleted or near depletion, from an agricultural standpoint, is empirical evidence that the

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[3] For an excellent discussion of the technological advances on the horizon, see Joseph L. Fisher and Haus H. Landsberg. Natural Resources Projections and Their Contribution to Technological Planning, Resources for the Future, Washington, D. C., Reprint No. 32, January 1962, pp. 127-37.

Ricardian-Malthusian scarcity model holds. Land rents are high and labor productivity and standards of living are extremely low.[4]

On the other hand, we find that the increased population pressures on our resource base in the United States and other developed countries have not resulted in high scarcity returns to the owners of the natural resources.

A Resources for the Future study by Barnett concludes that natural resources for agriculture and mineral production have declining economic importance over time.[5] Another Resources for the Future study by Potter and Christy concludes that the marginal productivity of labor in the use of natural resources have not declined; in fact, it has increased, causing lower labor costs per unit of output.[6]

Schultz concludes that new and improved factors have come into the production process for agriculture. He calls these resources "non-conventional."[7] In other words, the quality of natural resources has increased or certain elements in our environment have been manipulated to bring about effective substitutes for natural resources. In the experience of the U. S. and other highly developed nations at least, we have evidence that there has been natural resource development and substitution. In other words, drainage, irrigation, fertilizer

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[4]For a discussion of this view, see Jim E. Reese. "The Impact of Resource Decisions on America's Economic Development," Resource Use Policies: Their Formation and Impact (a series of background talks) Conservation and Resource-Use Educational Project, Joint Council of Economic Education, New York, May 1959.

[5]Harold J. Barnett. Measurement of Change in Natural Resource Economic Scarcity and Its Economic Effects, Reprint No. 26, Resources for the Future, Washington, D. C., March 1961, pp. 87-88.

[6]Neal Potter and Francis T. Christy, Jr. Employment and Output in the Natural Resource Industries, 1870-1955, Resources for the Future, Washington, Reprint No. 26, March 1961, p. 128.

[7]Op. cit. T. W. Schultz, Research Paper No. 3816, p. 37.

and other management inputs have improved the productive capacity of land.

In one sense, we have to agree, that conventional natural resources do command a declining share of the national product for the reasons discussed. But on the other hand, does this say that natural resources are becoming unimportant? I don't believe so. The fact that we have spent millions of dollars in the last 100 years in agricultural research on items that have become effective natural resource substitutes is evidence to the contrary. An abundant supply of natural resources could have lightened this research investment. If we had not had the research input and the adoption of scientific knowledge, would not our population have pressed against our resource base causing a negative impact in our growth rates? The scarcity doctrines are not denied; they simply have not been allowed to operate.

I hope I have made my point. We must manage our resources through conservation, development or substitution, so that resources do not place a lasting limitation on growth.

Schultz argues that we must place more emphasis on human capital. Obviously, if we are to be successful in manipulating our environment to provide for the economic welfare of people, we must increase our knowledge about existing and potential resources, their development potential and their substitution potential. Only through careful study can we wisely develop policies and programs concerning resource improvement and substitutions.

Hopefully, this provides a setting for a more specific discussion of water development for agricultural purposes as a factor in national and regional development.[8]

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[8] Obviously the role of agriculture to economic growth in developing and developed nations is broader than the provision of an agricultural resource for exploitation. An efficient agriculture can release workers to industry, lower food costs relative to income, expand the market for industrial goods, assist in the economic development of other countries, etc. For a discussion of these points, see Agriculture and Economic Growth, Agricultural Economics Report #8, ERS, USDA, March 1963, 33 pp.

Importance of Agricultural Resources in Regional Development

In order for a resource to have regional development potential, it must have several key characteristics.[9] They are:

1. Strong demand for the goods and services from the resource.

2. High comparative advantage for the region to produce the goods and services.

3. Low resource substitutability in the production of the goods and services.

4. Regionally strong forward and backward linkages in the production processes.

5. High regional multiplier in terms of income and employment generation.

I would like to discuss each of these criteria in light of regional water resource development for agricultural purposes. I would like also to discuss some published and unpublished materials relevant to these points. The empirical information available is sketchy. Very little information is available comparing agriculture with other economic activities in regional development.

Strong Demand for Regionally Produced Goods and Services--

A strong demand for goods and services is influenced by three principal factors: (1) price elasticity, (2) income elasticity, and (3) demand shifts.

The demand for agricultural products is inelastic. Agricultural commodities differ in their price elasticity. But, in general, increased supplies of agricultural commodities reduces total income. Consequently, any large scale development of the agricultural productive capacity in the nation or the region would depress prices and incomes. However, the agricultural development of small localities may not affect prices significantly. If all localities developed their agricultural

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[9] For a discussion of these factors see Harvey Perloff and Lowdon Wingo, Jr. Natural Resource Endowment and Regional Economic Growth, compendium of papers presented at conference on Natural Resources and Economic Growth, Joseph Spengler, Editor, pp. 201-202.

resources, the aggregate effect could be price depressing however. With inelastic demands, the terms of trade may not favor large-scale agricultural development; especially if there are no shifts in the demand for food and fibre products.

Disposable incomes are expected to be larger in the future. In general, the income elasticity of demand for conventional agricultural products is low. As incomes increase, consumers spend a decreasing portion of their disposable income for products from the agricultural resource. Some of the truck, vegetable and other specialty crops do have relatively high income elasticities. The generation of primary income within a resource sector is difficult when the demand shrinks in relation to increases in disposable incomes. However areas near large metropolitan areas may receive significant benefits from water resource development for specialty crops.

The sheer force of population increase can shift the demand function to exert pressures on the limited resource base but in this country, as has been pointed out before, development and substitution have prevented these pressures from becoming excessive.

In the river basin research conducted by the Economic Research Service, we are attempting to measure the agricultural production potential in the major water resource regions for the near future (1980) and the more distant future (2010). We are just now completing this type of study in the Ohio River Basin. We call these framework studies.

In the framework studies we utilize the basic soils mapping data developed in the Inventory of Soil and Water Conservation Needs by the USDA in 1958. These soils were grouped into homogeneous economic groupings. The Ohio Agricultural Experiment Station in cooperation with specialists from other experiment stations developed yield projections for us for 1980 and 2010. These projections were based primarily upon the expected adoption of known technology. We also developed production costs for each of the crop possibilities for each of the soils.

In these studies we make estimates of the potential effective demand for agricultural products on a national basis. The effective demand was derived by estimating per capita consumption rates in view of expected disposable incomes. We utilized Census Bureau

national population projections of 245 million in 1980 and 348 million in 2010. GNP was projected to gain 3.5 percent per year. Net exports of crops was assumed to double by 1980 and livestock feeding efficiencies improve about 10 percent. A share of the national effective demand was allocated to the Ohio region based on historical proportions.

We linked the supply potential and effective demand into a linear programming model in an attempt to identify the land-use patterns farm land owners might follow in the future. We used a minimum cost formulation of the linear program with bounds or constraints on the maximum shift in production within sub-areas of the Ohio Basin.

There are approximately 50 million acres of crop and pasture land in the Ohio region. Currently, about 8.5 million acres of the crop and pasture land in private ownership are idle. Under the assumption of our study and with no further public water resource development the effective demand could be met in 1980 with nearly 13 million acres not in use.[10] However, by 2010, the results indicate that only 1.5 million acres would be idle. The conclusion is that the population pressure would be so great that agricultural resource development must come about to prevent abnormal scarcity returns to agricultural resource owners as inferior grades of land are called into production. The agricultural resource can be improved in many ways. Presumably, agricultural land drainage, supplemental irrigation and flood protection for productive flood plains could be means of improving the land and water resource.

The point here is, that with the expected state of the arts, the long-term future could involve a shift in the terms of trade towards agriculture. Higher prices for agricultural commodities will favor national and regional water resource development programs. In the short-run future though, our productive capacity is such that there does not appear to be a strong demand for water resource development for agricultural purposes.

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[10] The expected reduction of cropland use in the Ohio region by 4.5 million acres appears consistent with the 51 million acres reduction estimated for the nation by 1980. See Land and Water Resources: A Policy Guide, USDA, Washington, D. C., May 1962, p. 43.

High Comparative Advantage--

The comparative advantage among agricultural regions is fairly evident within the U. S. today. With the present levels of land and water resource development, the feed grain, wheat, cotton and range livestock-producing areas are well defined. Water development for irrigation has had a significant impact on cotton-producing areas especially. The real question concerns the comparative advantage among regions for additional water resource developments for agricultural purposes.

The work of Ruttan and Headley on irrigation productivity and cost comparisons among regions in the United States is relevant.[11] They performed a Cobb-Douglas analysis using Census of Agriculture data. They correlated value of farm products sold with labor, capital, irrigated and non-irrigated land and current operating expenses. Marginal value productivities for irrigated land in the sixteen major water resource regions were developed. When calculated at the geometric mean, the marginal value productivities varied from $11 to $727 per acre.[12] These are aggregative estimates; certain local conditions could be expected which would cause higher and lower values.

In general, marginal value productivities from irrigation development are higher in the eastern regions of the United States. Irrigation development in the West appears to have reached the point where marginal value productivites are near zero. In fact, if the full amortized costs of irrigation development are measured against the marginal value product, very little additional water development of agricultural irrigation would be feasible in the West.[13] In the eastern humid areas, irrigation development would appear to be feasible in many cases.

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[11] J. C. Headley and V. W. Ruttan. "Regional Differences in the Impact of Irrigation on Farm Output," Chapter 9, Economics and Public Policy in Water Resource Development, Iowa State Press, 1964. See also Ruttan, Vernon W., The Economic Demand for Irrigated Acreage, Chapter 4, The John Hopkins Press, 1965.

[12] Ibid., V. W. Ruttan, pp. 49-52.

[13] Ibid., p. 52.

A separate study conducted by Pavelis of the Economic Research Service gives similar results.[14] This study dealt with historical irrigated acreage changes among the water resource regions. A regression analysis indicated growth rates in each region that were essentially consistent with the marginal value productivites developed in the Ruttan and Headley work.

One problem in these kinds of analyses concerns the range over which the marginal value productivity estimates might be applicable. Irrigated acreages presently in the humid areas are devoted in most cases to high-value crops such as fruits and vegetables and undoubtedly are reflected in the irrigation coefficients. Since there is an inelastic demand for these kinds of products, the high marginal value productivities as developed from existing census data may be short lived since the water requirements for spcialty crops may be satisfied with relatively small amounts of resource development. Nevertheless from this analysis, there would appear to be areas in the East, especially the Northeast and Great Lakes regions, where primary income could be generated through water development for irrigation.

Low Resource Substitutability--

Very few empirical studies are aimed specifically at measuring the substitution of one resource for another. In an aggregate sense, fertilizer is a land improvement measure that is competitive with water development for irrigation to make the land more productive.

Heady conducted research to determine the rate of substitution between fertilizer and land.[15] Based on fertilizer response date from Kansas, Iowa, North Carolina and Mississippi, one ton of fertilizer was equivalent to 24 acres of land on the average. Christiansen and Aines found similar results in a separate study.[16] Drainage

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[14] George A. Pavelis. "Irrigation Policy and Long-Term Growth Functions," Agricultural Economics Research, Vol. XVII, No. 2, April 1962, pp. 50-60.

[15] E. O. Heady. "Marginal Rates of Substitution between Technology, Land and Labor," Journal of Farm Economics, Vol. 45, No. 1, February 1963, p. 137.

[16] R. P. Christiansen and R. O. Aines. Economic Effects of Acreage Control Programs in the 1950's, Agricultural Economic Report No. 18, ERS, USDA, October 1962, p. 23.

and flood protection also are alternative ways of providing agricultural goods and services. In a regional context, agricultural productivity developed through drainage in the Corn Belt states serves as a substitute for marginal producing areas throughout the United States. Similarly, irrigation development in the West has had an impact on land-use patterns, especially in the Southeast.

The other form of substitution that has real potential for influencing regional water development for agricultural purposes concerns the use of the so called "man-made" fibres. These are rayons, acetates, acrylics, polyamides, polyesters and so forth. The basic resource in rayons and acetates is cellulose which is derived principally from wood pulp. The acrylics, polyamides, etc. are derivatives of coal, petroleum and natural gas.

The few fibres now involve about half the fabric market.[17] Thirty years ago these fibres accounted for about a tenth of the market; consequently, these synthetics have had a real impact on alleviating the pressure on our conventional agriculture resource base to produce plant and animal fibres for clothing and textiles.

Human foods have not been synthesized from alternative materials in a comparable manner to clothing and textile materials. The shifts that have occurred have been within the conventional agricultural resource base. The substitution of livestock products for cereal products and vegetable oils for animal fats has had regional impacts with respect to the use of the agricultural resource base.

Other minerals or matter might be used for food. For instance, if technology could provide a basis for synthesizing human food from the algae in the oceans, our conventional agricultural resource base would have less importance; consequently, potential improvements of it through water resource development also would be less important.

The inroads of resource substitutes and the changing consumer demands make agriculture somewhat instable as a source of regional development. We sorely need research in this area.

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[17] Haus H. Landsberg, Leonard L. Fischman and Joseph L. Fisher. Resources in America's Future, The John Hopkins Press, 1963, pp. 104-105.

Forward and Backward Linkages--

For a resource to be strong in regional development, the inputs that go into the utilization of the resource should be manufactured locally. Likewise the processing and further manufacture of the product should occur within the region.

Water resource development for agricultural purposes would appear to have a rather weak backward linkage. Most of the inputs used in agricultural production are manufactured at the source of their raw materials. Agricultural machinery and equipment are manufactured close to the source of iron ore. The same is true with irrigation and drainage equipment. Fertilizer, cement and clay products often are manufactured locally if the raw materials are available.

The further manufacture and processing of agricultural commodities usually is consumer oriented or is located geographically through custom. Vegetable and fruit canning and processing is uaually performed locally; consequently, a good forward linkage is associated with these high-valued crops. Grain and livestock processing have been centered in the Minneapolis, Chicago and Kansas City areas. But these markets may be decentralized in the future. In general, the forward linkages for agricultural products would be stronger than the backward linkages. But neither are rated high.

High Regional Multiplier--

Besides having a strong regional forward and backward linkage in the production and utilization process, there must also be a high income multiplier. Obviously, these are related but in varying degrees. A high income multiplier is associated with those industries that are labor intensive and have favorable terms of trade. The question concerns where farmer production and consumption expenditures are made and the amount of subsequent local income generated. If there are strong forward and backward linkages, the income multiplier may be high although this need not be true. For instance, fertilizer manufacture is not labor intensive and the terms of trade have not favored fertilizer producers. Even though fertilizer often is produced locally, the regional income multiplier effect through this backward linkage in increased agricultural activity may be negligible. On the other hand, a high income multiplier could be possible without strong linkage effects. The consumption expenditures of farmers could

generate local income and employment opportunities. However, if the consumption items are not produced locally, the income generation would relate only to the transportation and retail services provided.

Some research concerning the measurement of the local multiplier effect of increased primary income in the agricultural sector has been done by Jansma and Back[18] of the Economic Research Service in Oklahoma.

This study measured the net secondary income, or increases in net income of local people resulting from increases in primary income in agriculture and recreation. The local area in this case was a single county. It is mainly an agricultural area but substantial recreation activity has developed there as a result of floodwater-retarding reservoirs within the Washita River Basin. Agricultural income also has increased through the installation of structures for flood plain protection.

An input-output matrix of the local economy was developed by tracing the expenditure patterns through the local banking system. Households and business establishments in the county were classified according to type of enterprise or economic unit. The transactions during 1960 were characterized as:

1. local expenditures to local sectors,
2. local expenditures to non-local sectors, and
3. non-local expenditures to local sectors.

In this particular research, a dollar increase in gross receipts to agriculture generated $1.78 in local income. The 78¢ increase was centered in the agri-business sector, including establishments as automobile and farm equipment sales and repair, grain elevators, auctions and feed and produce stores.

In the recreation sector, a dollar increase in gross receipts generated only $1.13 in local income. The original dollar increase came in eating and drinking establishments, service stations, garages and enterprises that provide personal services. The 13¢ increase in local income came through a general impact on the remaining

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[18] J. Dean Jansma and W. B. Back. "Local Secondary Effects of Watershed Projects: A Case Study of Roger Mills County, Oklahoma," ERS 178, RDED, ERS, USDA, May 1964, 28 pp.

sectors. In this area at least, agriculture appears to have a greater local impact than recreation.

Trends in farm consolidation, farm management, bulk handling and transporting of farm inputs and the decline of small rural communities may also influence the local income and employment multipliers for agriculture. Tweeten and Walker in a study of southwestern Oklahoma concluded that through farm consolidation, the superior managers will increase expenditures per acre for production inputs.[19] But they also conclude that an increasing portion of these expenditures may go to communities outside the immediate area.

We need additional studies concerning the local income multiplier effects not only among agricultural regions but to compare agriculture with other primary income-earning sectors.

Implications

We cannot make specific conclusions about the importance of agricultural water resource development to regional growth. But in view of the criteria discussed here, one could conclude that agriculture would not represent a strong factor in regional growth at least in the near future. I hasten to add, for fear of misinterpretation, that this is not necessarily a conclusion about the role of agriculture in national growth. We are discussing here only the regional advantages that might accrue from agricultural resource development.

The inelastic demand, low income elasticity of demand for agricultural products, potential resource substitution and the moderately weak linkages and multipliers tend to discourage the use of water development for agriculture as a principal policy or program measure for regional growth. Undoubtedly there will be areas where water development for speciality crops would provide high pay offs but may be insignificant with respect to the total region.

I believe that water development for agriculture will be much more important in the longer term, both

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[19] Luther G. Tweeten and Odell L. Walker. Estimating Socio-economic Effects of a Declining Farm Population in a Sparse Area, proceedings of a workshop on Regional Development Analysis sponsored by the Agricultural Policy Institute, Oklahoma State University, p. 114.

nationally and regionally. We are beginning to collect evidence that the known technology available and expected to be adopted by the turn of the century will not prevent sizeable pressures on the agricultural land and water resources. To the extent that this happens, the terms of trade could turn in favor of agriculture and ultimately result in declining labor productivities. More favorable terms of trade to agriculture would favor water developments for agriculture.

The absolute availability of water may be a severe limitation in some regions. Water already is a limiting factor in the agricultural development of the Southwest. As water becomes more limiting in those regions in the decades ahead, the humid areas will have added pressures to increase agricultural production through irrigation, drainage and the protection of flood plains.

Water development for agricultural purposes may become quite competitive with other uses. This is especially true in the arid regions of the United States. But water resource development for agricultural purposes is not always competitive with other potential uses of the water development. Flood protection can benefit both industry and agriculture. Irrigation water supplies can come from ground water supplies thereby not influencing main stream flow materially. Channel improvements to provide drainage outlets may influence the seasonal flow of water somewhat but should not materially affect subsequent uses of the water. The point here is that the regional growth aspects of water resource development for agriculture might be possible, without major opportunity costs, even though the regional benefits may be meagre.

One final note concerns our research and educational strategies. Our water resource development problems appear to be more complex. Educational programs should be developed to explain concepts of resource development, conservation and substitution. Resource owners and consumers should be aware of regional development opportunities and also should be aware of opportunities that do not exist.

Decisions to develop the water resources for agricultural purposes should be based on the best information possible. We need more research on regional development potentials. As regional advantages are exploited, as resource substitutes are developed in various regions and as demand shifts favor agricultural products of one

region over another, national interregional studies become more important in guiding public and private resource development decisions. We can no longer make these decisions in isolation. Our research strategy must be one that will provide consistent information to the decision makers concerning development potentials.

CRITERIA FOR ALLOCATING PUBLIC FUNDS FOR WATER RESOURCE DEVELOPMENT - FEDERAL LEVEL

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Other speakers in this extension workshop on public policies relating to water have covered such matters as the water issues facing the United States, present policies being followed on water use and water resources development, and economic aspects of water.

In addressing myself to the subject assigned, "Criteria for Allocating Public Funds for Water at the Federal Level", it is helpful to consider the overall scope and magnitude of Federal water programs. The table on page 423 of the Budget for Fiscal Year 1966 indicates budget expenditures for water and related resource development were $1,462.4 million in fiscal year 1964. The estimate for fiscal 1965 was $1,564.2, increasing to $1,638.3 million in the 1966 fiscal year--a range from just under 1½ percent of the total Federal administrative budget to a little over 1½ percent in the latter fiscal year. The budgeted 1966 expenditures are divided roughly at about 30 percent for flood control work; 20 percent for navigation; 30 percent for multiple purpose dams and reservoirs with hydroelectric power facilities; about 10 percent for power transmission facilities; and about 5 percent or less each for irrigation and water conservation, waste treatment facility grants, and TVA steam electric power plants. Actual expenditures, of course, will vary somewhat from the estimates, depending on Congressional action on the President's budget and actual construction experience.

While upward of a billion and a half dollars for water programs seems like a tremendous sum when compared with the needs of any one State or project, in the context of the overall Federal budget it is not one of the larger programs. On the other hand, the bulk of the $100-billion-plus Federal budget is for things which are not controllable, such as national defense, interest on the public debt, veterans benefits, pensions, and other programs where the budgetary level is set by law

*Presented by Sid McFarland, Staff Director, House of Representatives Committee on Interior and Insular Affairs.

or by requirements of national security. Thus the task of allocating funds for and within the field of water resources is important, not only from the viewpoint of meeting ever more critical needs for water and related resources, but from the viewpoint that it is one of the few programs within the Federal budget that is controllable.

In preparing a paper on the subject of how the water resources funds are determined and allocated, one is handicapped because the criteria used in formulating the Federal budget are usually considered "administratively confidential" within the executive branch of the Federal government under the doctrine of executive privilege which is frequently invoked in connection with matters handled in the Executive Office of the President. Furthermore, as those who have been involved in preparing budgets for Federal programs know, it is not always possible to set down in words the criteria used in allocating funds between the various programs, since a certain degree of judgment and the interplay of personalities of agency officials is involved. Nevertheless, the water resources budget is the outcome of a certain rational process which is followed year after year and which can be discussed without depending on material that is considered privileged.

The budget process for a particular year goes on over a period of at least 2½ years, extending from about 18 months before the beginning of the fiscal year in question to the very end of the fiscal year. It is carried on at several levels within the Federal establishment. It is difficult to set down criteria used in allocating funds at each of the various levels because budgeting is a continuing process. The next year's budget must be prepared and submitted to the Budget Bureau in some instances even before the appropriations for the current year are available. Frequently, the criteria are changed between the time the earliest steps are taken and the time the budget is transmitted to Congress. Also, a great many agency management decisions affect the budget.

While the procedure changes from year to year and from administration to administration, the following steps are those that have been involved in the formulation of the water resources budget during the period when the author was a member of the staff of the Bureau of the Budget.

From about January to April, or about 15 to 18 months before the beginning of a given fiscal year, the Federal water resources agencies usually canvass their field offices for the purpose of formulating an optimum program for the following fiscal year. This is usually an internal operation within the agency, and provides an opportunity for estimates to be prepared for programs and activities that may have been eliminated or reduced in the President's Budget for the next preceding fiscal year, which would have just been transmitted to the Congress. At this stage, within criteria that may be established by the Department or agency head, there are few restraints and the programs are frequently formulated without a realistic monetary ceiling, with the need for the program being the only criterion. The program thus formulated, however, must run the gauntlet of agency, Departmental, Presidential, and Congressional budget surgery (or axing) before it can be effectuated through the appropriation of funds. Each agency has its own criteria at this stage, but the criteria generally used are aimed at producing an optimum program from the viewpoint of the agency, and without necessarily considering the level of related programs of other agencies. One of the difficulties in formulating a realistic program at this stage is the fact that in many cases the Congressional hearings on the preceding fiscal year budget have not yet been held. Nevertheless, the magnitude of the task of assembling a Federal budget is such that the step must be taken. Obviously, it usually results in a much larger program than can be expected to materialize.

At some time in mid-spring the Budget Bureau usually issues a preliminary statement of the President's policies to be followed in submission of budgets due the following September or October. These policies are usually based on studies of economic objectives of the Administration, participated in by the Cabinet, the Council of Economic Advisers, the Treasury Department, and of course the Bureau of the Budget, as well as other officials in the Administration. On the basis of the policies thus evolved, each Department then goes over its agencies' optimum programs and advises the Bureau of the Budget what it believes will be needed. This is usually handled in terms of totals for programs without the need for submission of detailed estimates.

The Departmental estimates are reviewed by the Bureau of the Budget, and the Departments are given advice to be used in preparing the detailed Budget estimates the following autumn. In some years budget

ceilings have been issued at this time and agencies are requested to make their budget request within the ceilings thus furnished. At times, over-ceiling requests have been permitted. In recent years, ceilings have been frowned on, because they give rise to a type of gamesmanship,[1] or budgetmanship, in which psychology may play too important a role.

Certain types of criteria nearly always are specified or agreed on between the agency and the Bureau of the Budget. The first criterion that is usually agreed on is that projects under construction must be funded at the most efficient, economical rate that will result in minimizing the total cost of the project to the government. If this can be accomplished within the given budgetary limits, attention is then given to selecting projects to be included in the budget as new starts. At this point it is possible to make a decision to give precedence to projects to accomplish a certain function; for example, it is likely at the present time that special attention would be given to projects that might help in alleviating the drought in the Northeast. Under other conditions special attention might be given to projects for flood control, navigation, hydroelectric power, or area development, if some compelling need is paramount or has widespread public support. The criteria of this nature are sometimes spelled out in the President's Budget message in the section that explains the Budget.

Less easy to describe are criteria with respect to geographic distribution of projects. While no bureaucrat is likely to admit it, there is probably a general desire to expend Federal funds so that each part of the country is getting a share of the resource dollars, or, more bluntly stated, to keep the workload in the agency field offices generally uniform, so as to avoid undue fluctuations in the number of employees.

When the Budget requests are transmitted to the Budget Bureau in September or October, some nine months before the beginning of the fiscal year, it is possible to become much more specific with respect to the actual amounts of funds needed for construction on specific projects or programs. Very careful scrutiny of estimates is given by the Budget Bureau under criteria that are usually not a matter of public record. Sometimes the criteria may stem from outside influences such as the

[1] Stephen Potter, The Theory and Practice of Gamesmanship, New York, Henry Holt, 1948.

desire to balance the budget in a year when the stimulus of Federal expenditures is not needed, or to increase the construction budget in years when some stimulus to the economy is needed. Until someone comes up with a common denominator for apples and oranges, or chickens and eggs, however, it is unlikely that there will ever be a criterion specified for weighing one program against another. Thus, each program is carefully measured against the overall budget criteria, rather than against other similar programs. An attempt is made to cut a little here and perhaps add a little there in order to bring the desired type of Presidental action to bear on the budget, but it is still possible to have, in the same budget, programs to reduce agricultural production, such as the soil bank, and programs to increase production, such as irrigation.

Since economical and efficient continuation of work underway is generally adopted as one of the basic criteria for any program, great emphasis is placed on "new starts" as a means of controlling the level of a program. Thus, for a few years during the Eisenhower Administration a policy of "no new starts" was followed in an attempt to reduce water resources program levels. The policy was abandoned, however, when it not only provided the opposition party with a telling political argument, but resulted in all of the new starts being picked by the Congress.

Rational criteria for new starts are usually worked out by the Bureau of the Budget. The type of criteria that are used include such matters as the total costs of completing projects, the amount required to begin construction in the initial year, the status of advance planning, amount and status of local cooperation, benefit-cost ratio, type and geographic locality of project, agency capability to construct the project without having additional staff, and so forth. Needless to say, in this and all other stages of the budget process, there is opportunity for considerable local pressure to be brought to bear in the form of representations as to the merits of particular projects.

After the agency estimates have been weighted against the written and the unwritten criteria, and final decisions have been made by the Administration, the budget is transmitted to Congress in January prior to the beginning of the fiscal year on July 1. Then the process of reviewing the budget begins all over again in the Congress. The Budget and the justifications thereof are referred to the Appropriations Committees of

the House of Representatives and the Senate. The staffs of the two appropriations committees are among the strongest staffs of any congressional committees and they subject the budgets to analysis under criteria established by the Committees. Such criteria are not often written out. Hearings are held, and agency officials are subjected to thorough examination. Opportunity is offered other members of Congress and local witnesses to be heard.

The Appropriations Committees' analyses are broken down by subcommittees in roughly the same way that the Bureau of the Budget's analysis is handled by different subcommittees. Each member of a subcommittee uses his own written or unwritten criteria; and great weight is given to the results of his own personal inspection trips to many of the areas involved. The subcommittees' recommendations are usually accepted by the full committees. In order to minimize the possibility of inconsistent treatment of the budgets of different agencies operating in the water resources field, both House and Senate Appropriations Committees have subcommittees on Public Works Appropriations, so that the budgets of the Corps of Engineers, Bureau of Reclamation, TVA, and other water resource development agencies will be considered by the same subcommittee.

In reporting the public works appropriations bill and bringing it up for action on the floor of the House or Senate, the chairman of the Appropriations Committee usually indicates that changes have been made in the Administration's recommendations in order to "balance the bill and in order to take care of worthy areas not previously included..."[2] While the latter criterion is easy to visualize, the former is less easy to define. It has sometimes been defined as balancing the bill with the needs of the country, and obviously allows room for a great deal of committee judgment to be exercised. In recent years, the Congress almost invariably has added a number of new starts to the water resources budget, while reducing the amounts requested for going work on the basis of later information as to delays and other reasons for reducing fund requirements for keeping

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[2]See remarks of Senator Ellender in reporting the Public Works Appropriation Act for Fiscal Year 1966. Congressional Record, August 23, 1965, p. 20565.

projects on schedule. One of the few Eisenhower vetoes that was over-ridden by Congress was over this issue.[3]

The final allocation of Federal funds occurs after the funds are appropriated. In recent years the public works appropriations have been made subject to subtraction of a large amount for slippage at the end of the tabulated list of projects. Thus it becomes necessary for the agencies to keep a very strict control over funds and allocate to projects only amounts that are sure to be expended. The slippage reduction must be allocated back among all the projects, hopefully in such a way that no project is slowed down for lack of funds. The need for economical construction is the overriding criterion for allocation of funds at this point.

The Budget Bureau also has the responsibility of apportioning funds into the four quarters of the fiscal year as a means of eliminating the need for deficiency appropriations. In the apportionment, efficiency of operations on particular projects is one of the primary criteria that is followed. As the year goes on, transfers can be made between projects and programs, usually with the consent of the Budget Bureau and the appropriations committees or the chairman thereof as required to meet needs for funds as they arise.

In summary, then, it can be stated that the primary criterion for allocating funds in the public works construction field is the need for maintaining economical progress on work underway, while striking a balance between the total funds available and the needs of an expanding Nation, and giving recognition always to geographic distribution as brought to the attention of budgeting officials and appropriations committees by representatives of those geographic areas.

From time to time efforts have been made to use expenditures for water resource development as a means of offsetting cyclical trends in the volume of private construction. It is the author's view that this is unwise for two reasons. First, the time lag between budgeting for, and expenditure of, funds for Federal water resources projects is usually so great that the increase in construction volume does not actually take place until after the need for stimulation has passed,

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[3]Public Works Appropriations, Fiscal Year 1960, Approved by overriding Presidential veto, September 2, 1959. Congressional Record, p. 17752.

so that the increased Federal expenditures add to the next boom, rather than filling in the trough of a recession. Second, the needs in the field of water resources are too important to the overall health of the Nation's economy to be dealt with on this basis. It is probably necessary from this time forward that the Nation mount an effective water resources development program, in order that future needs can be met without permitting lack of adequate quantity and quality of water to become a drag on the economy. Some changes in emphasis may be needed, and it would be desirable if more adequate criteria could be evolved to accomplish this.

Some idea of what is being accomplished in allocating Federal funds for water resources is given by an examination of the budget figures for water resources development for the last three years.[4] They show, for example, that budgeted funds for irrigation and water conservation works of the Bureau of Reclamation are decreasing from $99.2 million in 1964 to $67.7 in 1965 and $29.5 in 1966, presumably reflecting a belief that the need for funds for irrigation is decreasing because of the agricultural surpluses. On the other hand, in the same three years, funds for electric power transmission facilities are increasing from $129.2 million in 1964 and $146.4 million in 1965, to an estimate of $191.6 million in 1966, in reflection of the importance of regional transmission line interconnections. Similarly grants for waste treatment facilities made by the Public Health Service are shown to be increasing from $66.4 million to $74 million to $80 million in the current fiscal year. Trends in flood control, navigation and multiple purpose dams and reservoirs are not as easy to determine, since the allocation of funds to specific purposes depends to a great extent on the nature of the individual projects. However, the overall budget for water resources is increasing, to take care of the Nation's growing water problems. It is still substantially less, in percentage of the gross national product, than it was during the decade of the 1930's.

Many workers in the water resources field believe that their field has been slighted in recent years. They point to the vast expenditures made for foreign aid, for agricultural surpluses, and many other programs,

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[4] The Budget of the United States, Fiscal Year 1966, p. 423.

and suggest that greater attention should be given to the conservation and development of the Nation's natural resources, including water. It is likely that workers in other fields of controllable budget expenditures also feel that their areas have been slighted in allocation of funds. It may never be possible to make any definitive judgment on these matters until the common denominator mentioned earlier is discovered. The needs are so great, however, and becoming more critical as our Nation expands in population and industry, that workers in the water field must exert their utmost efforts to see that this field receives an adequate share of public funds. Likewise, all available information must be brought to bear in the decision-making process so that the available funds will be allocated to the various segments of the water resources program in such a way that the needs of the Nation can be met in the most efficient way.

Several suggestions have been made as to ways in which the budgeting process can be improved. Among these are proposals for a capital budget. Under this concept, funds for permanent improvements would not be considered a part of the operating budget, but would be accounted for as investments, and the funds therefore would not have to be compared with current receipts. Another proposal is for a permanent Joint Congrssional Committee on the Budget, to improve congressional budgeting procedures. Other possibilities that have been mentioned that might improve the budgeting procedures are the establishment of a Council of Resources Advisers to keep an overall eye on the natural resources needs of the Nation. The reports of this Council would provide a helpful measuring rod against which budgetary needs could be measured. It is also suggested that the establishment of a Department of Natural Resources or a Department of Water Resources bringing all water functions into the same department would provide a more uniform method of dealing with budgets and allocation of funds for water resources. On the other hand, it is argued that this would merely transfer the budgeting and allocation process to an inter-departmental committee instead of having it handled in the present way. Numerous other suggestions have been made from time to time.

The author believes that our present criteria for allocating Federal funds might be improved, but that there is no panacea that will solve all of the present problems.

CRITERIA FOR ALLOCATING PUBLIC FUNDS FOR WATER RESOURCE DEVELOPMENT - STATE LEVEL

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The rule for allocating public funds, simply stated, is "where the most good is done for the most people." However, I would be quick to point out that it is much easier said than done. How do we determine where the "most good" is done? When we say "most people," do we mean those directly affected or indirectly benefited? We could accept any statement, principle, or criteria that seems fair and equitable on paper, but in practice abandon or reject it for more practical considerations or pressures. Should allocations be made on the basis of legislative mandate, administrative decision, or from public grass roots support on the basis that the "squeaking wheel gets the grease?"

Should a cost-benefit ratio be applied to state and local water projects as it is on the Federal projects or should a decision be made purely on an economic basis and thereby expect a return on each dollar invested in a reasonable length of time. On the other hand, can you justify expenditures on the regional development approach discussed this morning? For example, a dry industry might locate in a particular region because water had created good recreational facilities for its employees.

If you will pardon my comparison, regional economic development programs sometimes sound like the commercials used by insulation salesmen as they talk about cutting heat costs. If you add the percentage saved by adding storm doors, storm windows, new siding and the like, you wouldn't even need the furnace! Since expenditure for water has become respectable, the benefits derived therefrom, taken literally, would probably wipe out the tax rate! Well, you all know it isn't so--no one ever took out his furnace and they are still paying property tax in the areas where the most successful water development projects are located.

There are, scattered over the country, a lot of "monuments to poor judgement." Most of them resulted from a good job of salesmanship at the particular time,

and a basic lack of education or understanding on the part of large segments of the public. Extensions' role is to educate the public on good and bad points, rather than sell. The reason I point this out is that most economic justifications require a fifty year life barring no obsolescence, and no county extension agent should really want his name chiseled on a poor example.

I have deliberately raised some questions before attempting to outline some of the criteria. These same questions were posed in decisions that had to be made during the time I was Director of the Department of Conservation, a member of the State Soil Conservation Committee, and a member of the Stream Pollution Board. A set of rules or guides are necessary to permit decisions, and they need to be rigid enough to be able to take a firm stand and flexible enough to avoid the all too common bureaucratic mish-mash. Perhaps the best way to illustrate my point is to give you an actual example of a problem that occurred during my tenure in the Department of Conservation.

Prior to my becoming Director, my predecessor, during election time, had publicly promised citizens in the Crawford County area, that a lake would be built on the Little Blue River in Crawford County, Indiana. He had further stated, and it was so printed in the newspapers, that it would be a reality, regardless of who won the election.

A different administration succeeded to power and following the meeting of the legislature, of which I was a member, I was appointed the Director of the Department of Conservation. Immediately I was confronted by local people asking when we would be getting started on the lake to be built on the Little Blue River in Crawford County. After being briefed on the situation and checking with various members of the permanent staff I found that funds simply were not available to do other than maintain the status quo on the regular programs. In addition, our engineering division had made borings at the three proposed sites which indicated it was doubtful whether a lake of the proposed size would hold water.

With funds unavailable and the geology doubtful, we did nothing but try to explain our position. In light of what had been said previously, our inaction was criticized on the basis of politics. In 1963, we proposed a program for the Department of Conservation and suggested an increase in the cigarette tax to

finance it. Our proposed program did not include a reservoir on Little Blue River.

The 1963 General Assembly was controlled by the opposite political party from the Administration and the Chairman of the Resources Committee was the representative of Crawford County. The legislature adopted our proposal and raised the cigarette tax but gave one half to the Flood Control and Water Resources Commission, directing them to consider the Little Blue Reservoir and two other projects which we had rejected.

To make a long story short, responsible people in my agency knew that these projects were not feasible, but did not have a set of standards in black and white. With two state agencies pitted against each other, the Governor, naturally, had to become involved. The Governor suggested that each agency select a competent consulting firm, and the two firms issue a joint report. It was decided further that the two agencies would abide by the decision. In the ensuing study we asked that criteria for selection be outlined and particular projects be subjected to the proposed criteria.

I will list the seven criteria which were developed. Each can be applied to the project I have used as an example. They are as follows:

1. Determination of state interest - (Justification for state to participate. Will people other than local use the facility?)
2. Compatibility - (Is it compatible with existing or planned projects in the area. Does it fit into an over-all water plan?)
3. Functional and physical feasibility - (Are there favorable slopes for recreation? Will the lake retain the water?)
4. Cost (capital, maintenance, operation).
5. Benefits (direct and indirect).
6. Benefit - cost comparisons - (return on investment)
7. Public interest and support - (Is the public interested in project?)

The above criteria were developed, assuming that money would be made available. Another assumption which was made is that the welfare of the state of Indiana and its people collectively, must overrule the interests of state agencies, areas of the state, and special interests groups.

The state also has an interest in other than state projects because many worthwhile projects, such as Public Law 566 may not be carried out because of lack of financial support at the local level. One overriding consideration in a state aid program is that funds should be equally available to all areas of the state. Because funds are limited, criteria needs to be established so that all areas of the state may be assisted in a equitable manner.

We established an arbitrary limitation of one multi-purpose reservoir to the county and/or one watershed. The granting of funds was limited to the following:

1. The construction of dam and spillways.
2. The lands needed for construction of the dam and spillways.
3. The lands needed for the permanent pool.
4. The lands needed for a protective strip around the lake.

The preference or most worthwhile project must be basically decided by the previously stated criteria. Any one of the principle headings can be broken down into sub-headings for more refined analysis.

In the allocations of funds in stream pollution control, the state has determined priority for distribution of Federal funds by a system of points, much of it based on approved plans and the extent of the pollution now taking place. Since considerable local funds are necessary, the available Federal funds allocated by the state have been ready at about the same ratio as local projects were developed.

In summary, there are no absolutes in allocating funds for water development at the state level. The problems are complex enough that over zealous promotion of a project not carefully thought through may cause the decision to be made on a political rather than a logical basis. And, interesting enough, some of the persons who deplore political action the most are often

those that force this kind of decision.

Let me say in conclusion that you are to be congratulated in having this type of conference. Education of the public to the problems and alternative solutions to these problems should help provide an atmosphere whereby more rational decisions can be made.

ALTERNATIVE TYPES OF ADMINISTRATIVE STRUCTURE FOR PLANNING AND IMPLEMENTING WATER DEVELOPMENT PROJECTS

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How do you develop water? We will assume that developing has to do with something that is already in existence. At the risk of sounding naive to the professionals in the water field, I have assumed that the following activities can be classed as water development:

1. Storage for any beneficial purpose.

2. Retardation of flow to increase benefits and minimize flooding and soil damage.

3. Re-location by any means--pipes, aqueducts, ditches, channels, pumps, wells, levees, cloud-seeding, garden hose, buckets, taps, faucets, spigots.

4. Desalinization to make it usable inside of bodies as well as outside of boats.

5. Any other activity that improves water quality for particular uses such as re-circulation.

6. Any activity that reduces pollution and increases water safety and usability.

7. Projects that increase the miles and quantity of navigation.

8. Projects that increase the volume and variety of water use by improving and protecting shorelines and land adjacent to water.

What administrative structures or legal bodies can plan and implement these projects? Allowing for great variety in the extent to which they can do the things just listed, here are some of them:

1. United States and its agencies.

2. Various interstate agencies.

3. The states and their various agencies.

4. Municipalities and their agencies.

5. Counties.

6. Townships.

7. Many kinds of special districts under enabling acts, some with sub-districts:

Soil Conservation	Irrigation
Drainage	Flood Control
Levee	Mosquito Abatement
River Conservancy	Sanitary
Watershed	Water
Surface Water Protection	Water Service
Public Health	Public Water
Park and Recreation	

8. Authorities:

Water
Public Water
Port

9. Incorporated bodies under various incorporation laws:

River Basin or Valley Associations
Watershed Associations.

10. Specially created districts or entities such as the Chicago Sanitary District.

Without proceeding further it is obvious that in most instances there are many alternatives for the accomplishment of the same set of multiple purposes. For example, an analysis of the legal functions of 24 different kinds of Illinois agencies with some water development responsibilities discloses that 12 have a general taxing power, 5 can levy special assessments, 7 can maintain waterworks, 9 can control pollution, 6 can prevent and control flood waters, 4 can carry out drainage practices, 5 can maintain sewerage works, 3 can reclaim submerged land, 4 can alter control watercourses and 5 can acquire land for recreational purposes.

There seem to be four basic kinds of alternatives:

1. An agency of the State or a subdivision of such agency.

2. Counties and townships.

3. Municipalities.

4. Special districts.

All of these have some limitations: Agencies of the State tend to preclude local initiative and control; local political subdivisions are not always clothed with appropriate authority, may not be able to tax equitably for the purpose, and are also not likely to coincide with physically desired boundaries; and municipalities

are limited in jurisdiction. The special district holds the most promise for total water development, though all the others can play a role.

Among the special districts, the most appropriate are those that can best do all the things which ought to be done in a given situation. For example, the drainage district would not be a feasible agency in Illinois for a multi-purpose program because its legal functions are too limited. This is also true of several other special districts--surface water protection, sanitary and public water.

It goes without saying that a district with no power to tax or assess would be unacceptable--the soil conservation district for example--and in Illinois the only example. Some districts may not be able to tax and assess equitably so the burdens and benefits may be properly distributed. Further legislation may be needed.

There is much promise in a cooperative effort under which two or more agencies or special districts legally contract to make a contribution to an enterprise which neither could do wholly alone, but which each can legally support insofar as it achieves a legal purpose of the participating entity without an illegal sacrifice of authority or control, or an unauthorized use of funds. Massachusetts law provides specifically that combinations of political subdivisions of the State and soil conservation districts may constitute a "local organization" for carrying out the P.L. 566 program. New York has provided for "County Small Watershed Protection Districts." It is within the power of the state legislature to enlarge the authority of existing agencies or to create new ones. The real problem is deciding just what is wanted, and then pressing for satisfaction.

In the absence of special districts created specifically for more comprehensive water development, it would seem that the river conservancy district and soil conservation districts with the power to tax provide the most feasible medium. But here again, the method of taxing and assessing permissible under law becomes extremely important. For specific projects not involving a multi-purpose approach some other entity may be much better--the water authority for example. The size of an area can have a profound effect on the tasks to be undertaken, the complexity of organization and involvement with other agencies. The scope of the Muskingum Water Conservancy District program makes it more like TVA than another conservancy district of say 10,000 acres.

In their 1963 report on the status of state watershed legislation, Hedges and Garner point out that the states have provided for additional local cooperation in five general ways:

1. Authorizing state agencies to participate.

2. Enlarging the authority of political subdivisions and municipalities.

3. Giving soil conservation districts or their subdistricts broader powers, including the power to tax.

4. Providing for the creation of watershed districts.

5. Providing for the creation of other special purpose districts including watershed associations and interstate cooperative agencies.

How about the planning function? Lest the discussion become oriented wholly toward carrying out watershed projects, let it be said there is a place for planning agencies, both interstate and intrastate. Water resources boards, development boards, planning departments and commissions and interstate agencies (the Wabash Valley Interstate Commission for example) have a vital role to play in protecting the broader interests involved, and in guiding development so pressures from vested interests can be resisted in favor of better and longer term solutions.

Summary

A variety of legal bodies now exist in every state, through which water development projects can be planned and implemented. More can be added if there is a need. Legislation encouraging more cooperation between agencies, and authorizing them to contract with each other can also be procured if needed. The law on existing agencies can be amended to improve their functioning. If there is local understanding and desire, coupled with the leadership necessary to define the need and push for action, most assuredly there is a local entity which can become the medium for achievement. There are problems to be solved, some of which may not be easy. A knotty one, purposely not discussed here, is how to resolve the jurisdictional disputes which can arise when a larger agency exercises functions which smaller agencies within the larger are also empowered to exercise (drainage districts in a soil conservation or conservancy district for example). Additional legislation may be needed to provide the necessary authority, make resources available in an equitable manner and keep jurisdictional lines clear.

EXPERIENCES WITH WATER MANAGEMENT DISTRICTS IN OHIO

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Watershed management may have gotten its start elsewhere than Ohio. The early drafters of the Ohio Conservancy Law drew some of their ideas from a British version of conservancies used in India. Germany has long had its Genossenschaften, water management associations which operate on a watershed basis. But for the United States the real basic start for watershed management with flood control structures probably can be traced to the Ohio Conservancy District Law which was brought into being in 1914. Some fifteen states and the Province of Ontario, it has been said, have used the Ohio Conservancy Act as a model for the development of similar water management statutes.

The urgency and necessity of developing a Conservancy District law grew out of the great floods of 1913 which wrecked great havoc in Ohio, particularly in the Miami river valley in the southwestern part of the State, where in the city of Dayton and adjoining cities and communities more than 400 people lost their lives. Following the Dayton flood, John H. Patterson of National Cash Register in Dayton organized a citizens flood relief commission which riased over $1,000,000 to provide assistance to flood victims and also to employ engineering counsel to draft a flood control plan. Arthur E. Morgan was appointed as engineer. He later became engineer for the Miami Conservancy District, and then head of TVA.

As Mr. Morgan got into his engineering plan, it became obvious that some kind of a legal vehicle was needed whereby groups of communities and counties and various other political subdivisions could be organized together for water management. Mr. Morgan had developed the concept of developing reservoirs to catch flood waters and this was an entirely new concept for flood protection. Up to this time cities and communities had depended on trying to stay dry behind levees. With the help of competent legal counsel, the Ohio Conservancy Bill was drafted and after many stormy sessions and the appearance of more than 1,000 people before a special Ohio General Assembly committee, the Ohio Conservancy Act was finally passed into law. Shortly thereafter in 1915 the Miami Conservancy District was created and

following several years of engineering and construction, its works of improvement were completed.

The Miami Conservancy District gave to this country the first successful accomplishment in a river basin water management for a single purpose--flood control. It provided a then new concept of locally financed "social cooperation." Its flood storage reservoirs were a new concept in handling flood waters. It pioneered a concept of eminent domain powers in land acquisition for the public good by a public agency. It instituted new labor management techniques. It marked the single greatest and largest special assessment project on private property ever undertaken in this country. More than 75,000 properties were involved.

The passage of the Conservancy Law and the fruition of the Miami Conservancy District were both marked with stormy public sessions and legal action. No law was ever attacked so violently. The Miami Conservancy District officials had to fight their way to the Supreme Court to be sure of their existence. The legal battles which marked the early days in the Miami Conservancy District have not diminished with passing years. The early drafters of the Conservancy Act built in ample safeguards to permit citizen protest and these have generally been used to their fullest.

Today the Miami Conservancy District is one of 32 in Ohio. It provides the general yardstick for measuring the success of the law in the events which have followed in the use of this law in Ohio.

A conservancy district is a political subdivision of the State. It is created by petitions of land owners or political subdivision to the Common Please Court. One judge from each county in the proposed district sits at a hearing to decide whether a conservancy district should be organized. The State may also be heard at such hearings. The court appoints a board of 3 directors who administer the district. They are empowered to employ staff, prepare a plan, undertake construction and administer the maintenance of the district.

A conservancy district may be organized for any one of several purposes: (a) preventing floods; (b) regulating stream channels; (c) reclaiming or filling overflowed lands; (d) providing for irrigation; (e) regulating the flow of streams and conserving water; (f) diverting or eliminating water courses; (g) providing water supply for domestic, industrial and public use;

(h) providing for the collection and disposal of sewerage and other liquid wastes; (i) arresting erosion along the shores of Lake Erie. Recreation has also been added as one of the functions of a district, although it may not be created for this purpose.

Following organization, a conservancy district board of directors prepares a plan which is approved by the court. No construction can be undertaken until the court approves the plan and determines by appraisal that the benefits are sufficient to justify its cost. The court appoints a board of 3 appraisers to make the appraisal of benefits and damages. After the appraisals have been completed the court holds a hearing to determine the exceptions to the appraisal in order to remedy any injustice or any inequity. If the appraisal shows that the benefits are less than the cost, the court may authorize new or amended plans or may disorganize the district. If there is sufficient protest, the court may also order the hearing stopped.

A district is originally financed by a preliminary fund. Under the law it authorizes a levy up to three-tenths of a mill in each of two years. This is a special benefit assessment on property only. A court decision in 1953 held this levy as described in a law to be "a tax". However, the General Assembly in 1959 amended the preliminary levy as a benefit assessment. The maximum that can be levied is 30 cents on a $1,000 valuation in each of 2 years. This money is used to pay the costs of forming a district, engineering and other expenses and appraisals, or generally expenses up to the time of receiving money from bonds and construction and maintenance.

A district may receive contributions to the preliminary fund from the State, political subdivisions, corporations or individuals.

Because of the problems of initial financing, a conservancy district loan fund has been created by the General Assembly and loans from it are recommended by the Ohio Water Commission. This law became effective in 1964 and nine loans have been made of the $250,000 appropriated to it. This liquidated the fund and the Commission is now awaiting the return of loan payments, the first of which is due in December, 1965. The largest loan to date has been to the Hocking Conservancy District for $59,520 and the smallest to the Miami Conservancy District for $14,000.

The improvements of a district are financed entirely through local assessments, or on some projects, are financed jointly by Federal or State agencies with local interests. The local share of the cost can be paid by assessments in proportion to the appraised benefits. Those not benefited do not pay. Property cannot be assessed for improvements that benefit only some part of the district. The assessment is not necessarily a total amount of the appraised benefits--only that percentage required to pay for the improvement. Bonds issued to pay for construction are retired by assessment on benefited property or on benefited policitcal subdivisions.

For many years and in more recent origin, the State has enunciated a policy of the need for water management on a watershed basis. However, despite the Conservancy Law, progress in this direction continues painfully slow and confused.

Despite the fact that the Conservancy Law is 50 years old, Ohio today lacks a single watershedwide conservancy district which can accept and meet the responsibilities of long-range planning and development of water resources, coordination with Federal, State and local agencies, and regulate stream channel encroachments.

A total of 32 conservancy districts have been created since 1915. Their status is as follows:

(1) Of the 32 districts, only one has made and continues to make assessments for water management projects on an area involving more than one county. Yet conservancy law was conceived for multi-county financing of water improvements.

(2) Twelve districts have constructed water improvement projects. Eight have been entirely locally financed, and seven of these have been single county districts. The other four districts have depended on federal programs. Ten of twleve districts constructing projects have been less than a county in size.

(3) Six districts are inactive. They have no plans, nor any indication of preparing any.

(4) Thirteen other districts are in some sort of "planning" status, eight of which are small districts to participate in the federal small watershed program. One of the other multi-county districts in "planning" status is in court litigation.

(5) In one section of the State there are five conservancy districts or subdistricts layered over each other.

(6) Several conservancy districts have been organized with the apparent purpose of "harassing" water management programs of other entities.

(7) The problem of benefit assessment methods for proposed water improvements continues.

(8) The State's role in creation or disapproval of conservancy districts has been weak and ineffectual.

In 1962 efforts to modernize the conservancy district resulted in a new type of watershed district law for Ohio. This law provided a means of creating a watershed district on a major river basin basis for the purposes of long-range planning, to coordinate effort and to provide a means for contracting for construction projects or seeing that construction was done, either through smaller conservancy districts or by the State, Federal Government or some other combination. One feature of the new law provided that regulated stream channels can be authorized after public hearing to prevent the encroachments which would impede flow of flood waters. Action in creating these new districts is undertaken by the chief of the Division of Water who must file a description of the district's boundaries. These boundaries follow the hydrologic divide as close as possible. Within 60 days after filing such description the county commissioners must organize to appoint a 5-man board of directors and adopt a budget for the district.

To date no district has been created under this law, although one appears to be in the offing. While this law leaves greater opportunity for river basin districts to be created, it leaves unresolved the problem of financing and the need to have adequate educational support and ground work laid, so that the creation of such districts are acceptable and given some reasonable assurance of success.

General Conclusions

It is possible at this time to reflect on 50 years of experiences with the Conservancy Law and with watershed management in Ohio from which we reach certain conclusions.

1. The greatest problem the Conservancy District law faces is time itself. Fifty years have elapsed since it was created as a flood control measure. This was before there were active State and Federal programs in water management. It was created at a time when a single-purpose water management project could be implemented

without concern for other needs of water management. The urbanization of Ohio and the trend toward centralization of effort in planning and development is swiftly bypassing a law whose roots are so deeply tied in local pocketbooks.

2. The Conservancy Act is cumbersome. Since it was created for construction purposes and with the concept of local financing, it has had to build into the law many features to safeguard local interests and also to assure local funds. Recent amendments to the law have further added to this cumbersomeness. It is now required that every property being appraised must also have title assured and land owner notified by special letter. The cost of appraisals of benefits and notification of land owners generally exceeds the costs of engineering. For some projects such heavy initial expense make the costs greater than the benefits and notification of land owners generally exceeds the costs of engineering. For some projects such heavy initial expense make the costs greater than the benefits to be derived from the works of improvement. One district has completely exhausted its funds and cannot make a reappraisal of benefits requested by the court. The district is at an impasse despite the fact that four Federal dollars are available for each local dollar. The district is now asking the State to finance it. If the State provides all the finances needed and eliminates the needs for assessment on the private property owners who are protesting, it will have completely assumed all of the financial obligations of the district.

3. In small districts the conservancy court is subject to understandable pressure. Court actions in many instances are adverse to the recommendations of State agencies. Only as it might control loans, the State has little effective voice in stopping creation of unsatisfactory districts.

4. In terms of broad river basin management too many small unrelated water entities are created under the Conservancy Act. In a time when metro-type government and broader regional type of governmental utility services are being pushed, water management continues to be diffused into more and more smaller public entities. The need for local representation and interest on small projects, such as Public Law 566 is desirable. On the other hand, such districts are very difficult to manage because of the excessive overhead costs and the inability of small districts to provide the financing needed to have adequate or competent staff and services.

5. The Conservancy Act, in terms of today's water management concept, does not provide for broad river basin planning. The Conservancy Law conceived of programs which would lead to actual construction of projects. Today with the various Federal and State programs in water management, more effort needs to be directed to coordinated planning and development of water management programs.

6. Another problem in the concept of watershed management is that metropolitan and urban areas often extend over several watersheds or river basins. Furthermore, the water supply for a metropolitan area may need to come from watersheds not a part of the metropolitan area. Since the concept of Conservancy and Watershed District Law applies to the people living in the watershed, the use of the waters within an area by an entity living outside of it understandably presents many problems.

7. There is no assurance that districts will be created. If the State is dependent on a policy of Statewide watershed management wherein State, Federal and local interests are to be assured an opportunity for joint action, there are many gaps when left to a hit-and-miss system of local water management entities.

8. A Statewide system of Conservancy Districts as one of the partners in State and Federal water management appears to have a rather uncertain future. Unless major modifications are made in the law, its use as a tool in water management in Ohio will become less and less signigicant. There are some who feel that even now to attempt such modification would be hopeless.

Regardless of its future, the conservancy district made and deserves its rightful mark as a water management device.

ROLE OF THE LAND-GRANT INSTITUTION IN THE DEVELOPMENT OF WATER POLICIES

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The land-grant institutions have an unparalleled opportunity to play a potent role in the development of water policies in the years ahead. Through their educational activities, both academic (campus) and adult (Cooperative Extension Service), and strong research programs through a Federal-State continuing partnership, they have become a major factor in determining the character of American agriculture and our rural economy. Opportunities now facing them in research and training supporting sound planning, development, and management of our water resources are even greater than those they have had and continue to have in agriculture.

The Water Resources Research Act of 1964 has set up a continuing Federal-State water research and training program with land-grant institutions somewhat after the fashion of Federal legislation including the Hatch Act of 1887 setting up the agricultural experiment station system. Land-grant institutions are designated in the 1964 Act as the location of the water resources research center in a state (one in each state and Puerto Rico), unless some other institution is designated by specific act of the state legislature.

Water Research Centers at Land-Grant Universities

Today, all 51 state centers are established and operating and all but one are located at land-grant universities established in accordance with the Morrill Act of 1862. The exception, Georgia, is a special case. The Regents of the University System in Georgia had designated the Georgia Institute of Technology at Atlanta as the unit in the system where water research would be emphasized, prior to passage of the Congressional Act. The legislature meeting last winter, passed an act designating Georgia Tech in keeping with the earlier action of the Regents. The current water research program, however, involves projects at both Georgia Institute of Technology at Atlanta and the University of Georgia at Athens and the administrative board or council of the water research center has membership from the staffs of both institutions.

Thus far, the state water research centers or institutes are the only means through which the new program is financed and operated. Section 100 of the Act authorizes an annual allotment of federal funds to each of the 51 centers. This current fiscal year the allotment is $87,500. In fiscal year 1967, the allotment is the same, but in 1968, it increases to $100,000 and continues at this level thereafter. Under this part of the program, 378 new water research projects are now underway.

Section 101 of the Act authorizes matching funds for the centers. The centers must match Federal funds dollar for dollar with state or non-Federal funds available to them. Ninety-nine projects have been submitted by 26 of the 51 centers, requesting nearly $3 million in matching funds or nearly three times the one million dollars available in the regular 1966 appropriation. Sixty-two of these 99 projects have been funded with the $1 million. The first supplemental appropriation Act of 1966 passed in the late hours of the first session of Congress October 22, made an additional one-half million dollars of matching funds available. The 1964 Act authorizes $1 million for matching funds the first year (Fiscal Year 1965) and increases this by one million each year until in Fiscal Year 1969, $5 million is authorized. This authorization continues thereafter at this amount.

The center universities are not limited to projects by staff members from their own institution for either the allotment funds or the matching funds, but may submit projects from other universities or other individuals if they desire to do so. With relatively small sums available for both the allotments and the matching grants, the center universities thus far are limited in how much support they can give to research projects outside their own insitution. Nevertheless, several centers, especially where the land-grant university and the state university are separate, have included projects in their allotment programs from the state university. In one state, the center land-grant university included a project from a staff member of a private university in the state in their allotment program. These are good evidences of cooperation and coordination which strengthen the overall water research program.

Pending Amendments to the Water Research Act and Their Significance

Title II of the Act (Section 200) authorizes $1 million a year for 10 years for making grants, contracts,

matching or other arrangements with educational institutions other than those at which water research centers are located; private foundations; private firms and individuals; and local, State and Federal Government agencies. No funds have been requested by the Executive Branch and none have been appropriated to activate the Title II provisions. President Johnson objected to certain wording requiring Congressional clearance of individual projects and requested this part of the Act be amended to remove such requirement.

The Senate has passed legislation amending Title II of the Act to remove the Congressional clearance of individual projects requirement. But it also made three other highly significant changes: (1) it removed the terminating date of fund authorizations of 10 years; (2) it increased the authorized appropriation from one million dollars a year to $5 million the first year, increasing by $1 million each year to $10 million the fifth year, and continuing at that amount thereafter; and (3) it put the center universities in the list of agencies eligible for Title II funding.

The House has not yet held hearings or taken any action of the Senate amendments to Title II. However, several bills have been introduced by House members that are identical with the Senate amendments. If these amendments are approved by the House and become law, the role of the land-grant universities would be a still larger one than the highly significant role they now play in this new water research program, depending on the degree to which they are competitively successful in getting Title II funds. The total annual authorized appropriations under the Act for water research would be slightly over $20 million in place of the present maximum authorization of $11 million, or about double the present.

The Role of the Research Centers

Each state center or institute has the duty of conducting competent research, investigations, and experiments of either a basic or practical nature, or both, dealing with "water and resources related to water", and to provide for the training of scientists through such research, investigation, and experiments.

The Act authorizes a broad area of research, including, but not limited to, aspects of the hydrologic cycle; supply and demand for water; conservation and best use of supplies of water; methods for increasing such supplies; and economic, legal, social, engineering, recreational biological, geographic, ecological, and

other aspects of water problems, giving due attention to the varying conditions and needs of the different states and keeping in mind water research projects being undertaken by other agencies, including Federal and State governments.

Our Office in Washington regards the state research centers as the focal point in the state for planning and carrying out the partnership program. The centers should take the initiative to arrange with other institutions in their state, both public and private, for participating in the water research and water scientist training program. In the case of regional problems, the centers should work with other centers in neighboring states to attack water problems of the region. In the Northeast, 12 states have formed a regional association to attack regional water research problems as a group.

As a rule, the centers are under the general management of a director, appointed by the head of the institution. In most cases, an executive or administrative board for the center is appointed by the president of the institution consisting of staff members from several major divisions or disciplines. The number on the board varies from as low as three to as high as 11, butthe most common are 5, 7 or 9. Where the land-grant university and the state university are separate, staff members of both intitutions are represented on the board. In some cases, representatives from these two institutions and the college of mines and technology or a total of three institutions are represented on the board. In this manner, effective coordination and cooperation within the center university and other universities or colleges in the state is facilitated.

Many of the centers have set up state-wide advisory boards or councils consisting of leading citizens of the state and representatives of Federal, state and local agencies concerned with water resources planning, development, and management in the state. This advisory council can be very helpful to the center director, the executive board and the research staff in helping to plan water research most needed, and to keep unnecessary and wasteful duplication of research to a minimum.

The land-grant institutions with the water research centers located on their campus, should be the prime movers or leaders in developing a strong research and training program in water and resources related to water. They should use every means possible to pull together the total research and training competence of the state

by encouraging water research participation by representatives of all major disciplines within the institution, and among other public and private institutions of the state. Although Federal funds currently are small, this is just the beginning of the program, but coordination and maximum cooperation should be emphasized at the beginning and continued and improved as the program progresses. They should take the leadership role in development of policies that would result in the development of the total uses of a given water resource which would achieve maximum total benefits to the entire population.

The Special Role of Universities in Setting Goals and Developing Policy

Land-grant colleges and universities have an important role in the development of water policy. These institutions have recognized competencies in water and other natural resources research and training and, through agricultural extension programs, in continuing adult education.

Whereas many Federal and State agencies have outstanding capabilities for conducting in-house research on mission-oriented water resources problems and in managing Government-owned land and water areas, the universities are, in many respects, in a better position to develop policies, i.e., the Government can carry on research and management programs very effectively but the universities, with their interdisciplinary composition and capabilities, and their academic freedom, should be instrumental in setting the goals for society and developing policy.

Land-Grant Institutions Have Many Things Going for Them

With respect to the development of water policy, land-grant institutions have many things going for them:

1. They have the water resources research institutes authorized and funded under P.L. 88-379. This law provides the mechanism or vehicle for accomplishing research on most types of water resources problems including socio-economic, organizational, political, and planning aspects.

2. They have recognized leaders in research and training in water-related fields. Staff members through their research and publications, through public addresses, through the made-to-order extension service

programs, through their teaching and supervision of students, throught public forums for adults, through the Universities Council Committee on Water Resources and through membership in professional and scientific societies, can wield tremendous influence in the development of water policy.

3. Colleges and universities have long been looked upon by the public as fountains of knowledge. Research findings from a university study are often accepted by the public as sound, whereas similar findings published by an action agency may be viewed with skepticism or considered to be biased, and a type of whitewashing to support existing or desired agency programs and policies. This might be considered as a psychological advantage which universities have over public or private agencies.

4. Land-grant institutions have many cooperative arrangements with Federal and State agencies other than the programs authorized by P.L. 88-379 which relate to water--the Cooperative Agricultural Experiment Stations, the McIntire-Stennis Program, and the Forest Recreation Research Units supported through the U. S. Department of Agriculture; and the Cooperative Wildlife Research Units and the Cooperative Fishery Units partially supported by the U. S. Department of the Interior, are examples. The universities play an important part in all of these programs and help make policy.

5. Students trained at the land-grant institutions often reflect the attitudes and philosophies of their professors. Whether they assume jobs with public agencies, private industry, municipal groups, or go into business for themselves, they retain many of these attitudes and in their turn, influence others.

6. The expertise available at land-grant institutions among the many scientific and engineering disciplines to be found there, needs only harnessing, directing, and coordinating to develop water policy.

Needed Research and Training Land-Grant Institutions Can Perform

1. Research needed in developing management techniques and producing information essential to water resources management can be performed.

2. Research on methods of developing and evaluating water policies and plans themselves can be undertaken.

3. Water-related courses which involve participation of two or more departments and cut across scientific disciplines can be developed for better training of tomorrow's water resources scientists, engineers, and planners.

4. Adult forums in which outstanding speakers are employed can be very influential in molding public opinion in such a way as to accept or reject water policies, or promote or discourage legislation relating to water policies and planning.

Types of Water Policies Toward Which Land-Grant Institutions Should Work

Insofar as the type of water policies toward which the land-grant colleges and universities should work is concerned, it would seem desirable to broaden our interests well beyond traditional agricultural interests. In addition to water for agriculture, we should consider competing interests including the amenities. We should emphasize quality of water and improved methods of water conservation. We should recognize that a stretch of wild river might be more valuable to more people over a long period ot time if left in its present condition than if dammed for power or irrigation. We should dispel any notion which may still exist that land-grant colleges are oriented strictly to crop production or resource management for resources, and help educate the public in terms of research and management needs and water policies which will benefit society generally now and in the future.

Inherent in the development of a water policy should be recognition of the effects, both current and over a long period of time, of water development on the total ecology of an area and man's place in the scheme of things. Let us consider, for example, the long-term effects of irrigation on the soil; let us consider the effects of phreatophyte (water stealing plants) control on the wildlife of an area; let us think of esthetics as well as strictly economic values, especially the longer run esthetic, social and related values for society generally and not simply the immediate economic or political returns.

Conclusions and Prospects

The land-grant institutions are in a strategic position in the new Federal-State cooperative water research and training program. They have a wonderful

opportunity to play a key role in the development of water policies through this program and those related, associated, or stemming from it.

The role which these institutions play will be limited only by the imagination, cooperation, and coordinating ingenuity and skill of their leaders. With our growing water problems and a growing public awareness and concern of them, the setting is laid for land-grant institutions to reach new heights of public service in the development of water policies that will serve the state and national economies most beneficially in the years ahead.

PUBLIC PARTICIPATION IN WATER RESOURCE DECISIONS

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Some of the things I was planning to say on public participation in the decisions on water have already been touched on by other speakers. Nevertheless, you might be interested to hear one working level bureaucratic point of view as an illustration of the manner by which policy expressions sometimes achieve reality.

I propose to approach the subject by giving you another picture of the environment within which decisions on water are made; one often ignored when proposals are made for procedural improvements. Then, drawing from my own experience, I would like to suggest a means by which public participation seems to have been most effective in the decision process. Finally, I will suggest some of the points which it seems to me the public should be considering if they are to participate.

I want to emphasize at this point that, while I am now an employee of the Corps of Engineers and have been for some years, the views expressed here are strictly my own personal property. So far as I know, they bear no resemblance to those held, officially or unofficially, by the Corps or any other agency.

Obviously, when we talk about public participation, we don't mean that 190 million people study reports and literally decide which course to follow. Nor do I think they should. What I mean is a formal organization of, and the means for presenting, a rational decision-making process which is followed by designated decision-makers and which can be clearly understood by the informed and interested citizen if he so desires. In the field of water resource development at least, it is my opinion that this rational process does not exist. And the obstacles to the establishment of such a process are so great that I seriously doubt if a well articulated

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[1]The views expressed are those of the author's and do not represent the position of the Board of Engineers or the Corps of Engineers.

procedure is likely to be in use very soon. There may be paper formulae, but when the going gets tough it's easy to throw away the book.

There are several basic reasons for this pessimistic view.

Funds for water resource development traditionally have been considered political pork-barrel. This procedure has worked to the advantage of both politicians and public servants and as long as the public maintains a dewy-eyed vision of an idealistic intercourse among citizens, politicians, and public servants this procedure is likely to be around for a long time. Mr. Foltz covered this point rather well.

Another reason has also been touched on before. Professor Milliman has said that even though the data used in the planning decision process is less than the ideal we should still use it because it's an improvement over no data at all. I agree. Mr. Foltz noted that the benefit data were easy to adjust when we need a certain answer to meet certain "practical" needs. I agree. Data contained in technical reports are deficient in several ways. And I exclude the possibility of dishonesty because I'm convinced that, for the Corps at least, benefits get warped under political pressure because many of us making the analyses don't have the professional background to understand the use and importance of scientific method in social science investigation. When we move from the relatively well-defined boundaries of engineering to the relatively ill-defined boundaries of economics, for example, it often seems as though there is no firm basis on which to take a stand. Because of the apparently wide latitude within which economic decisions can be made, the project often gets the benefit of the doubt.

Nevertheless, deficiences do exist. Most reports don't contain enough information to permit a technically knowledgeable person to reconstruct the method followed. The benefit data contained in the reports are not comparable internally, and may bear little resemblance, other than in name, to benefits presented in other reports in adjoining areas or in other parts of the country. For example, benefits attributable to storage for flood control are based on an evaluation of the dollars saved from the estimated reduction in flood damages; the value of water supply storage is based on consumers' "willingness to pay" measured as the cost of the likely alternative source of supply. How can you

avoid a favorable benefit-to-cost ratio on that basis? In contrast, the value of recreation storage is based on a "simulated" market value, currently a consensus of judgement of qualified technicians, and may range from 50¢ to $1.50 or in special cases, up to $6.00 a visitor day.

This lack of comparability of data is compounded by inconsistencies between the published policies established as a basis for analysis and the actual procedures applied to specific studies. For example, as a basis for evaluating navigation projects, the Corps' manual provides a lengthy exposition on the importance of determining and providing for the efficient use of the nation's resources. Within this context, young Turks in the organization have spent many hours trying to work out an acceptable general method for evaluating savings attributable to proposed canals. In discussions, they have based their arguments on the need to show an efficient allocation of resources. However, other employees repeatedly point out that the Corps' function is to determine the value of a canal to prospective shippers; efficiency, regulations and policy statements notwithstanding. The point is that any organization will do that which is considered most likely to enhance the competitive position of that entity. And while I am using my own experience with the Corps as concrete examples, you know that every other agency follows the same policy in the face of competition. Certainly, there seems to be little internal motivation for establishing a firmly articulated and well understood decision-making process. Such a process would greatly reduce the opportunities for the bureaucrat to weigh "sound judgement" on the decision scale.

Finally, the public as an individual citizen, taxpayer, or voter probably is not interested in participating in the decision-making. It is even doubtful whether more rigorous procedures appear desirable enough for him to insist on their application. In fact, a formal system for decision could very well work to the disadvantage of the individual's view of his self-interest. Rarely, so far as I know, is the individual more than generally concerned or interested in the abstracts of good government or the efficient use of the nation's resources. Only if he sees himself gaining or losing does he seem to respond. Then he responds most effectively as a member of pressure groups organized specifically to promote special interest.

Two outstanding and opposing pressure groups from my experience are the Association of American Railroads on one hand and the American Waterways Operators on the other. As you well know, some agencies have developed their own supporting groups - the organization of Soil Conservation Districts for example and could we add the Extension Service? The Corps has not gone that far but there is no doubt that, in practice, the Corps tries to encourage the organization of local interests in the vicinity of Corps projects in order that proponents and opponents may work out their differences at home and before the Corps has to present a program to Congress.

I've mentioned some of the obstacles to public participation which seem most obvious to me. Much effort has been directed to removing or reducing those obstacles but it seems to be that much of that effort is made by people who fail to understand the nature of the friction to change.

Perhaps one of the most important impediments to developing and using a good formal system is that technicians seem never to realize that there is no moral force which will require decision-makers to adopt new, more rational procedures for selecting a course of action. This seems particularly true for economists. Generally, they seem to think that given enough time and with right-thinking, economics-oriented individuals in the decision-making structure, the development of a rational procedure is inevitable. But, as I hope the preceding points have demonstrated, the incentives for real progress in that direction seem to be lacking. Perhaps some improvement may be expected in measurement methods, but a realistic conclusion must be that changes will not be preceded by sudden idealistic enlightenment. While one might expect a bureaucrat to seek, even zealously seek, those methods leading to improvements on <u>non-controversial</u> problems, certainly few, if any, would incorporate those ideas which he may see as being detrimental to his own well-being.

These points have been touched on earlier this week, but I think they bear emphasizing. It seems to me that the most important point to carry from this discussion is that the public must be realistic. Idealistic action in the face of realities will accomplish nothing. And certainly, there is nothing wrong with an individual being concerned with improving his own interests...it's man's nature to wish to continue to exist. It's irrational, even psychopathic, to act contrary to our view of self-interest.

I used to think that the way to upgrade accomplishment in government was to teach society that public service is different from private enterprise. Where the goal of private enterprise is to make a profit, that is, to lengthen the firm's life expectancy, a public servant should consider that his goal is to do the job and get out or in effect to commit economic suicide. So let's face it, a normal public servant and I hope we do have and want normal ones, will try to compete for the public service business just as a grocery store will compete for the grocery business. If we recognize this and apply the appropriate incentives and restrictions in that context, it seems to me that we will more likely achieve those ends we, as the public, consider good, than if we ignore the realities.

It's one thing to recognize reality; it's another thing to face it and do something about it. And I did offer to suggest one possible course that appeared to hold some potential for increasing the public participation as it has been defined here.

The problem, it seems to me, is to identify some center of power which is interested in the same field as the federal water agencies but which has somewhat different ends in mind. At the same time that center should have available the technical capability to enter into a somewhat competitive relationship with those Feds. From my own experience, at the moment, it seems that something on the order of the Indiana organization for dealing with the Comprehensive River Basin Studies is most effective. Essentially, they have established an Ad Hoc committee, composed of representatives from Indiana and Purdue Universities and led by John Dunbar, to advise the state water agency. Perhaps it should be given more formal status, strengthened, assigned the broader responsibility of economic development rather than be limited to water development. On this point, we must be careful not to overemphasize water as a vehicle for economic development.

In any case, I think we must look for a state entity to provide the means for the people to get into the act. The state is the only other major power source. The state has access to intellectual resources and its interests and goals may be sufficiently different from that of the federal organization to provide a meaningful balance. Stronger action here would complement, not substitute for any river basin commission or other organization for water planning, because the purpose of those groups is planning, while the purpose of the state group is to

safeguard the state's interest in all phases of planning and program development. No doubt we will never achieve a perfect balance between federal and state interests, but it seems to me to be a goal to be pursued if public participation in public decisions is to be a real social objective.

Now to suggest the purposes the state organization could serve. First, and most important, it would tend to provide power balance and control closer to the citizens level. Secondly, to enlarge and upgrade the state's source of information, it could exert that power to insist on improvements on some of the reporting procedures we've discussed. Finally, it could provide that outlet for public participation by encouraging development of that rational decision-making process.

More explicitly, here are some of the objectives a state organization, or organizations, might pursue.

The organization of basic economic, engineering and social data is the foundation for rational decision-making. Since much of this should be available from federal studies and reports, a firm expression of state interest and need would tend to upgrade the quality of data developed and used by the federal agencies.

We've been increasing investment in flood control for years, yet we don't seem to be any closer to "control." An organization with the state's interests in mind eventually might inquire whether local people are getting their money's worth from the federal investment. They might insist on greater investigation of alternatives, including, for example, the potential for flood proofing and flood zoning which is indicated by the University of Chicago group. Of course, the local political value of federal construction funds might be too great to permit "better" decisions in all cases. However, there is some evidence that federal funds are parcelled out among the states and regions on some sort of quota system; that each area gets a certain amount of these funds in one form or another. If this is the case, a knowledgeable state agency might find that by choosing federal funds in the form of flood control, the state is foregoing federal funds in a more productive or desirable form. This might be true particularly if flood control could be achieved at least partly by management practices.

Water resource programs help provide recreational opportunities. But how much recreational opportunity

is required in any given area? How much recreation can or should the state's water resources be expected to provide--at what cost and for what return. Further, what economic stimulus would result from water resource recreation, if any, that could not be provided just as well or in greater degree by some other recreational development or even by other state-federal development opportunities?

For decisions on investment in water resources for navigation purposes, we do not know enough about the cost of alternative means of transportation, the potential technological developments in those alternatives or perhaps even in the navigation systems. In fact, I doubt if we really know how navigation fits into the overall transportation system. Surely the state interest in transportation might help to induce a comprehensive view of transportation of which water is a facet, just as we are now trying to be comprehensive in the total water resource picture.

A knowledgeable state agency could provide a meaningful check on the use of water for waste disposal and industrial development. State and local groups should ask how important is water as an industrial location decision factor. To what extent can industry find substitutions for water? To what extent is it in the public interest for them to find substitutes; perhaps an alternative location in certain cases, rail movement as a substitute for navigation or tennis courts as a substitute for reservoirs?

Finally, the states should critically review the way these economic factors are brought together to assist in rational decisions for water resource investments. Are social or political considerations now being included in the economic evaluation which, for rational decision-making, would be better analyzed separately--as "intangibles." More specifically, what are these "intangible" factors, how can they be identified, and how can they be brought into the decision-making process in such a way that the taxpayers know what they are paying for and what it costs? And this, of course, brings up what I believe to be the crux of the whole matter. What is the planning-decision-making process and what factors should be identified and evaluated and how should these factors which bear on the decision be prepared and presented? In looking to state's interests, it seems that a state agency could contribute powerful impetus toward finding these answers.

In summary, it appears that the public can participate in decisions on water only under certain conditions:

1. They must be realistic about the operation of the political process.

2. They must recognize that human self-interest and political power can be tools in the hands of the enlightened citizen.

3. They must devise the political structure which will use these tools to generate rational answers in a rational-decision-making process.

OUR CHALLENGE AS EXTENSION WORKERS IN THE AREA OF WATER RESOURCE DEVELOPMENT AND USE

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When you boil it down, our water problem is providing an adequate supply of the quality we want, where we want it, when we want it. This problem is becoming more important and critical each year. No more water falls each year now than fell when Columbus discovered America. However, the amount of water we use is doubling about each generation. Our population is increasing around 1.5 percent per year; the amount used per person is increasing several percent each year; and the rate at which we pollute that which we do use is going up.

As a nation of farmers, we concerned ourselves with drainage problems in high rainfall areas, allocating scarce water among ranchers, irrigation on arid areas, and walking water dowhill to reduce soil erosion. Improved drainage laws, expanded public drainage systems, small watershed programs and modern flood control reservoirs are evidence of this continuing interest.

Today, two-thirds of our people live in urban areas and this is having great influence on our water development problems and programs. Early city dwellers substituted pipelines of "city water" for their pumps. Then they put bathrooms in their houses. Next, came garbage disposal units. Since most of our people were located along rivers or lakes, water came into town clean at the upper end and went out polluted at the lower end. It was purified by aeration before it reached the next town. Greatly expanded industrial use with pollution from industrial waste, plus the increasing pollution by home owners has increased the waste content of effluent until natural streams and lake water are no longer adequate to flush out our cities and towns. Most of our water must be treated before it is safe for human consumption and more and more must be "depolluted" before it can be dumped back into our streams and lakes.

Water based recreation is also expanding greatly. This includes not only lakes for boating and skiing but also swimming pools in town. Transportation use is expanding.

As these problems grow we are going to have to learn more about how to (1) manage water runoff, (2) impound water where it is needed and valuable, (3) allocate water among competing uses, (4) convert salt water to usable specifications, (5) reuse water, (6) reduce pollution of water dumped into our streams and lakes, (7) develop tolerance levels of pollution for various uses, and (8) determine just how much water we do need.

To solve these problems is going to take vast amounts of new scientific information. Improved technology must be developed all along the line. Federal agencies alone are spending large amounts of money on water research programs in 1965. Research and development to convert sea water will cost $275 million or more. Under Public Law 88-379, water resources research is expected to cost $10 million annually by 1969. These are not large sums when you consider them alongside the $10 billion annually being spent in the United States for physical facilities such as dams, water works, sewage treatment facilities, pipelines, canals and levees. Time Magazine estimates that it will take $40 billion and ten years to clean up our pollution problem.

By now, the challenge of Extension workers in the area of water resource development and use should be abundantly clear. First, programs to extend scientific information of both the physical and biological sciences will have to be expanded for all facets of the water problem, particularly pollution control in urban areas. The total university must be included in this effort. Second, Extension programs in the economics of water supply development must be organized on a continuing basis in every state. Economic information available to the public to help them decide where to spend money for water supply development is almost non-existent when you consider it in terms of the problems ahead.

A high percentage of the decisions necessary for providing an adequate supply of water of the quality we want, where we want it, when we want it have to be made in the public affairs arena. This calls for greatly expanded efforts of the public affairs educator, for it is his responsibility to develop educational programs which will allow people to consider not only relevant facts but also their values concerning each important water issue.

Let me expand this last point further. The Public Policy specialist must help provide information

to make the general public aware of water problems as they exist today and help create understanding of the nature of the problems and conditions that give rise to it. In addition, he must delineate and define water supply issues to have an effective program. Once this is taken care of, he helps develop alternative solutions and analyze them in terms of their probable consequences.

In carrying out these expanded efforts, we should understand that it is our job to provide information leaving decision and action to private individuals and private and public decision-making bodies.

The object of this meeting has been to pull together the best information available in the country on some of our water problems and issues. This is a forerunner to the development of public policy issues involving water.

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