



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

Staff Papers Series

Staff Paper P90-36

May 1990

COST SHARING FOR LAKE/RESERVOIR MANAGEMENT: ISSUES AND PRINCIPLES

by

K. William Easter and John J. Waelti



Department of Agricultural and Applied Economics

University of Minnesota
Institute of Agriculture, Forestry and Home Economics
St. Paul, Minnesota 55108

Staff Paper P90-36

May 1990

**COST SHARING FOR LAKE/RESERVOIR MANAGEMENT:
ISSUES AND PRINCIPLES**

by

K. William Easter and John J. Waelti

Staff papers are published without formal review within the Department of Agricultural and Applied Economics.

The University of Minnesota is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, religion, color, sex, national origin, handicap, age, or veteran status.

COST SHARING FOR LAKE/RESERVOIR MANAGEMENT: ISSUES AND PRINCIPLES*

by

K. William Easter and John J. Waelti**

Introduction

Among the perennial questions arising in public endeavors such as water resources development and management is "who pays for it?" In his classic article on cost allocation, Ciriacy-Wantrup (1954) reminds us that issues such as repayment are among those intricately connected to the allocation of costs. Cost allocation refers to the apportioning of costs (particularly, joint costs) of multiple purpose projects to individual project purposes. In contrast, cost sharing (which we use as synonymous with "repayment") refers to the division of responsibility for the ultimate burden of furnishing real resources used in building a given project.

To clarify the relationship (and difference) between cost allocation and cost sharing, consider the following example. A public water development project may have costs allocated between water supply and flood control purposes as a basis for determining the rate of return for each purpose. Yet it may be decided that the beneficiaries of water supply share in paying for the project, but the beneficiaries of flood

*This will be a chapter in a book entitled "Socioeconomic Aspects of Lake/Reservoir Management", to be published by the International Lake Environment Committee Foundation and UNEP.

**Both are professors in the Department of Agricultural and Applied Economics, University of Minnesota.

control do not. The allocation of costs to a specific purpose does not necessarily imply sharing of the costs by the beneficiaries of that purpose.

Who should pay for lake/reservoir development and management? The objective of this chapter is to delineate key issues, and offer some rationale and policy guidelines for answering this perennial controversial question.

The Social Criteria

Lakes and streams are generally considered to be public resources. Consequently we begin with the premise that these resources should be used for the maximum net benefit to society, rather than with criteria such as maximum net monetary profits to a private entity, or maximum net benefit to a local government unit. While use of the broader criterion of net social benefit entails measurement problems, this complication does not warrant changing the criterion for mere convenience.

While economists are concerned with efficient resource allocation to maximize net social benefits, we also consider equity - fairness in the distribution of income - to be important. In a representative democracy, equity is reflected, however imperfectly, in the political process. Thus, social economic efficiency and political feasibility (the latter as a proxy for equity) are the criteria on which we base the policy guidelines suggested for cost sharing.

Efficiency, Equity and the "Benefits Received" Principle

A good starting point is Ciriacy-Wantrup's 1954 contention that: "It appears economically justified and politically equitable that beneficiaries from public resource development pay for the benefits received--provided such benefits are practically assessable and provided that enough incentive is left for beneficiaries to participate in resource development," (p. 116).

In some cases, this may mean that beneficiaries repay more than the share of total costs allocated "their" project purpose, such as irrigation or hydroelectric power. However, the point that beneficiaries pay something is paramount. In practice, there may be cases where it is administratively infeasible or otherwise impractical to assess beneficiaries for some specific purposes. Cases may also occur where the repayment should be extracted indirectly so that the repayment does not have unwarranted impacts on the incentives to more fully use the resource.

IDENTIFYING BENEFICIARIES

If cost sharing is to be based primarily on benefits received, then we must be able to identify beneficiaries and measure the benefits they receive. For many goods or services, this is not a problem. Consumers pay x amount for goods or services and consume them. The benefits they receive are equal to or greater than the amount they pay, and they have exclusive use of the good or service. Problems arise in valuing goods or services when they are either not exchanged in the market, or there is no exclusive use.

Non-exclusive/Exclusive Goods

A difficult problem arises in the case of non-exclusive goods, i.e., where no one can be excluded from using the good or service (see Table 1 for discussion of terms). Since by definition people cannot be excluded from use, it is also likely to be very difficult to directly collect user charges or fees. If you cannot exclude people from using the good or service, how can you collect fees for such use? Consequently, these goods or services, in most cases, must be financed by the public sector or private foundations. The only question usually involved is that of the level of the public sector to cost share (local, state or national). Many types of recreation and some commercial fishing fall in this category, particularly if the costs of exclusion and/or user fee collection are considered.

Non-rival/rival goods

Many of the goods or services which are non-exclusive are also non-rival goods (sometimes called public goods), where one person's use of the good or service does not decrease its value to others who use the good or service (Randall, 1987). Flood control is a good example of a non-rival and non-exclusive service. Rival goods or services are just the opposite (my use precludes your use). They include most of the normal market goods as well as water supplied from a lake/reservoir for domestic or industrial uses.

Since non-rival goods are not consumed (in the traditional sense) when used, they can continue to provide the same benefits to everyone as long as they are not damaged or congested. Thus, the more they are used,

the larger is the benefit stream they produce. As long as there are no costs to society for added use, then use should not be discouraged. This suggests that the economically efficient user price would be zero because the marginal cost of serving another user is zero. However, this does not mean that the beneficiaries of a non-rival good should not make some payment for the good. A payment scheme can be devised which is unrelated to the amount of service obtained, so that the payments will not influence the consumption decision. The marginal price will still be zero.

This is an efficient policy as long as there is no congestion or other costs associated with increased use, i.e., too many people at a recreation site or added management costs. Once congestion costs occur, user fees need to be charged, based on the congestion costs that one more user imposes on the other users. The marginal cost is no longer zero for another person to use the resource. The marginal cost is equal to the marginal congestion costs, plus any added management costs.

Lumpy benefits

A closely related problem involves the provision of many non-rival goods in large lumpy units. In such cases, the consumer does not have the opportunity to purchase different levels of the good or service. Usually, only one level is provided. The user cannot be charged based on quantity consumed, because only one quantity is provided. It is also likely to be difficult and expensive to determine how much each individual benefits. Flood control is an example of such lumpy goods. A given area is provided with a set level of potential flood protection. This can be varied somewhat by varying the lake/reservoir level, but the range of

flood control is constrained by the physical capacity of the lake/reservoir and its other uses.

DISASSOCIATION OF BENEFITS AND COSTS

Another area of concern involves cases where the benefits from a management activity accrue in a location removed from where the activity (cost) takes place. In other words, one group's or individual's activities create externalities for others. Soil conservation activities in the watershed above a lake/reservoir is a classic example. If upstream farmers or foresters implement soil conservation practices, many of the benefits accrue to those using the lake/reservoir downstream. To get the upstream resource users to apply the socially optimum amount of soil conservation, the downstream interests must develop ways to share in the cost of the practices. Otherwise, pollution levels are likely to be high in the lake/reservoir.

The problem is one of sharing the costs between the pollutee and the polluter. If the rights are clearly specified, it may not be a difficult task. When the users of the lake/reservoir have the rights to clean water, then the polluter must pay to prevent the pollution. In contrast, if the polluter has the right to discharge soil into the lake/reservoir, then the pollutee must pay enough of the costs of pollution control to get the polluter to stop or reduce discharges. The polluter may receive some benefits from increased future production, due to reduced soil erosion, and be willing to pay some of the costs while society, or those damaged, pay the rest.

When the rights are unclear, then cost shares among pollutees and polluters should be based on the benefits received. This assumes that the benefits can be estimated. Measuring downstream benefits from reduced soil erosion is not easy, but methods for measuring these benefits, such as contingent markets, travel costs and changes in productivity, are available (Hufschmidt et al., 1983 and Easter et al., 1986).

COST ALLOCATION

Recall that cost allocation and cost sharing (repayment) for project costs are related, but separate, issues. Cost sharing for a specific purpose, while dependent in some measure on cost allocation, may well exceed the costs of a project attributable for that purpose. To illustrate this relationship, consider an example of a multi-purpose water development project costing \$100 million for irrigation, hydroelectric power, and flood control. The project includes features which are directly attributable to irrigation, such as the distribution canals. It also includes features, such as the generator and turbines which are directly attributable to power generation. However, a major part of the project, such as the dam, and the opportunity costs of the land, are necessary for all three purposes, and hence are not assignable exclusively to either of the three purposes. This is essentially a problem of joint production, and there is no single theoretically best way in which to assign these costs to specific purposes. If beneficiaries anticipate that they will pay for the project in proportion to costs assigned to specific purposes, they have an incentive to apply political pressure to apportion costs to other purposes.

How might such joint costs be apportioned? One method which is fairly consistent with principles of equity and efficiency, and is reasonably simple and operational, is the "separable costs--remaining benefits" method of cost allocation. One of the basic ideas behind this approach, when used for cost sharing, is that repayment and ability to pay are related to benefits received (see Easter and Waelti [1980] for more detail).

In this method of cost allocation, the first step is to calculate the costs of the project without each of the individual purposes. This process yields the separable costs which are assignable to each purpose. In our example of a project costing \$100 million, assume that \$20 million is directly attributable to irrigation, and \$40 million is directly attributable to hydropower power generation. This leaves \$40 million for joint costs--costs which, for purposes of cost allocation, must be assigned with some degree of arbitrariness to the specific project purposes of irrigation, power generation, and flood control.

Under this method of cost allocation, the separable costs for each purpose are subtracted from the benefits for each purpose to attain what are called remaining benefits. (These benefits are estimated as a part of the initial economic feasibility study.) To illustrate the method, assume that the benefits are \$40 million for irrigation, \$80 million for power, and \$40 million for flood control, for a total of \$160 million. Subtracting the separable costs for each purpose leaves $(\$40 - \$20)$, \$20 million for irrigation; $(\$80 - \$40)$, \$40 million for power; and $(\$40 - 0)$, \$40 million for flood control, for a total of \$100 million in remaining benefits. The proportion of remaining benefits for each purpose to total

remaining benefits is then used as the proportion to allocate the \$40 million in joint costs: in this case, $(.2 \times \$40)$, \$8 million to irrigation, $(.4 \times \$40)$, \$16 million to power, and $(.4 \times \$40)$, \$16 million to flood control. The amount of the joint costs, plus the separable costs for each purpose, constitute the total costs of the project allocated to each purpose, i.e., \$28 million for irrigation, \$56 million for power and \$16 million for flood control.

Another approach would be to allocate costs so as to minimize distortions caused by cost sharing requirements that total revenues equal or exceed total costs of a purpose, rather than marginal benefits equal marginal costs (Eckstein, 1958). This method involves allocating costs in inverse proportion to the elasticity of demand for outputs of each purpose. The rationale for this method is that those outputs with the smallest elasticity (steepest demand curve) will have greater price flexibility without causing much change in the quantity demanded. For "a given price change to cover project costs, those outputs which have the least elastic demand will be purchased in the least diminished quantity relative to those with higher elasticity. This suggests that those outputs having low elasticity can be allocated a greater proportion of the costs and priced accordingly for repayment purposes", (Easter, Waelti, 1980, p. 45).

This method might be difficult to implement, since the elasticity of demand would need to be estimated for each purpose involved in the cost sharing. Furthermore, if the cost sharing is also used to allocate the resource rather than just for repayment, one may want to change levels of

use. If this is the case, then allocating costs to purposes with the smallest elasticity may not be as desirable.

Again, we stress that the allocation of costs to a specific purpose does not necessarily imply that the beneficiaries of each purpose should be assessed for benefits received. In some cases, beneficiaries may not be directly assessed at all, while in other cases, beneficiaries might be asked to repay considerably more than the costs allocated to a specific purpose of the project. In fact, in the U.S., repayment has varied widely over time by project purpose (Waelti, 1984).

What factors, other than pure politics and political pressure, might account for what could be construed as different repayment obligations for various purposes? The apparent discrepancy is accounted for by factors discussed earlier in this chapter--namely, differences in the ease of identification of beneficiaries, and the differences in the efficacy and practicality of collection from beneficiaries of various project purposes.

ALTERNATIVES FOR COLLECTING COST SHARES

Once the cost shares have been decided by purpose or type of good, the next question is how should the shares be collected. The method most frequently discussed in the literature is that of user charges. They can be used primarily to collect some of the economic rents (benefits) users receive, or to pay all or some of the project costs. The user charges can also be employed as a means to regulate or limit use of the good or service. The type of user charge best suited for a particular situation will depend on which of the above functions is most important. If regulating use is important, then the user charge must be tied in some

manner to the quantity used. As more is used, the amount paid by the user must go up. This increase in payment creates an incentive for users to conserve the resource.

On the other hand, if we are dealing with a non-rival good and no congestion, and the main function of user charges is repayment, then there is no economic efficiency reason to tie changes to quantity used. All users might be charged the same amount, or the charge might be a percentage of their land or property tax. The users still pay, but the quantity used would not influence the payment directly. For flood control, large scale land owners could pay more land taxes than the small scale owners, but the payment would not be directly tied to the amount of flood protection provided.

In some cases, either because the good is nonexclusive or the cost of collecting from users is too high, user charges are not imposed. For these situations, some level of government and/or some community group must pay for that management service. When most of the benefits are very local in nature, then local governments are best positioned to decide on the level of service and to pay for it. In contrast, when the service provides benefits for users over a wide area, the state or provincial governments should pay some or all of the costs. Again, the share which each level of government pays could be based on the relative share of the benefits which accrue to local users as compared to users from the rest of the state or country.

Local user groups might also pay a share of the costs for non-exclusive goods that mostly benefit a given area, such as an area protected by a flood control project. A flood control district or a soil

conservation association are good examples of such groups that could pay their share of costs.

COST SHARING FOR SPECIFIC PURPOSES

What does all this mean in terms of specific management purposes for lakes/reservoirs? It is clear that the products and services provided by lakes/reservoirs vary from rival goods to non-rival goods, some of which are more or less exclusive, whereas others are non-exclusive. But how can the general rule concerning rival and non-rival goods be applied to lakes/reservoirs? To answer these questions, we will examine products and services provided by lakes/reservoirs in more detail, including water supply, irrigation, hydropower, navigation, recreation, environmental quality and flood control.

Water Supply. Water supply for municipal and industrial purposes is a rival good from which others can be excluded from use. The product can be precisely measured and sold in discrete units. A charge can be levied and collected, and the system can be designed so that service can be cut off if payment is not forthcoming. The major exception occurs in cities where open taps or stand pipes are provided for anyone to use free of charge, or where meters have not been installed.

Finally, since beneficiaries may continue to receive a valuable product long after the project costs are repaid, there is no reason not to continue assessing for the product after the costs allocated to water supply are repaid. There will continue to be operation and maintenance (O&M) costs associated with water delivery, and funds collected in excess of O&M can be used as a sinking fund for major new investment which may be

required. This may be especially important for developing countries where capital is in short supply.

Electric Power. Many of the above conditions for water supply apply to the sale of electricity. Beneficiaries receive a quantifiable product for which a charge can be levied and collected. In fact, the record in collecting from electric power users is generally much better than those from direct water users. The counterpart of stand pipes does not exist for electricity, so it is more difficult to get free electricity. Also, electricity is generally not considered a basic right as, in some countries, is water supply.

Irrigation water. Some of the same conditions for municipal and industrial purposes also apply to irrigation water, since it is basically a rival good as long as return flows are not important. What makes irrigation water different, particularly large gravity flow systems from lakes/reservoirs, is the difficulties involved in monitoring water delivered to the numerous users, and in excluding others from illegally using the water. The water delivery system can be designed, at a cost, so that the product can be measured and sold in discrete units. A charge can be levied and collected, based on amounts received, if the appropriate measurement and institutional arrangements are made. Finally, the system can be designed so that the product can be cut off if payment is not forthcoming. However, for large gravity flow irrigation systems from lakes/reservoirs, water deliveries and charges are very difficult to monitor and enforce. With many small scale farmers, as one finds in developing countries (1 ha average), it is expensive to design a large system that allows the control and measurement of water delivered to each

farmer's field. Consequently, it is difficult to assess water users according to quantities received. The case is quite different, however, for small systems, particularly those supplied by wells.

To get around these monitoring and enforcement problems, new institutional and organizational arrangements may need to be established so that measurement and control is done at a higher level of aggregation than the individual farm. Ideally, water user organizations can take control of the water and enforce water delivery schedules and payments. In many developing countries, this may be essential if irrigation officials expect irrigation users to repay their cost share.

Navigation. Navigation is a less clear cut situation, since it is a non-rival good unless congestion exists. The output is easily identifiable as generally lower cost transportation. Beneficiaries include producers who can ship at lower costs, and consumers who may benefit through lower product prices. In developed nations, to the extent that shipping is done by a few large firms, it is feasible to help pay for public navigation projects through a fuel tax or a charge per vessel or amount of cargo. In developing countries, if beneficiaries are widely dispersed, such means may be impractical. Further, broadly dispersed benefits resulting from lower cost transportation, and its non-rival nature, may mean that no attempt should be made to collect costs from shippers. However, as soon as congestion occurs, fees for use of the navigation channels are justified as a means to reduce congestion costs. Also, if locks and dams are involved, then the cost of an additional vessel is positive, and fee collection can be done at the locks.

Furthermore, the existence of locks provides a means of exclusion for those who do not pay.

Flood Control. As discussed earlier, flood control is a non-rival and non-exclusive good provided in large lumpy units. The benefits of a particular flood control project are the real resources saved, and the increased production resulting from a reduction in flood damages. Some of these benefits will accrue to land and other property owners through increased productivity, which is capitalized into land and other property values. Thus, a tax on land and real estate is one means of capturing some of these gains if repayment of project costs is an important objective. If the fees are based on the value of land and buildings, then payments will be directly related to benefits received, since increases in property value are dependent on the degree of flood protection provided.

Two aspects of flood control deserve mention. First, given that flood control is provided for a specific area, it becomes available to every one in that area. Provision for one person cannot be accomplished while excluding someone else in the area. A fee for service on a voluntary basis is, therefore, impossible. In addition, if economic activity increases in areas outside the flood plane because of the flood protection, a land and property tax in the flood plane would miss these beneficiaries. It may also miss some other beneficiaries in the flood plane.

Second, provision of flood control for the purpose of reducing flood damages can have perverse effects. The mere existence of increased flood protection may increase economic activity in the "protected" region.

Since no flood control measure is absolute, the occasional (and inevitable) "record flood" might cause more damage than before "protection", because of the increased level of economic activity induced by the perceived protection. The net result is that if investment in flood control is to achieve its intended goal of reduced flood damages, other policy tools will be needed. The so called "nonstructural" tools such as zoning will be required to restrict economic activity in the flood plane. This is especially important if beneficiaries of flood protection are not asked to cost share in full for benefits received. If the general public has to pay most of the costs for flood protection in a given area (with the predominant share of benefits going to beneficiaries in the protected area), it is reasonable for that same public to insist that the area not be placed at greater risk through increasing economic activity in the protected area. This is particularly important when the general public is expected to provide disaster aid for flood victims.

In practice, beneficiaries seldom share fully in costs of flood protection, probably through a combination of political pressure and the difficulties involved in collection. Greater efforts at restricting economic activity in the flood plane that usually accompanies flood control projects would, in our view, move in the direction of improving both economic efficiency and equity.

Recreation. Fish and Wildlife. With these goods and services, we move into a group which vary considerably both in ease of identifying beneficiaries and ease of fee collection. Certain recreation activities are non-rival in nature, while others are rival. Some are non-exclusive, and congestion is a big problem for many popular recreation

activities, particularly during peak vacation time periods (weekends and holidays).

For activities such as power boating, it is relatively easy to identify beneficiaries and to exact payment through a boat license or other forms of user fees. With sport fishing and hunting, exclusion and fee collection is more difficult except through a hunting or fish license fee collected by the state. A portion of such fees could be allocated to a specific project to help finance it. Similarly, it may be possible to collect fees for maintaining public camping facilities. For activities such as hiking, biking, bird watching, or swimming, it may be impractical to collect fees. Even if beneficiaries can be identified, the costs of collection may not be justified in light of anticipated revenues from fee collections. Further, the efficacy of collecting fees for such activities may be circumscribed by local custom and tradition and the fact that they are non-rival. For example, the father taking his son fishing is celebrated in American folklore. Similarly, in many parts of the world, the idea of collecting fees for certain activities relating to water and land use may run counter to cultural values.

Yet, fees can be charged for using areas that are set aside for recreation, such as national, state or local parks. As long as entrance can be restricted and fees can cover the costs of collection, a user fee for lake/reservoir recreational services is feasible. The implementation depends on management objectives, the demands for repayment and the level of congestion.

Environmental Protection. In environmental protection, we approach the classic case of the non-rival good, where its provision to one party

automatically includes provision to all parties. One person's use within the protected area does not exclude another's use. In addition, the beneficiaries are, in most cases, not those who cause the pollution. However, for many lakes, pollution by lake shore owners will eventually damage all users of the lake. The pollution is not carried downstream as it is in a river. Thus, lake shore owners would receive some benefits from reducing their own pollution discharges.

Examples of environmental protection include watershed protection through prevention of soil erosion, preservation of aesthetic benefits through enhanced vegetative cover or reforestation, and preservation or enhancement of species of fish, plants and wildlife. These benefits may be difficult to measure in a quantitative, scientific sense. However, inconvenience in measurement neither diminishes the importance nor the magnitude of such benefits where they exist. And, as pointed out above, improved techniques for estimating these benefits are available.

Since much of the environmental damage, particularly in the case of soil erosion, occurs downstream or downwind, there is a disassociation of benefits and costs. If the upstream land users are to use conservation practices, cost sharing arrangements must be provided or regulations imposed. Otherwise, the pollution will continue. This means devising institutional arrangements that allow cost sharing by society or by those being damaged. In some cases, this might even involve outright management of upstream watershed by downstream groups. For example, a downstream community might rent or purchase an upstream area and reforest it. This is a means of internalizing the external costs and should lead to an optimum level of soil conservation. Those damaged by the erosion

would have an incentive to reduce the erosion to a level where the marginal benefits from reduced damages is equal to the marginal costs of added protection.

A number of approaches have been tried to internalize upstream erosion externalities. Before 1920 in Japan, "irrigation associations and municipalities downstream were very active in improving the deteriorated watersheds at their own expense . . . The most common measures taken by the water users downstream were the acquisition of critical watersheds and profit sharing plantations on alien lands" (Kumazaki, 1982, p. 113). Later on, municipalities and power companies shared the costs of upland plantation projects. As water use increased, however, prefectural governments took over more responsibility and "leased the privately owned watersheds and planted tree(s), with financial cooperation for the water users downstream, who in turn enjoyed a certain share of the revenues from the plantations" (Kumazaki, 1982, p. 116).

Thus collective action and cost sharing by all beneficiaries of lake clean-up efforts can be an important way of improving lake water quality and quantity. The level of a country's economic and institutional development, and the degree of pressure on the resource, appear to play major roles in determining the organizational and institutional forms adopted. Early on, formal and informal private and collective actions may be the primary impetus for water quality improvement. As government agencies become technically more capable and efficient, they can play a larger role in protecting water resources.

One of the key components of such collective action is a good understanding by downstream water users of the benefits they receive from

conservation activities upstream. Given this knowledge, then institutional arrangements need to be in place that allow them to assist in conservation activities. If they are cost sharing, then they need to know that the funds will be efficiently used for the desired purposes. When they want to have more direct control, they need to have the option to lease or purchase easements in the upper watershed.

Cost sharing by downstream interests would be considered fair by upstream land owners, since the downstream interests get most of the benefits. These activities may even encourage upstream land owners to engage in more conservation practices. This would be an application of the principle of reciprocity (Sugden, 1984). Since downstream users are installing and cost sharing on conservation practices, the upstream owners may feel they should do their share.

In summary, the general principle of "the beneficiary pays" is usually compatible with both efficiency and equity goals of public lake/reservoir management. However, it is more practical to collect on a "benefits received" principle for those goods approximating "rival goods". For goods which more closely resemble non-rival goods, or for which beneficiaries are more difficult to identify and assess on a "benefits received" basis, there are good theoretical grounds as well as a strong "common sense" basis for financing them from other sources or with indirect taxes. These sources would include state or local governments, water user organizations and the central government if the lake/reservoir generally benefits the whole country.

Table 1 Types of Goods or Services and Cost Sharing Rules¹

	<u>Non-exclusive goods²</u>	<u>Exclusive Goods</u>
<u>Non-rival Goods</u>	Lump sum payments by the government unit closest to beneficiaries.	Lump sum charges to beneficiaries.
<u>Rival Goods</u>	Charges based on amount of good or service provided and paid by user-group or government unit closest to beneficiaries.	Fees charged to beneficiaries based on amount of services or goods received.

¹The cost sharing rules assume no congestion. If congestion occurs, the user charges need to include this cost.

²Definitions:

Non-rival, non-exclusive goods--goods for which one person's consumption does not reduce or subtract from the value obtained by others consuming the same good. In addition, users cannot be excluded from consuming the good.

Rival, non-exclusive goods--goods for which consumption by one person precludes consumption by others. However, individuals cannot be excluded from its use.

Non-rival, exclusive goods--again, goods for which one person's consumption does not detract from any other person's consumption of the same good. However, if one so desired, individuals can be excluded from using the good.

Rival-exclusive goods--this is the typical good that is best provided by the private market. One person's consumption preclude consumption by other consumers and individuals can be excluded from using the good:

Source: Randall, 1987, p. 175-176.

REFERENCES

- Ciriacy-Wantrup, S.V., 1954. "Cost Allocations in Relation to Western Water Policies", Journal of Farm Economics, Vol. XXXVI, No. 1, p. 108-129.
- Easter, K. William, et al., 1986. Watershed Resources Management: an Integrated Framework with Studies from Asia and the Pacific, Westview Press, Boulder, Co.
- Easter, K. William and John J. Waelti, 1980. The Application of Project Analysis to Natural Resource Decisions, 1980 Water Resources Research Center Bulletin 103, University of Minnesota, 169 p.
- Eckstein, Otto, 1958. Water-Resource Developments: The Economics of Project Evaluation, Harvard University Press, Cambridge, Mass..
- Hufschmidt, Maynard M. et al., 1983. Environment, Natural Systems and Development: an Economic Valuation Guide, The Johns Hopkins University Press, Baltimore, 319 p.
- Kumazaki, Minoru, 1982. "Sharing Financial Responsibility with Water Users for Improvement in Forested Watersheds", in The Current State of Japanese Forestry (II). Its Problems and Future, Tokyo, Japan, the Japanese Forestry Economic Society, pp. 106-114.
- Randall, Alan, 1987. Resource Economics: An Economic Approach to Natural Resource and Environmental Policy, John Wiley & Son, New York, 424 p.
- Sugden, R., 1984. "Reciprocity: The Supply of Public Goods through Voluntary Contributions", The Economic Journal, Vol. 94, pp. 772-787 (December).
- Waelti, John J., 1985. "Cost Sharing for Federal Water Projects: Trends and Implications", Water Resources Research, Vol. 21, No. 2, p. 153-158.