P R O J E C T T E R M I N A T I O N R E P O R T

LEGAL, FINANCIAL, AND ECONOMIC ANALYSIS OF A WATER SUPPLY BANK IN IDAHO: A PRELIMINARY REPORT*

Progress Report

BY

Faramarz Damanpour
(Department of Business, University of Idaho)

AND

Catherine A. Hofmann
(Department of Economics, University of Idaho)

Submitted to the
Idaho Water Resources Research Institute
(University of Idaho, Moscow, Idaho)
September, 1978

*Research funded by an OWRT Allotment Grant; Project No. A-061-IDA

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PREFACE

Objectives and Description of Research Performed

It has been suggested that water is being inefficiently allocated in Idaho because there exist no institutional mechanism for the intrastate transfer of water from people with surplus to people with shortages. A water supply bank has been proposed as a mechanism for facilitating water transfers.

The objectives of this study are:

1. Determine the legal, financial, and economic steps necessary in setting up a water supply bank.
2. Determine the feasibility of a water supply bank
3. Determine the cost and price structure of water to be transferred by the water supply banks.
4. Determinine the application of a water supply bank to other regions of the nation.

Presently the following research objectives have been performed:

1. A review of Idaho water law with particular attention to legal issues affecting a transfer and the implementation of water banking. This discussion will address present legal constraints to more efficient water transfers, and the manner in which a water supply bank would over come the constraints.

2. A description and analysis of existing irrigation districts and organizations in Southern Idaho. The emphasis of this analysis focuses on arrangements which accommodate or constrain water transfers among agricultural water users.

3. A formal analysis of the economic criteria for achieving efficient allocation of water, with reference to present procedures and water banking procedures.

4. A formal analysis of the form and structure of a water supply bank as an institutional mechanism to facilitate voluntary water transfers within and between irrigation districts and/or companies.

5. The formulation and design of a survey (to be conducted later this year) to be administered to irrigation water organizations and users in southern Idaho. The survey seeks to measure irrigation farmers' attitudes and acceptance of an institutional arrangement (i.e. water supply bank) to improve and facilitate the voluntary transfers of water within and between irrigation districts. The data derived from the survey will aid in formulating the organizational mechanisms of a functional water supply bank. The results will also generate information on the feasibility of a water market mechanisms. The survey has been disigned to investigate and evaluate externalities, or third party effects which may hamper the market mechanism in water transfers.

INTRODUCTION

The concept of water as an economic resource is gradually emerging as water becomes scarce in relation to demand. In any economic system it is important that resources be mobile in order to adapt their allocation to changing preferences and productivities and assure economic efficiency. One of the efficiency problems faced in transferring water via the market process results from the physical and legal difficulty of ascertaining the nature of property rights. Difficulties arises from the physical interrelation of water supplies, and third party effects resulting from a change in use and/or a change in point of diversion. Devising property-right rules and organizational mechanisms to facilitate voluntary transfer of water is part of the institutional evolution of water as an economic resource.

In this study we attempt to analyze, investigate and evaluate the feasibility of water banking as an institutional arrangement to encourage the efficient allocation of water within the framework of the agricultural irrigation districts of Southern Idaho. We are considering a system composed of many independent users or organizations (districts or companies) who hold property rights to water in a situation where there may be economic forces necessitating water

reallocation but legal prohibitions or uncertainties prevent voluntary water transfers from achieving efficient allocation. Present water law recognizes the interrelatedness of water supplies by protecting users rights, but procedures have not been developed to permit transfers to occur in a manner consistent with economic efficiency. Water banking--the purchase of water from some users by an agency and its resale to other users--is proposed as a mechanism to facilitate voluntary water transfers while protecting existing water rights and entitlements. Institutional water banking will improve private and social efficiency as it attempts to internalize third party effects or externalites which may occur in water uses.

Before going into detail regarding water banking, we will describe the present system and explain why water transfers are relatively rare within the present system.

IDAHO'S WATER ALLOCATION SYSTEM

Since a major section is devoted to the legal discussion, this section discusses water law only in terms of the institutional arrangements. In Idaho a system of government agencies and organizations allocates water according to water law--a complex system formulated over time by the state constitution, the legislature, and the courts. In Idaho,

as in most western states, water law has developed according to the appropriation doctrine.[1] The basis for establishing a right is essentially "beneficial use of unappropriated waters". The right is specified in terms of diversion and use with dimensions of time, location, and quantity of flow. The right is best characterized as a use privilege, since there is no tangible property to which ownership could be claimed.

What constitutes "reasonable beneficial use" is defined in terms of practice through a number of institutional mechanisms namely: through statutes; through rules of the Idaho Department of Water Resources; through court decisions; and through regulations of irrigation (water) districts.

Most water delivery organizations in Idaho were created around the turn of the century. With long canals frequently required to carry water from the river to the arable lands many miles distant, the magnitude of work and investment was beyond the capacity of individual settlers. The task could be accomplished only through cooperation. Most irrigators formed organizations to expedite the construction and maintenance of joint works, collect assessments, and provide the administrative machinery to deliver water. There are

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[1] Wells Hutchins: "The Development and Present Status of Water Rights and Water Policy in the United States"; Journal of Farm Economics, December 1955

nearly 350 water management organizations in the intensively managed Snake River Basin of Idaho. Controls on the flow are imposed by a system of reservoirs and diversions.

Irrigation is the principle use of Snake River system water, it accounts for an estimated 99 percent of the consumptive use. The majority of irrigation districts lie in the Snake River Valley from St. Anthony in Fremont County, to Weiser in Washington County. Others are located in the valleys tributary to the Snake and still others in the extreme southeastern parts of the State.

These irrigation districts or companies are responsible for the delivery of both stored and natural river flow water to users in accordance with existing water rights. These districts supply a specified number of acre feet per land acre per year for irrigation purposes. To receive water from a company or irrigation district, farmers must own shares in the organization; the number of shares reflects the amount of water entitlement. This means that effectively one owns the right to have water diverted to one's land. The irrigation district is a public corporation organized under state law to provide a water supply for irrigation of lands within its mandated boundaries. It is empowered to issue bonds,and derives its revenues from assessments levied upon the land, and tolls charged for water delivery. The lands within the

district frequently are the collateral for the issue of bonds. The primary concern of the district is community development through the irrigation of agricultural land. In most irrigation districts the district rather than its individual members holds the water rights.

Mutual irrigation companies or cooperatives are another form of organization to deliver irrigation water to farmers. They are less numerous than irrigation districts because of financial capital requirements associated with Bureau of Reclamation projects which required large financial committments not suited to the collateral basis of mutual irrigation companies. The distinctive feature of the mutual irrigation company is that land need not be encumbered to finance irrigation works; the irrigation works themselves constituted the collateral. Stock represents the company's capital, with shares representing the right to receive water. Water rights are most frequently held by the individual members rather than the company.

In both forms of organization, ownership of water rights is non-transferable, and the individual farmer usually cannot sell or rent his right to water to another member, although some organizations do allow for transfer or rental of water rights within the organization, and in a few cases rentals can occur to non-members. The quantitative extent

of water transfers within and between irrigation districts is discussed below.

Most water irrigation organizations are governed by a board of directors, usually elected. The directors are responsible for management of the organization, and have supervisory power over the manager, the water masters, and the ditch riders. "Water masters" are usually responsible for the measurement and distribution of an entire water supply, whereas "ditch riders" open the headgates at the river head and at the single and multiple user turnouts.

The time for diversion of water is dependent on the weather, requests for water delivery by members, arrangements with reservoir authorities, and decisions by the water master, and policies of the directors and manager. The typical delivery period lasts about five to six months, May through October.

WATER TRANSFERS-CURRENT STATUS

Water transfers occur among agricultural irrigators in the Snake River Basin of Southern Idaho, but their rarity suggests intitutional impediments or difficulties. The State Department of Water Resources surveyed agricultural water distribution organizations and users in late 1977 and early 1978.[2]

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[2] Idaho Department of Water Resources; "Summary Analysis of Water Organization Survey" Draft 12/23/77; "Temporary Transfer Survey", Draft 4/28/78-unpublished reports

These surveys sought to determine evidence of water transfers and attitudes toward transfers. The surveys specifically attempted to document the extent of temporary and permanent water transfers. Over half of the responding organizations did not allow the transfer of water from one member to another on a permanent basis. Over three quarters of the districts or companies did not allow permanent transfers of water from a member to a non-member. Temporary or seasonal water transfers are often ill-defined and fear of forfeiture of water-rights inhibit users from participating or taking advantage of water supplies through these types of transaction. Less than half (47.1%) of the organizations allow the transfer of water on a temporary basis between members. Less than fifteen percent (14.3%) allow temporary transfer of water from a member to a non-member.

These results suggest that the factor limiting the amount of transference of water rights among users is not the individual farmers' lack of desire to conduct such transactions, but rather the legal prohibitions and institutional constraints that inhibit them. Over all these surveys indicate that farm operators would like to realize the benefits of water market but do not participate because they belive transfers are not legal or may result in a forfeiture of their water rights.

Disparities between existing conditions and the socially optimum conditions might be resolved if water law had more flexibility to facilitate water transfers. Access to water transfers via a market machanism would benefit both society--in the form of increased efficiency in water use--and participants--through mutually advantageous voluntary transactions.

Besides the outright prohibition on water transfers which are part of the provisions governing many irrigation districts or companies, the interpretation of the "beneficial doctrine" may act as an impediment to mutually advantageous transactions. The "beneficial doctrine" has been interpreted to limit all water rights to amounts "reasonably required for a beneficial use." While the doctrine was adopted as an attempt to limit the waste water, it now may have the effect of inhibiting voluntary reallocation of existing allotments to others who may place higher value on the water.

Idaho water law[3] does permit transfer or lease of water rights. These requests for transfers require petition to, and approval by the State Department of Water Resources. In matters involving a change in point of diversion, or place, or method of use, the Director of the Department of Water Resources may hold formal or informal hearing; procedure re-

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[3]Idaho Code: 42-2501-42-2608

quires thirty days public notice to inform parties who might be adversely affected by the transfer. Decisions by the Department of Water Resources may be appealed to the appropriate district court.

While these procedures are critical in assuring the security of water rights, they also tend to create rigidity in water use. Security requires that the appropriator be certain that all deferred revenues and costs will be taken into account and fully compensated if his right is transferred to other users. Voluntary transfer of water rights through buying and selling is the obvious mechanism to assure flexibility as well as security. Strict adherence to "first in time, first in right" interpretation of the appropriation doctrine-- without the market mechanism-- assures security but not economic flexibility.

ECONOMIC EFFICIENCY CRITERIA

In discussions on the allocation of water supplies such terms as "beneficial use," "fair shares," and "reasonable requirements" are often suggested as criteria. These terms are essentially concerned with equity or distributional issues. The difficulty is determining what is "fair," "beneficial," or "reasonable." Economics as a discipline can address distri-

butional questions, but its primary is efficiency criteria. Economics alone cannot give answers to distributional policy issues; it can indicate the costs of inefficiency and how to attain efficiency. Economic analysis can then address what the distributional consequences of attaining efficiency in alternative ways may be.

Economic analysis asserts one universal principle which characterizes an efficient allocation--the equal-marginal value in use principle. The value in use of any unit of water, whether purchases by an ultimate or an intermediate user, is measured by the maximum amount of resources(money) which the user would be willing to pay for that unit. Marginal value in use is the value in use of the last unit consumed, and for any given consumer, marginal value in use will ordinarily diminish as the quantity of water consumed in any period increases. The equi-marginal principle is that all consumers or users derive equal value in use from the marginal unit consumed or used.

As far as efficient allocation of water is concerned the ideal solution is that the value of the marginal product from the resource be equal in all uses. When we take transfer costs into consideration, transfers should take place so long as the disparity in marginal values in use exceeds the transfer costs. If perfect markets for water existed, this result would be

brought about automatically since the higher valued uses could always buy out the lower valued uses at some mutually advantageous price. If resources are to be put to their most efficient use, there should be no uncertainty of tenure or in security of the property right, and no restrictions upon the use. Insecurity of right interferes because individuals will be unwilling to pay for property or its use if a secure right cannot be conveyed. Existing holders of a property will be unwilling to bear the costs in development or conservation of the resources if there is a risk of seizure without compensation. Restrictions upon voluntary choice of use--whether upon place, purpose, or transfer--interferes with the market process which will tend to allocate resources to their most productive use.

In water use the measurement may be considered either a stock unit such as an acre-foot, or a flow such as a cubic foot per second. Value per unit of water resources are usually considered on an annual basis, although the exchange of rights would also involve capital values. The relevant measurement of water use in a productive process is termed consumptive use. In assessing the value of the marginal product of water, determining allocative efficiency consumptive use is an important factor, since the availability of return flow or water re-use potential becomes a part of the issue of efficiency. Upstream use of water has frequently been favored

over downstream use because of the re-use potential of return flow. Where water is transferred some distance in unlined canals or ditches, losses occur through evaporation and seepage, thus the consumptive use and diversion of water may be quite different. An ideal method for valuing water would take account of both gross diversion and consumptive use; recognizing there are two characteristics to the resource--consumptive use and return flow(in the case of streams) or recharge water (in the case of ground water). Valuation procedures would involve a payment for the first use, and credit or compensation for the second. Practical difficulties are inherent in measuring the water returned, especially in the case of ground water return or recharge. Hydrological knowledge and information may be the limiting factor.

Third Party Effects and Efficiency Criteria

As previously mentioned, present water law recognizes the interrelatedness of water supplies by providing procedures to protect users' rights when a transfer is proposed that changes the point or type of us. However, these procedures have not been developed to permit a change or transfer of water consistent with economic efficiency. In situations where there are a number of diversions from a flowing river, stream, ditch or canal, some fraction of the water may be returned to the stream as "return flow," which represents a potential quantity

of water for use. In these situations exchanges between upstream and downstream users affect uses at intermediate locations or sequential use. In these cases the users are partially complementary in the non-consumptive use. Optimal allocation within these situations would be determined by equating marginal products per unit of consumptive use. Allocation among groups of users would require equating joint marginal products.[4]

In general, a test of allocative efficiency between any two points is that the value of the marginal product in the first use plus the value of the marginal product from each succeeding return flow is equal between all points of use. As market conditions for products change, the value of the marginal product of water will change, which will require reallocation of water to achieve efficiency. Because of externalities or third-party effects, the water transfer may not occur, thus economic efficiency will not be achieved. Suppose two parties motivated by profit incentives begin negotioations for a purchase or rental transaction of water that would require changing the point of diversion of water. The greater the divergence in the value of the marginal product of water, the greater the incentive for the transaction.

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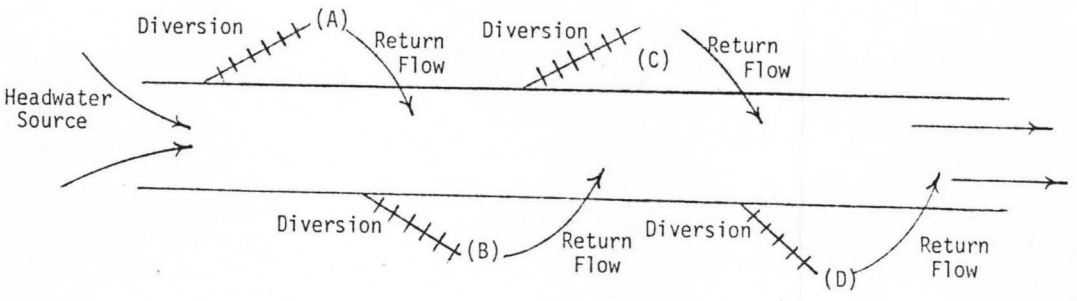
[4]A rigorous discussion of these complexities is provided by Jack Hirshleifer, J. DeHaven, J. Milliman: Water Supply, (Rand Corporation, University of Chicago, 1960); especially Chapter III, "Economics of Utilization of Existing Water Supplies", pages 32-73.

An issue arises concerning the nature of the water right; a change in point of diversion will often change the return flow pattern and affect other users--the externalities or third party effects. Transfers in such cases are generally restricted to the habitual consumptive use. An efficient transfer would occur if the value of the marginal product in the preferred use plus the value of the marginal product of the return flows in this use was greater than the potential suppliers' value of the marginal product plus the value of the marginal products for return flows from his use. Since the two negotiating parties only consider their respective values of the marginal product of water, and not the values of sequential users, the private interests of the two parties above do not result in an economically efficient transfer.

A simplified diagram is provided to more clearly illustrate and examine the transfer problem. The diagram shows a simplified river or canal system. To illustrate the previous discussion, consider a situation where there is an incentive to transfer water rights held at diversion (A) to the diversion at (C). Diversion (B) in the schematic diagram represents intermediate water uses between (A) and (C) that are partly dependent upon return flows from (A), except during reduced stream flows when they may be totally dependent upon the return flows from (A). Users at (D) are likewise, partially

SCHEMATIC DIAGRAM OF SIMPLIFIED RIVER OR STREAM



dependent on return flows from (C). If the water right at (A) is transferred permanently (sale) or temporarily (rented) to (C), then the users at (B) lose the return flows from (A). These flows, if not totally consumed by (C), are redistributed to the users below(C) shown in the diagram by diversions at (D). Present procedures may well prohibit the transfer, or restrict the transfer to the consumptive use at (A) in order to protect the (B) rights that rely on the return flows from (A).

Procedures Facilitating Efficient Transfers

A procedure permitting efficient transfer would make the (C) user free to sell the return flow to downstream users, i.e. to (D). The (C) user could buy the return flow of (A) from the (B) users and transfer the full amount of the (A) right or forego the return flow, transferring only the consumptive use of (A). The achievement of an efficient transfer, however, depends on sale of return flow from (C) to downstream users. The buying and selling of return flows considers both the full sequence of uses of water in its present allocation and the anticipated allocation of the full sequential uses at the new diversion. This procedure would involve internalizing the external costs and benefits in reallocating water into the market's valuation process. Internalization of the externalities would enable potential buyers and sellers to weigh the full productive use of a given quantity of water in present and anticipated use, so that there would be a possibility for the market to bring about an efficient transfer.

This efficient transfer process or procedure would be facilitated by an intermediary agency which could provide information on the externalities, and thus reduce the transaction costs to potential buyers and sellers. In the situation described above, for example this intermediary agency could inform the downstream users (D), that new return flow from

(C) is available for use. This availability would be contingent upon the (D) users compensating (C). The water bank concept would introduce such an intermediatiary agency facilitating and encouraging the market process to achieve economically efficient water transfers.

WATER SUPPLY BANK

There are provisions for the establishment of the water banking concept in the State Water Plan formulated by the State Department of Water Resources and endorsed by the Legislature in the spring of 1978. Policy Number 11 of the Water Plan,[5] as amended states:

> The water supply bank should be established for the purpose of acquiring water rights or water entitlements from willing sellers for reallocation by sale or lease to other new or existing uses, within the State of Idaho, provided anothers' water rights are not infringed nor endangered. Legislation authorizing the water supply bank should also provide the bank to be self-financing in the long run with initial funding to be provided by creation of a water management fund as provided for in Policy 31.
>
> Policy 31
>
> The State of Idaho should establish a major water resource funding program to supplement private and federal monies to develop, preserve, conserve, and restore the water and related land resources of Idaho and implement the State Water Plan. The recommended funds are Water Management Fund, Rehabilitation Fund and Energy Development and Study Fund.

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[5] State of Idaho; Concurrent House Resolution, Number 48, 1978.

A water bank would be established under the auspices of an authorized agency to facilitate the voluntary exchange of water. Prices for water would not be set by the water bank; it would only act as an intermediary, with values and prices of water determined by market forces of supply and demand. Individuals who deposit their water in the bank would receive payment or compensation for its use, and users who withdraw water from the bank would pay the price determined by the forces of demand and supply. The bank acts only as an intermediary between voluntary sellers and buyers, facilitating transfers by providing information, maintaining records, and trying to assure that all the various interests involved in and affected by the transactions are reflected in the market process.

All water deposited in the water bank during one period will be withdrawn during the same period; there would be no carryover from one period to another. Price adjustments will provide the mechanism to assure that the market clears. The higher the price of bank water, the greater the incentive to make deposits and the less incentive to make withdrawals. Individuals will voluntarily deposit water in the bank if the price received is worth more to them than the marginal value of the use of the water. Users, on the other hand, will make withdrawals if the water has a higher marginal value in use to them than the asking price. The relative

value of water to any particular agricultural user depends on the marginal productivity of water, the anticipated prices of agricultural commodities to be produced by using the water, and the cost of water from alternate sources. These values will change as preferences, productivities, and availabilities change. Thus the price of bank water would be expected to vary in time and place as circumstances and forces alter the determinants of supply and demand.

Deposit or withdrawal of water in the bank would be completely voluntary. Participation in the water transfer market via the bank should not affect annual water entitlements, nor existing appropriation rights. Individuals or organizations should be entitled to water the appropriation doctrine allows, regardless of their decision about participation in the water bank. Legal uncertainties over the "beneficial use doctrine" may require legislation to clarify the issue and assure that voluntary water transfers via the bank constitute "beneficial use." Leasing of water, as with leasing of other resources, should not threaten forfeiture of the original property right. This threat may presently be partially responsible for the farmers' reluctance to participate in mutually advantageous water transfers.

Water banking should allow a farmer to use his regular allotted water, deposit part or all of his water entitlement in a bank, or purchase additional supplies. An individual who deposits only a portion of his regular allotment in the bank would still have use of the remainder. Likewise, an individual paying for withdrawals would receive this water in addition to his usual water entitlement.

The purpose of water banking is to improve the economic efficiency of water use and application by enabling mutually beneficial transfers. The resulting market prices will provide explicit information to help guide individual decisions. As a consequence, waste of water and economically inefficient transportation arrangements will be clearer since the opportunity costs will be reflected in market prices.

Terms of Transactions

Water deposits or withdrawals in the bank could be authorized for either a short or a long period. Deposits of water could be for a week, a month, a year, five years, or any length of time selected: the same term selection process could apply to withdrawals.[6] Standard periods may

[6]To facilitate long-term transaction water districts may need to transfer assessments between parcels of land or accept security other than land as collateral for water banking transactions. Michael Brewer in Water Pricing and Allocation with Particular Reference to California Irrigation
(continued on the next page)

be established by the water bank to simplify adminstration. Various irrigation districts and companies have different provisions for water transfers. As indicated in the earlier discussion, there may be outright prohibition against water transfers either because of fear of forfeiture of a water right or possible adverse external effects suffered by third parties. Third-party effects and the use right transfer problem have been discussed, as well as procedures to internalize third-party effects of water transfers. The water bank's role in implementing the internalization process to achieve economic efficiency in water transfers is refined in the discussion below. The threat of forfeiture surrounding water transfers could probably be eliminated by legislation declaring water banking transactions as "beneficial use" of appropriated water.

Both short-term and long-term transactions are operative in California, where transactions between individual members of irrigation districts are limited to one-year periods.[7]

Districts: Giannini Foundation Report No. 235, Berkely, California, University of California; 1960 reports that assessments are transferred by some California irrigation districts in conjunction with intra-district water transfers.

[7]California Water Code, section 22251

Long-term transactions between the state and federal projects or local water agencies are also common.[8]

Reducing Transaction Costs

As indicated in the analytical section, "externalities", adverse and/or beneficial frequently occur in water transfer situations; these hydrologic effects are due to the commonality and/or interdependence of water supplies in the hydrologic cycle. Present procedures (administrative and legal) restrict or hamper market water transfers because the transaction costs contemplated or incurred under these requirements can be greater than the mutual advantages and benefits to potential buyers and sellers. Water banking is envisaged as an innovation seeking to reduce these costs, thus facilitating more efficient allocation of water through a market mechanism.

Transaction costs are incurred for several reasons. There are costs in time and effort involved in obtaining information on potential buyers and sellers--economists call these "search costs"[9] There are also costs of securing

[8]California State Department of Water Resources; The California State Water Project in 1975, Bulletin no. 132-75; (Sacramento, California, 1975) and U.S. Bureau of Reclamation; Executed Contracts and Water Shortage Plans, Febuary 1,1977; (Sacramento, California, U.S. Dept. of Interior, Bureau of Reclamation)

[9]George Stigler: "The Economics of Information", Journal of Political Economy; Vol. LXIX, No. 3, June 1961.

property rights, or verifying water rights which enable owners to make decisions as to use. Costs are also encountered in assuring the right to transfer or trade these rights with others. Legal enforcement of performance, and policing of transactions are possible additional costs.

Currently, water masters, irrigation districts, the State Department of Water Resources and the courts-- the institutions administering water allocation according to "water law"--have procedures to execute water transfers. These institutions' procedures are only incidentally concerned with efficient mechanisms to lower or reduce the transactions costs associated with voluntary water transfers. Their procedures are actually more likely to increase transaction costs, since they were primarily designed to protect water rights rather than provide the right to transfer or trade these rights.

Water banking will reduce "search costs" for voluntary market participants by providing centralized information on potential buyers and sellers of water. The resulting water prices will also provide guidance information on the explicit opportunity costs and benefits to individuals making decisions on water uses and quantities to be utilized. By facilitating the establishment of rational prices of water, the bank will help to reduce ignorance of alternatives due to lack of information. Water banking should provide centralization

of information, thus enabling voluntary trading activity to occur. In the sense that search costs are reduced, transaction costs should also be reduced.[10]

Transaction costs should also be reduced substantially when water banking transactions are recognized as constituting "beneficial use" of water, removing both the uncertainty of security of water rights and the right to transfer or trade water rights. By consolidating or eliminating the present time-consuming legal and administrative procedures needed to transfer rights, the water bank will reduce these transaction costs. More rapid resolution of the present uncertainty of security and transfer rights will reduce the time and effort currently required.

Other economies of transaction costs will result by standardizing contracts and centralizing the recording of transactions. These devices provided by the water bank will reduce the cost of enforcing contracts and assuring their performance. Costs of negotiating transactions will be reduced as the information provided by market prices will be conveyed through a centralized exchange.

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[10] For a fuller discussion of transaction costs see H. Demsetz; "The Cost of Transacting", Quarterly Journal of Economics, Vol 82, Feb. 1968.

In reducing transaction costs, the water bank would permit greater development of the market process in allocating water usage, yet assure the security of ownership of water rights. Flexibility of water usage and economic efficiency should result as the value of the marginal products and the marginal costs of water change to reflect changing preferences, productivities, and availabilities, through the calculus of prices. Holders of water rights will transfer or rent their property right to the most productive uses as owners of property, motivated by self-interest (i.e. profit motive) and guided through the price system. In order to achieve these results, property rights require clear definition; water rights will require definition in terms of the full conditions of diversion, so the right becomes cetain. While all"externalities" will be difficult to determine and assess, damages to third-parties can be alleviated through the payment of compensation to injured or harmed parties, <u>if</u> property rights are clearly defined. As an intermediary the bank will expedite the determination and assessment of these externalities by providing specialized knowledge and information on hydrology and law when a change in point of diversion or change in method or place of use of water is considered. The coordination of the market process by some institution is necessitated by these externalities.

Since the framework is conceptual in this discussion, the aspects of structure, form, and performance of the bank outlined here will not include all the refinements and details afforded through actual operation. The intentions have only been to suggest the intermediation role of the water banks in developing the market process to solve problems of water transfers.

PRICING

Under water banking, prices of water will be determined primarily by the voluntary deposits and withdrawals of water and will reflect the underlying forces determining demand and supply within any discrete time period. Since the water bank acts as an intermediary to facilitate market exchange, it will be providing a service which should be included in the prices paid by buyers of water. The charge for these services will be in addition to the price paid by water buyers to water depositors, and will compensate the bank for costs incurred in facilitating transactions. These costs represent transcation costs, but as has been suggested they should be lower than under current institutional arrangements.

In the banking system deposits and withdrawals will be a function of the anticipated price of water. Individuals or organizations will deposit water in a bank if the monetary return or price received is worth more to them than the value of the marginal productivity of water in their uses. Essentially this water will be surplus to these individuals at some reservation price. Similarly, individuals or organizations will decide to withdraw water if the value of the marginal productivity of additional water is greater than the additional cost or price to be paid for it. The reservation price or minimum asking price of suppliers (depositors of water) may well be determined largely by the assessments which many irrigation districts or companies have levied on water right holders to cover capital improvements embodied in irrigation works of a district.

Economic variables other than the price of water will also determine the quantities deposited or withdrawn. Potential values of the marginal productivities of water actually in use influence the quantities demanded and supplied. Suppliers will offer water for transfer if the price to be paid for its use is greater than the values to be derived from utilizing it themselves; than the value of the marginal productivity of water in their uses. In the case of agricultural uses, the expected prices of various

agricultural commodities will induce changes in the desired quantities of water to be utilized in producing these commodities because these prices reflect the value of the marginal productivity of water. The optimal level of utilization (or conservation) of water will be guided by the price of water as decision makers choose those quantities of water which equate the value of the marginal productivity of water to its marginal cost.

Innovations in management, capital, hardware, or techniques will also influence decisions on water utilization by altering productivities and thus the marginal values. Prices of these inputs (capital and labor) also affect the optimum quantities of water to apply; as the relative prices of these change, substitutions will occur. While primarily a function of price supplies of water will also be determined by factors affecting their physical availability. Natural factors such as precipitation are obviously significant. In years of drought the market prices will tend to be high as supplies are generally reduced, while in years of abundant precipitation flows will be greater consequently prices will tend to be low. Actual prices received and paid will also differ because of transportation cost. Since surface distribution of agricultural waters requires conveyance to individual farmers, transportation and distribution costs will have to be incurred and paid by withdrawers. A

practical consideration is that because of different locations and use patterns, the marginal costs of delivery will vary. The solution is to have prices equal marginal costs to account for the difference in transportation and distribution costs; prices may differ because of the difference in marginal costs. Experience in California during the recent drought tends to confirm these expectations. Some Bureau of Reclamation customers paid $150 per acre foot for water when normal Bureau rates averaged three dollars per acre foot; in this particular case transportation costs represented nearly half of the price paid.[11] These startling prices were paid because the value of the marginal productivity of water to these users was worth at least the $150 per acre foot.

Prices will also differ between water suppliers and buyers to provide compensation for third-parties damaged by water transfer transactions. Insofar as water banks will be authorized to compensate third parties harmed by water transfers, these costs will be added to the price charged for withdrawals. Compensation could take the form of decreased assessments or charges for water, or could be direct monetary payment. For instance, if the deposit of water

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[11] Reported by Neil Schild at the Water Transfer Workshop; Graduate School of Public Policy, University of California, Berkely, California; May 20, 1977.

by an individual into the bank resulted in the loss of return flows to others (third parties), the bank could compensate the damage by increasing the price charged for withdrawing that water and distribute the compensation to the damaged parties. If third party effects are extensive, the compensation charges would be large. If withdrawers are willing to pay the price, the transaction will be voluntary and mutually beneficial. If the price is too high, then the third-party effects (costs in this case) will exceed the benefits of the transfer, and the transaction will not occur. Just as third-party costs are incorporated in the market process, the water bank should try to account for third-party benefits that occur as a result of bank transactions. In this instance third-party benefits would be deducted from withdrawal prices; ideally third-party beneficiaries should be assessed for the benefits they receive as a result of water banking transactions, to prevent windfall gains from occurring. The bank's function will be to try to foster equality and equity of benefits and costs.

Models of Pricing

A formal pricing model should be developed to incorporate the variables and determinants suggested as affecting incentives to deposit or withdraw water from the water bank.

The relationship's complexity requires careful specification of the functional and structural forms. Models formulating part of the process have been developed using fixed programming models and the technique of linear programming.[12] However, few of these models try to formally incorporate "externalities" or third-party effects. Richard Hart is currently conducting an examination of water prices under various transfer arrangements. While his research is primarily concerned with water quality, the results of his investigation should reveal data on the transfer problem. Hart's preliminary study[13] conceptualized the issues and formulated several alternative hypotheses for resolving the transfer problem ; water banking was one of his suggestions for improving the economic efficiency of water allocation and transfer. Empirical examination will be required to test and evaluate his hypothesis. A formal pricing model incorporating all the variables and their functional

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[12] Micheal Greenberg and Robert Harden; Water Supply Planning: A Case Study and System Analysis, (Rutgers, the State University of New Jersey, New Brunswick, N.J. 1976) and Mark H. Anderson; "An Economic Analysis of Supply and Demand for Irrigation Water in Utah: ALinear Programming Approach," (M.S. Thesis, Utah State University, Logan, Utah, 1973)

[13] Richard Hart, "Water Markets and Water Quality," (Preliminary report submitted to the Idaho State Department of Water Resources," August 1978)

relationships has not been developed. The equilibrium requirements suggest certain identities must hold; pricing will be contingent on these:

$$P_{wb} = P_d + T_c + S_{wb} + C_e - B_e$$

P_{wb}: the transaction price for water bank withdrawals

P_d : the price paid to water banks depositors

T_c : the transportation and delivery cost of water

S_{wb}: the service charge or transactions costs incurred by the water banking agancy

C_e : the compensation to third-parties injured by banking transactions(i.e. external costs)

B_e : an assessment to third-parties benefitting from water bank transactions (i.e. external benefits).

These will vary with time, location and the determinants of supply and demand for water: the determinants should be modeled in a functional model capable of application.

ADVANTANGES OF WATER BANKING

The advantages of water banking will accrue both to the individuals participating in water banking transactions, and society at large. Individuals will have access to a viable market process where voluntary exchange can be mutually beneficial. Individuals depositing water in a bank will be able to capture the implicit rent in the value of their asset (water right) as additional income. If the water right is permanently transferred, the value of this income earning asset will be equal to the discounted value of the future income stream of the asset, i.e. $V = \sum_{t=1}^{n} \frac{R_t}{(1+i)^t}$

where V represents the value of the asset, R represents the annual income stream, and i is the rate of discount. In this case the experted rental value will be capitalized in the price of the asset (water right). If transfers are on a temporary basis, the price received would represent the rental value for use, with a time limit to the use right. Individuals paying to withdraw water from the bank will benefit by having the opportunity to use water in order to maximize the productivity in a productive process from which they benefit.

The absence of a free market process to transfer water or water rights has denied these potential gains or benefits both to individuals and society. In providing the development of a market process water banking will aid the develop-

ment of more rational prices of water. Users presently lacking the guidance of ratioal prices of water are often unaware of the opportunity costs of water; consequently they may misallocate or overutilize water, or even waste it. Rational prices guide efficient allocation while irrational prices act as a disincentive to achieve optimum utilization and allocation. With water banking transactions recognized as "beneficial use," voluntary exchanges through purchase and sale of water will produce more rational prices. Rational prices in turn will guide and direct water to uses that maximize waters' productivity, and help to achieve economic efficiency. The movement to optimality in terms of economic efficiency improves over all well being or social welfare.

Rational pricing will also make the opportunity cost of water explicit to users and holders of water rights. Profit incentives guided by rational prices will direct users to the optimum level of conservation and utilization of water and water will be allocated from less productive uses to more productive uses.

Increased economic efficiency as a by product of water banking will provide gains or benefits to all society. When economic efficiency is improved the total output of goods and services or total income is enhanced. By helping to shift water from production of commodities with low values in the market place to commodities more highly valued in the market, total productivity and well being will be increased.

Water banking should also result in more efficient transportation of water. The current inflexibility of water allocation often requires water users to backhaul or cross-haul[15] water in order to obtain additional supplies through development of other sources. While bartering is sometimes used to solve these problems, it becomes difficult when more than two parties are involved. Water banking, by providing a monetary exchange mechanism, would facilitate such multi-lateral trades. Inefficient transportation and delivery of water would be alleviated by providing more rational alter-antives. Water users would also be encouraged to prevent waste of water through seepage and evaporation if they were more aware of the true opportunity cost of this waste. Explicit pricing of water via the market machanism, facilitated by water banking will provide this true cost.

SUMMARY

We have tried to analyze the water allocation system presently operative in Idaho. We suggest that much of the present misuse of water is due to a lack of a market

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[15] Mason Gaffney; "Diseconomies Inherent in Western Water Laws: A California Case Study," Conference Proceedings of the Committee on the Economics of Water Resource Development of the Western Agricultural Economic Council, Report No. 9 (Tucson, Arizona, Jan. 23-24, 1961)

mechanism to transfer water or water rights. Water law and its interpretation and administration appear to be constraints on the development of market transfers of water and water rights. Lacking a market mechanism, the economic benefits and costs of water are difficult to assess, thus users are not encouraged to seek economically efficient allocation.

Transfers are rare at present because of the fears of legal forfeiture of rights, and also because of outright prohibitions on transfers. Evidence suggests that transfers are desired by irrigators and users but legal constraints and uncertainty of security prevent actual transactions from occurrring.

"Externalities" or third-party complications are also a constraint on water transfers and may be the basis of the institutionalized legal constraints or prohibitions. They occur frequently in water transfer because of the interdependence of use. Economic efficiency in the use of water can not be achieved without the guidance of a market mechanism. Water banking, an intermediating agency, appears to be a fruitful innovation to improve the development of a market process enabling the transfer water and water rights. Voluntary participation in water deposit and withdrawal in a bank would be encouraged by the development of a rational price system, a development which would be facilitated

by water banking. Water banking would do this by providing information and services in securing water rights and the right to transfer or trade them. By reducing transaction costs, which are probably prohibitive under current institutional arrangements, the bank would make voluntary exchange mutually beneficial to water users and holders of water rights.

The water bank will try to resolve the externalities problem by internalizing the external benefits and costs into the market transactions of water transfers. In the case of external costs incurred in water transfers, the third-parties will be compensated in monetary terms or in kind (water). Third-parties to who windfall benefits accrue through water bank transactions will be assessed for those benefits by the bank.

FURTHER RESEARCH REQUIREMENTS

The major thrust of the analysis of this study has been theoretical--the conceptualization of water transfer issues and the proposal of water banking as an institutional innovation to improve economic efficiency in the allocation of water. Empirical testing of these theoretical expectations, however, requires the collection of data and the analysis of data to evaluate the expectations.

Institutional procedures were investigated and analyzed in terms of their logical effects. While some survey data was evaluated, it was insufficient to empirically estimate the diseconomies of present water transfer procedures and the economies of water banking. Further efforts require derivation of these estimates. A survey of water users and water management organizations in Southern Idaho's agricultural irrigation districts has been designed to achieve the data, and will be conducted later this year upon the approval of the State Department of Water Resources. Results from this survey will help yeild quantitative estimates of the costs and benefits of water banking. Data collected through surveys should provide insights into the development and refinement of a pricing model which can facilitate application of the concept of water banking. The survey is also intended to appraise the more purely financial

fessibility of water banking. Present assessment procedures of many districts and companies raise complex issues of financial responsibility which require resolution before water banking can become functional. Current financial commitments and arrangements between districts and federal agencies, (i.e. Bureau of Reclamation) in water delivery will require special detailed legal and financial analysis. The legal and financial transactions incidental to an operating water bank will have to be developed so that legal rights of all parties are protected. All of these research requirements must be met before the operating structure, form, and details of a water bank becomes operational. Implementation will require knowledge of the actual benefits and costs incurred by participants. Uncertainty about these costs and benefits may prevent acceptance of the water banking concept. Therefore reliable costs and benefits estimates are critical. The research methodolgy to accomplish the empirical requirements outlined above, has been discussed and explanined in the original research proposal.[15]

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[15] Damanpour, Faramarz; Hofmann, Catherine; and Wegman, Jerry; "Legal, Financial and Economic Analysis of a Water Supply Banks in Idaho," Idaho Water Resources Research Institute, Project No. A-061-1DA. 1978.

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