The Colorado River Salinity Problem: Direct Economic Damages in Mexico

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The Colorado River winds for over fourteen hundred miles from its headwaters in the Rocky Mountains before it discharges into the Gulf of California in Mexico. In common with most rivers in arid lands, the Colorado accumulates dissolved salts (salinity) in its course to the sea. These salts are picked up from both natural sources (dissolved in surface runoff or discharged from salt springs) and man-made sources (irrigation return flows, municipal and industrial discharge). From a near pristine quality in the high mountains, the mineral concentrations in the waters of the Colorado reach 800-900 parts per million (ppm) in the lower basin, and still higher levels in Mexico.

The "United States-Mexico Treaty for Utilization of Waters of the Colorado and Tijuana Rivers and of the Rio Grande," signed in 1944, provides that Mexico is guaranteed an annual quantity of 1.5 million acre-feet (m.a.f.) of the waters of the Colorado River. Neither the quantity nor the quality of the water was an issue until about 1961. Prior to that time, Mexico had received flows well in excess of treaty requirements, which served to dilute saline irrigation return flows from the U.S. to a quality very nearly of that utilized in California and Arizona. (Physical, legal and economic aspects of the problem are detailed in the "international Symposium on the Salinity of the Colorado River." *Natural Resources Journal,* Volume 15, Number 1, January 1975. See also Herbert Brownell and Samuel Eaton.)

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The authors are grateful to Resources for the Future, Inc., Washington, D.C., and the Colorado State University Experiment Station for research expenses. During most of the period of the research, Dr. Oyarzabal was supported by a doctoral study fellowship from the Government of Mexico. None of these agencies necessarily endorses the opinions expressed here.

However, in 1961, the Wellton-Mohawk Division of the Bureau of Reclamation's Gila Project in southwestern Arizona commenced operation of a system of drainage wells which discharged saline water into the Colorado below the last U.S. diversion point. The drainage water had an initial salinity of 6000 ppm, since it consisted in substantial portion of ground water that had been concentrated through re-use over several previous decades of irrigation. Also in 1961, a reduction in deliveries to Mexico had an impact on water quality. For the period 1951-60, Mexico received, on the average, over 4 m.a.f. per year. Due to the need for storage in Lake Powell, behind the nearly completed Glen Canyon Dam, the average flow after 1961 dropped to the compact limit, 1.5 m.a.f. As a consequence, the waters delivered to Mexico were degraded to over 2000 ppm for a period in 1962 as compared with about 800 ppm in 1960.

High concentration of salinity in the irrigation water reduces yields of crops. Acreage of land cropped in the Mexicali Valley fell as marginal lands were abandoned due to decreased yields and as the irrigation district reduced water allotments to cope with the lower supply level. The Mexicali farmers reacted vigorously and formal protests to the U.S. were lodged by the Mexican authorities.

Consequently, a series of argreements were negotiated, and the U.S. undertook measures to reduce the impact of saline return flows. These steps included construction of an extension of the Wellton-Mohawk drain so as to provide Mexico with the option of bypassing the drainage waters or accepting them, and replacing a portion of bypassed waters with pumped or storage water in excess of the treaty commitment. As a result of these efforts, the annual salinity concentration dropped to more tolerable levels, reaching about 1200 ppm by 1970 and 1971.

The Mexican Government initiated an extensive program to rehabilitate the irrigation district facilities in response to the reductions in water quantity and quality. An estimated $100 million (U.S.) has been spent in lining canals, improving drainage, and consolidating lands served by the system.

Further negotiations were undertaken beginning in 1971. In 1972 President Nixon assigned former Attorney General Herbert Brownell the task of finding a "permanent, definitive and just" solution to the problem. As a result, an agreement was reached in August, 1973, which was approved by the two presidents and incorporated into Minute 242 of the International Boundary Commission. A key provision requires that the U.S. deliver to Mexico waters with an average annual salinity of not more than 115 ppm (± 30 ppm) above the quality of diversions at Imperial Dam (the last U.S. diversion point). To implement this provision, the U.S. proposed construction of a major desalting plant for Wellton-Mohawk drainage waters, as well as other temporary steps to reduce the impact of Wellton-Mohawk salinity. Pending construction of the desalination facilities, the water quality is being maintained by bypassing Mohawk drainage water and substituting upstream stored waters to meet the treaty quota.

Minute 242 assures Mexico a water quality not much different from that of Imperial Dam. However, further agricultural, industrial and energy development in the Colorado River Basin may raise salinity on both sides of the border.

We recently developed a function which relates economic damages in the Mexicali Valley to various degrees of salinity in irrigation water. This damage function enables the prediction of direct economic impacts on the Mexicali region economy of any changes in water quality caused by water management activities upstream in the United States. Further, since benefits of pollution abatement programs are equavalent to downstream damages avoided, the damage function can be employed to estimate program benefits (Peskin and Seskin). In this paper, we summarize our procedures and findings, and discuss some policy implications.

The Study Area

The region studied is the area under jurisdiction of the Water Resources Ministry, Irrigation District No. 14, known as the Colorado River Irrigation District. The District is located next to the U.S. border on both sides of the Colorado River, and comprises the Mexicali Valley in the state of Baja California and the San Luis Valley in the state of Sonora. For convenience, the entire region will be referred to as the Mexicali Valley.

Water rights are available for 203,000 hectares (about 500,000 acres) and the system serves about 11,900 farmers. Due to land tenure reform programs, the holdings are small and relatively uniform in size. Private property landholdings account for 43 percent of irrigated lands, while "ejido" holdings (federally owned, but individually farmed) account for the remainder. In both classes, about 20 hectares (49 acres) is the modal size. Water is available for only one crop cycle per year for any given landholding.

As elsewhere in the lower Colorado River Basin, the climate is hot and dry. Average rainfall is a little over two inches per year, while potential evapotranspiration is estimated at 92 inches.

Soils are basically Colorado River alluvial deposits, similar to but with somewhat better drainage than those in the Imperial Valley. About twenty-three percent are heavy soils with poor internal drainage, while medium textured soils with adequate drainage acount for the balance.

In addition to surface water supplies from the Colorado (1.5 m.a.f.), about 1 m.a.f. is pumped from aquifers, mainly in the northeastern section of the region. (Since ground water is also pumped in Arizona from the common aquifer, a conflict over distribution of these waters is emerging.)

Concepts and Procedures

Economic damages from degraded water quality arise from decreased resource productivity and/or increased production costs (Peskin and Seskin). However, alternative production technologies may be employed which are less expensive to the farmer than suffering the damage. Hence, a net income change measure of damages is more appropriate than simply a crop yield reduction approach.

We estimated net returns at each water quality to provide points on a curve of net returns to water quality. The regional salinity damage function is then derived by relating predicted net income at various levels of Colorado River salinity as compared to net income at the selected base salinity level. This process is equivalent to the technique for measuring water supply benefits known as the "change in net income" method, in which the maximum willingness to pay of affected producers is taken to be the net producer's income with, as compared without, a public project or program (see U.S. Water Resources Council and Young and Gray).

The effect of alternative water quality levels on net farm income is analyzed with a series of linear programming models. For any given water quality, the model will select the cropping pattern, irrigation frequencies, and, implicitly, the amount of water to apply which maximizes net return. The procedure is similar to that utilized in the preceding paper by Alan Kleinman and Bruce Brown, and is based on the approach developed by Charles Moore and others (see also Young, *et al.*, 1973).

Assumptions. The usual rationality and optimizing conditions from production economic theory are postulated. The conditions necessary for aggregation of linear programming models are assumed to be met (see Paris and Rausser). The model is developed to represent the current, post-rehabilitation status of the water distribution and drainage facilities, so our results are not necessarily representative of the damages which actually occurred at the onset of high salinity immediately after 1960. Prices and production technology which existed in 1975 are assumed. Prices in Mexican pesos are converted in this paper to U.S. dollars at the current official exchange rate of 12.5 pesos to the dollar. Impacts on regional economic sectors which are indirectly linked to irrigation crop production are not considered. It is likely that indirect impacts were large, particularly in the period immediately following the drastic decline in water quantity and quality. Household and industrial impacts are also not considered, although, due to a relatively low consumption rate, they are not considered to be large.

Methods. Considerable detailed data about the actual production practices and resource organization were required to develop the models. For primary data on resource organization and production technology, a survey of the Mexicali Valley was carried out during the summer of 1975. Interviews with 189 farmers in the area were obtained. The sample was stratified according to land tenure and soil type (see Francisco Oyarzabal-Tamargo for details).

The estimation of yield decrements to salinity follows Robinson's approach which utilized the criteria given by the California Committee of Consultants report for salt tolerance of crops. A ratio of soil extract electrical conductivity to irrigation water conductivity for each soil type was obtained. Assuming a steady-state balance in each soil, irrigation management influence was taken as a function of the soil layer from which water was extracted by the crops. Five levels of irrigation water applications were considered. The soil salinity value computed for each level, and the corresponding yield declination was obtained from relationships presented by the California "Committee of Consultants Guidelines" and from Maas and Hoffman. The proportions of constituent ions in dissolved solids in Colorado River water are assumed to remain constant over the range of salinity studied. Crop yield decrements estimates are adjusted to reflect the high gypsum ($CaSO_4$) content of Colorado River waters.

For the models, the Mexicali Valley was divided into the two soil types, and further stratified by two property types and two degrees of mechanization. The seven main crops (cotton, barley, sorghum, wheat, alfalfa, rye grass, and safflower) were considered. Models representing crop production in the Mexicali Valley for the various salinity levels each consisted of 280 real activities (7 crops x 5 irrigation practices x 2 soil types x 2 tenure types x 2 technology levels = 280). The net income and resource requirement coefficients were calculated for each of fourteen salinity levels, from 700 ppm to 2000 ppm at 100 ppm increments. For each irrigation water salinity level, a "maximum" value of the Valley net returns was obtained, together with estimates of optimal cropped acreages.

The threshold level for detrimental effects on yields of crops commonly produced in the area is 700 ppm. Net returns are reduced when salinity levels are above 700 ppm, due to estimated decreases in crop yield and changes in crop acreage as salinity increases. Cost of water per hectare, as well as the irrigation labor costs will increase as salinity increases—because more water and more careful and frequent irrigation will be needed.

A smooth curve fitted to the points of estimated regional net income as related to irrigation water salinity is shown in Figure 1.

The difference between the "net income" function and the base "net income" results in the damage function for the Mexicali Valley. A polynominal of second degree fitted to the damage projections by regression procedures yielded the following equation:

$$Y = -7423 + 4.08X + 0.0091X^2$$

Where: Y: Estimated annual damage (10^3 \$U.S.)
X: Irrigation water salinity (ppm)

The damage function so obtained appears in Figure 2.

Marginal damages can be computed from this function. Marginal damages are smaller at lower concentrations than at higher concentrations. The marginal damages vary from U.S. \$16,000/ppm within the 700- to 800-ppm irrigation water salinity range to U.S. \$39,000/ppm in the 1900- to 2000-ppm range. The average marginal damages for the whole salinity range considered (700 to 2000 ppm) is U.S. \$28,620/ppm. Converted to area terms, the annual damages are approximately U.S. \$0.050 ppm per acre (when the function is evaluated at 1200 ppm).

Other analyses were performed to assess the sensitivity of the results to alternative assumptions concerning irrigable land, water supply and commodity prices. While the aggregate net income function (Figure 1) was shifted in these cases, total and marginal damage estimates were relatively unaffected.

Implication for Salinity Abatement Policy

We present in this section some illustrative computations of direct economic damages associated with specified increments of irrigation water salinity levels. Implications for water management policy from the perspectives of both Mexico and

Fig. 1. Effect of irrigation water salinity on aggregate net income, Mexicali Valley (\$U.S., 1975 prices)

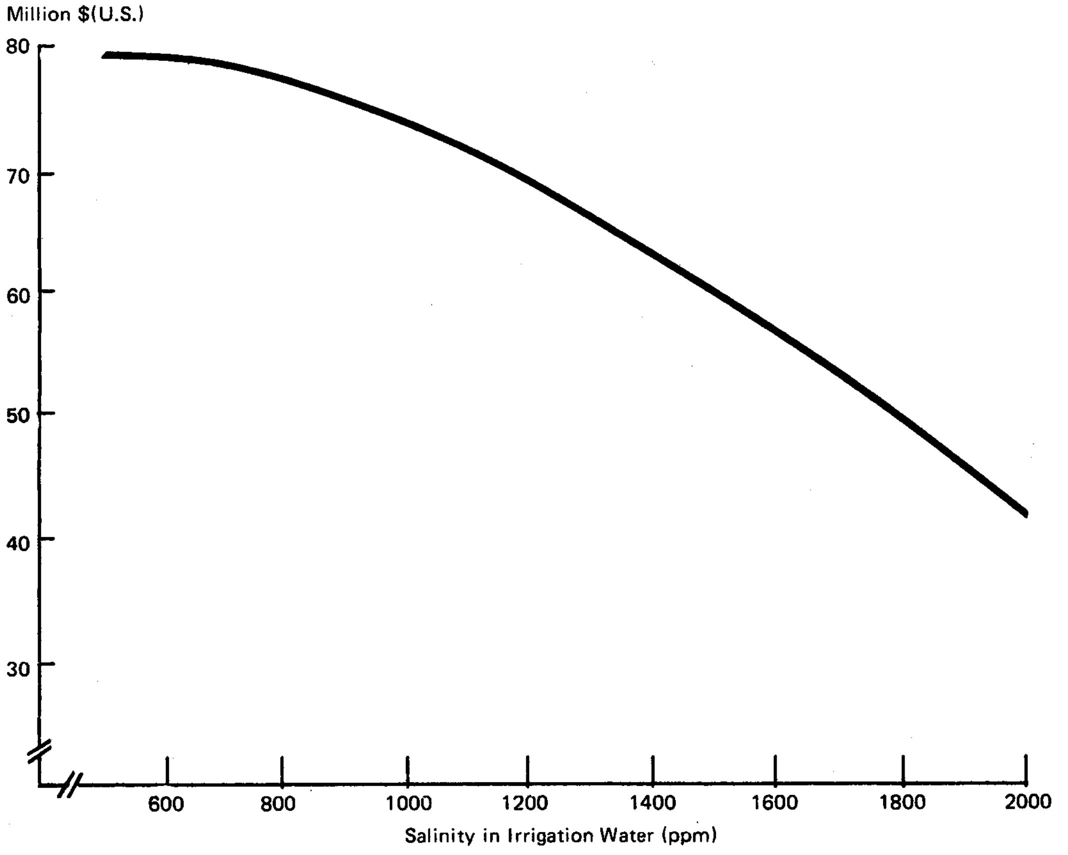
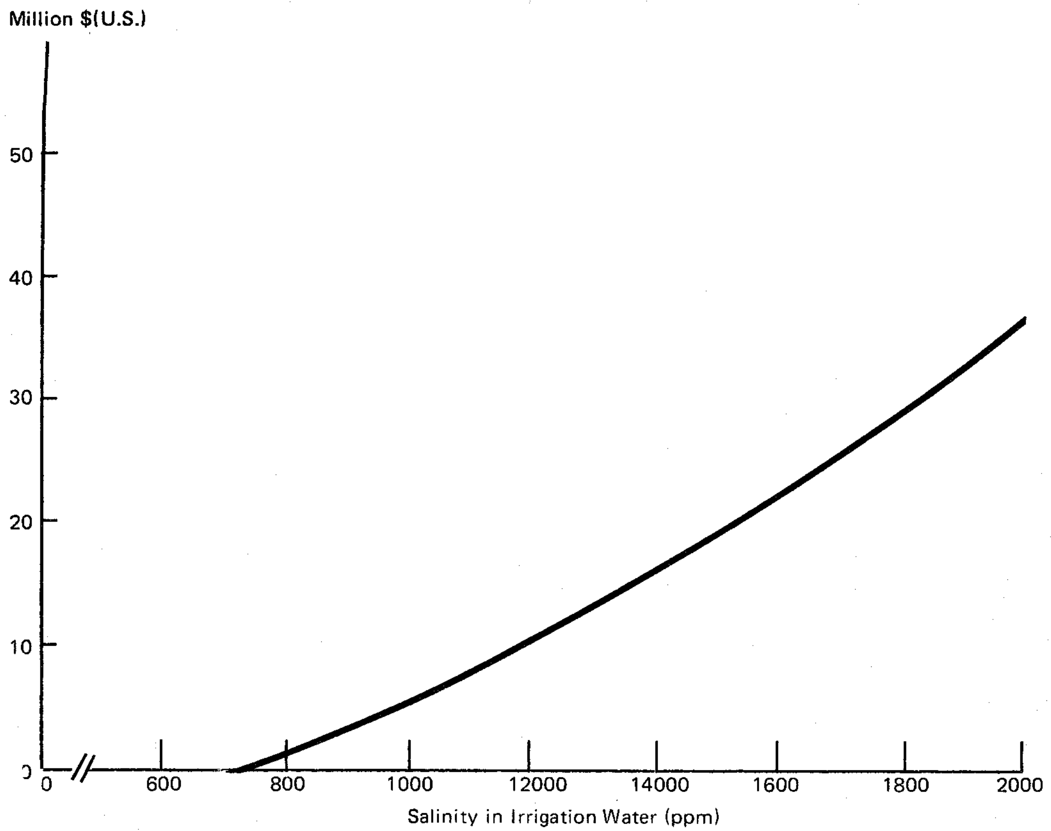


Fig. 2. Projected economic damages from alternative salinity levels, Mexicali Valley ($U.S., 1975 prices)



the United States are pointed out. While the damage function can be employed to measure benefits to Mexico of any change in water quality, we limit our discussion of policy implications to the possible impacts of return flows from the Wellton-Mohawk Division in western Arizona. Saline water from the Wellton-Mohawk drainage system is the principal source of the additional salt which has created problems for Mexican farmers and precipitated the conflicts between the U.S. and Mexico over the past fifteen years.

Implications from the Mexican Viewpoint. The Wellton-Mohawk drainage system over the recent period of years discharged an average annual flow of 220,00 acre-feet with a total dissolved solids concentration of about 3,700 ppm (U.S. Office of Saline Water and U.S. Bureau of Reclamation, 1974), If drainage water of this quality is mixed with regular Colorado River flows to help meet the 1.5 million acre-feet compact obligation, an increment of some 400 ppm in the quality of water received by Mexico is implied.

Assuming the water salinity in the Colorado River before it is augmented by the Wllton-Mohawk drainage water stands at 950 ppm, the direct damages to the agricultural sector in the Mexicali Valley were computed from the damage function. These computations imply that a 400 ppm increment in dissolved solids would impose an annual cost of U.S. $0.051 per ppm per acre. Given this estimate of direct cost for a salinity increment, the direct aggregated damages at Mexicali Valley are U.S. $10.2 million per year.

For another perspective, we can calculate the cost per farm. Villareal reports that the modal farm in the Mexicali Valley comprises about twenty hectares or about 49 acres (see also Oyarzabal, table 4). The direct annual damages to a typical farm for the assumed salinity increment are U.S. $1008. This figure represents over 10% of the average farm gross income. (It is important to add that such estimated average direct damages are for increments in salinity of 400 ppm in the range of current levels. In the case of the much greater salinity increments which occurred in the early 1960's when the Wellton-Mohawk drainage system started pumping water with salinity concentrations of more than 6000 ppm, the annual direct cost per acre would have been for a short period two to three times higher. Further, the improved irrigation and drainage systems which were installed to cope with increased salinity and reduced water supplies were not yet in place. Therefore the actual damages in the Mexicali Valley were probably even larger than would be estimated by our damage function.)

Irrigation water salinity increments, of such magnitude as that described above, represent a considerable loss for the individual Mexicali Valley farmer, and precipitated a prompt and vociferous reaction on his part. These estimates of economic damages make it clear that the protests by the Mexican Government to the U.S. Government over the quality decrement were fully justified. It is also clear that the sharp reduction in water quality and quantity experienced in the Mexicali Valley in 1961 required the major irrigation system rehabilitation program that the Mexican government initiated in 1968.

Mexico can be seen to have achieved most of its objectives in the 1973 salinity agreement, but some concessions were made. The main problem, the impact of the Wellton-Mohawk drainage water, will be largely solved. However, the Mexican authorities accepted a small increment in salinity (115 ppm above that at Imperial Dam). More significant, no compensatory payments for past damages were received. However, linking Mexico's water quality to that at Imperial Dam will assure Mexico of sharing in any future improvements in water quality which might be achieved when the proposed Colorado River Water Quality Improvement Program is implemented in the Upper Colorado River Basin.

Economic Considerations in Determining U.S. Salinity Policy Regarding Mexico. The U.S. response regarding Mexican objections to increased salinity has proceeded from a) denial that there was a problem, to b) denial that there was an obligation to solve the problem, to c) grudging steps toward its solution, to d) full acceptance of responsibility by the U.S. for controlling Wellton-Mohawk salinity. We believe that acceptance of responsibility for the salinity of Wellton-Mohawk project return flows represents the only legitimate position for the U.S. However, it is not at all clear that the water management measures for fulfilling the terms of Minute 242 proposed by the Brownell Commission represent the most economical solution to the problem.

U.S. policy makers must make decisions on two aspects of salinity control regarding Mexico. The first decision involves choice of which level (or levels) of the government (federal, regional, state, local district) and if the private sector water users should assume responsibility for implementing and financing the control program. Economic efficiency considerations would suggest that the economic units which are the source of the problem, the Wellton-Mohawk Division water users, should be confronted with the external costs which they are imposing on the downstream user. Faced with the total social cost of their irrigation practices, Wellton-Mohawk Division water users, should be confronted with the external cost of their irrigation practices, Wellton-Mohawk Division farmers would be expected to alter their allocation of resources in such a way as to move toward a level and mix of production activities which maximizes productivity of the water resource. Equity considerations also suggest that those responsible for the problem bear the costs of mitigation, rather than passing the cost off to the federal taxpayer, although in this instance, the point is less clear. (The contrary argument runs somewhat as follows. Since the federal government, through the Bureau of Reclamation created the Wellton-Mohawk Division, it should assume financial responsibility for any unanticipated side effects of its earlier water development programs. The point has merit, but its acceptance would perpetuate the situation in which the local beneficiary groups who, in fact, initiate reclamation projects remain in a "no-lose" situation. Irrigation projects are typically financed in such a way as to assure that water users receive a generous federal subsidy. It would seem appropriate that, along with the gains, project beneficiaries accept at least some proportion of the risk of unanticipated spillover effects.)

The second decision facing the U.S. involves the choice of technique for mitigation or solution. Possible mitigation techniques range from, on the one hand, structural approaches (which involve engineering works of some sort) to changes in rules and incentive systems. While the politics of water resource management has invariably favored approaches emphasizing construction of facilities by federal agencies and financing from the public treasury, non-structural approaches may often provide much more economical solutions to water management problems (see Gilbert White).

The Brownell Commission proposal centers around construction and operation of a desalination plant on the Wellton-Mohawk drain near Yuma, Arizona. It also includes a program to achieve improved irrigation efficiences in the Division, a reduction in the Division's size and other, mostly temporary actions. Costs of the plan would be largely obtained from federal appropriations. This proposal was selected by the United States from among other alternatives considered such as: 1) total shutdown of the Wellton-Mohawk Division; b) augmentation of the Colorado River by an exchange agreement for substitution of water from the California State Water Project or by weather modification; c) a moratorium on future development in the Colorado River Basin; d) no action (see Brownell and Eaton).

The proposed solution can be seen to embody federal responsibility and financing and an engineering-structural approach.

William Martin has criticized the proposal, noting that it represents a structural/engineering solution which avoids confronting the institutional causes of the problem. Disincentives to polluters are not even included in the alternatives considered.

With regard to the issue of establishing responsibility for the salt discharge, the opportunity to assign the costs where they belong, to Arizona, was apparently missed. A President whose authority was crumbling from the Watergate affair, and who himself was a southern Californian, did not insist that the federal taxpayer not be the source of the solution. Arizona thus can "have its cake and eat it too." That is, degraded return flows will not be charged against Arizona's Colorado River entitlement, an that State will not be faced with hard choices about whether to use water in the Wellton-Mohawk, elsewhere in Yuma County, or in Central Arizona.

Two examples will suffice to show that a non-structural approach can be much more economical than the desalination plant alternative. Our first case is the economist's favorite policy instrument, an effleunt tax (Kneese and Schultze).

A direct charge on saline return flow is probably technically infeasible, due to the difficulty of assigning drainage water to specific producers. However, a tax levied indirectly on water deliveries is more practical, since water supplied to individual producers can be readily measured. An equitable method might be to impose a charge for water delivered in excess of reasonable evapotranspiration and leaching requirements.

An efficient effluent charge should reflect the damages imposed on downstream water users. Without a complex hydro-salinity model, the precise effects of a reduction in drainage water on total salt discharge cannot be determined. However, some rough calculations could be suggested. Our computations show that damages in the Mexicali area amount to about $46 per acre-foot of drainage water released from the Wellton-Mohawk Division. The findings of Kelso, Martin and Mack indicate a water charge of this magnitude on excess water diversions would be expected to have a significant impact on water management and salinity in return flows.

We have also analyzed the economic desirability of direct compensation to Mexico as an alternative to the proposed desalination plant. The U.S. Office of Saline Water and the Bureau of Reclamation's Environmental Impact Station indicates an annual cost of $16.5 million (even at 1973 prices) for capital and operating expenses for the desalination complex. We reported above an estimate of 10.2 million in annual damages in Mexico. Direct reparations for damages is therefore a less expensive approach, by over six million dollars per year.

If the federal government is to be responsible, a more desirable alternative would be to avoid any irreversible commitments to a desalination complex and keep policy options open. We feel that the interim solution which is in effect while the program planning takes place, probably is the most efficient course for some time, perhaps for two or more decades. Drainage water is being bypassed without charge to the Mexican quota, and the full 1.5 million acre-feet is being supplied from upstream releases. In spite of considerable rhetoric to the contrary, water is not scarce at present in the Colorado River Basin. Arizona and the Upper Basin states do not at present use their allotment, and will not do so for some years. The California Water Project provides southern California with a supply of good quality water which will suffice for the remainder of the century. Hence the realistic alternative use for much of the water supply is adding to storage in the Basin. Two hundred twenty thousand acre-feet per year to replace Wellton-Mohawk drainage will not involve any significant sacrifice of alternative uses for the next decade or two. Even then, only completion of the Central Arizona Project combined with massive energy development (oil shale, coal gasification) would create demands in excess of expected supplies.

Conclusion

The problem of salinity in Colorado River waters entering Mexico has been perhaps the most troublesome issue in Mexican-American relations in recent years. The technical complexity of the problem and the strong political forces on either side of the border have made it difficult to achieve a mutually satisfactory resolution.

The salinity damage function estimated for the Mexicali Valley implies that inclusion in the Mexican water quota of untreated saline irrigation return flows from the Wellton-Mohawk project would cause net income reduction of over ten million dollars per year. This finding confirms the validity of the Mexican protests on the issue.

The acceptance of responsibility by the U.S. for the quality degradation is laudable, and plans to implement the intent of the 1973 agreement should be carried out. The structural solution—a desalination plant—is excessively expensive, and a long-term solution which involves shifting of incentives so as to discourage excess salt discharges should be sought on both efficiency and equity grounds.

References

Brownell, Herbert, and S. D. Eaton. "The Colorado River Salinity Problem with Mexico." *American Journal of International Law,* Vol. 69, No. 2 (June 1975):255-69.

Holburt, Myron E. "International Problems of the Colorado River." *Natural Resources Journal,* Vol. 15, No. 1 (January 1975).

Kelso, M. M., W. E. Martin and L. E. Mack. *Water Supplies and Economic Growth in an Arid Environment: An Arizona Case Study.* U. of Ariz. Press, 1973.

Kneese, A. V., and C. Schultze. *Pollution, Prices and Public Policy,* Washington, D.C., Brookings Institute, 1975.

Maas, E. ,V. and G. J. Hoffman. "Crop Salt Tolerance—Current Assessment." U.S. Salinity Laboratory, ARS, USDA, 1975 (To be published.)

Martin W. E. "Economic Magnitudes and Economic Alternatives in Lower Basin Use of Colorado River Water." *Natural Resources Journal,* Vol. 15, No. 1, (January, 1975):229-39.

Moore C. V., P. C. Sun and J. H. Snyder "Effect of Colorado River Water Quality and Supply on Irrigated Agriculture." *Water Resources Research,* Vol. 10, No. 2 (April, 1974):137-44.

Oyarzabal-Tamargo, Francisco. "Economic Impact of Saline Irrigation Water: Mexicali Valley, Mexico." Unpublished Ph. D. dissertation, Colorado State University, 1976.

Paris, Q., and G. C. Rausser. "Sufficient Conditions for Aggregation of Linear Programming Models." *American Journal of Agricultural Economics,* Vol. 55 (November, 1973).

Peskin, H. M., and E. P. Seskin, eds. *Cost-Benefit Analysis and Water Pollution Policy,* Washington, D.C. Urban Institute, 1975.

Robinson, F. E. *Salinity Management Options for the Colorado River.* Calif. Agr. Exp. Stat., Univ. of Calif., El Centro, 1974.

U.S. Office of Saline Water and Bureau of Reclamation, Dept. of the Interior. *Colorado River International Salinity Control Project, Environmental Impact Statement.* Int. Des 74-39 (April 1974):24.

U.S. Water Resources Council. "Principles and Standards for Planning Water and Related Land Resources." *Federal Register* (Sept. 10, 1973), Washington, D.C., U.S. Govt. Printing Office.

University of California *ad hoc* Committee of Consultants. *Guidelines for Interpretation of Water Quality for Agriculture.* Agr. Ext. Service, Jan. 1974.

Villarreal, Humberto J. *El Valle de Mexicali.* Memorandum 294, Secretaria de Recursos Hidraulicos, Mexico, D.F. (June 1971):50.

White, Gilbert. *Strategies for American Water Management,* Ann Arbor, University of Michigan Press, 1969.

Young, R. A. and S. L. Gray. *Economic Value of Water: Concepts and Empirical Estimates.* Technical Report, National Water Commission, 1972.

Young, R. A., W. T. Franklin and K. C. Nobe. "Evaluating Economic Effects of Salinity Abatement Projects in the Colorado River Basin." In *Salinity in Water Resources,* J. B. Flack and C. W. Howe, eds. Merriman Publ. Co., Boulder, Co., 1974.