

EMSC

*“Integrating Environmental Management into  
the Current Economic Situation in Armenia”*

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for

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May 19, 1995

## **I. Introduction**

As part of my responsibilities here at the American University of Armenia, I was asked to perform a study which “considering Armenia’s needs for economic development,... present[s] the importance of environmental management with special reference to policy interventions to prevent the degradation of natural resources.” The areas of specific study to be emphasized were specified as follows:

- (1) new technologies for identifying the existing natural resource base.
- (2) economic and social consequences of the use of natural resources.
- (3) areas that require policy interventions in order to eliminate adverse effects or to create incentives to prevent degradation of natural resources.
- (4) methods for integrating environmental issues into economic planning.
- (5) programs in education and institutional reform for resource conservation and exploitation.

Area (1) is more of an engineering question, and one to which there is little to contribute from an economic standpoint. Areas (2) - (5) are areas in which environmental economics can play a very important role, and are the areas discussed in this report.

In this period of difficult economic transition for Armenia, people will say that this country cannot afford to concern itself with environmental concerns. The object of this report is to argue that Armenia cannot afford not to concern itself with the environment. Specifically, the failure to do so is likely to be costly in terms of environmental degradation but also in scarce resources being used in inefficient ways. This is something that can hardly be afforded in a period when resources are needed in so many areas.

Because of the limited period of time available, data already collected by individuals at the Environmental Research Management Center (ERMC) were used. Fortunately, Varton Tserounian was able to provide some studies of water quality and quantity problems that have been done by the ERMC, in cooperation with the Republic of Armenia Ministry of Nature and Environmental Protection (NEPM).

The reports provided were:

Report I, Part 1:

”Review on Water Supply for the City of Yerevan and Water Quality Control”

Report I, Part 2:

“Assessment of Environmental Conditions of Surface Waters in the Republic of Armenia”

Report II:

“Lake Sevan”

The purpose of the main part of this report is to look at each ERM report critically from an environmental economics point of view, and to suggest ways in which this and every report can incorporate environmental concerns. In addition, proposals for immediate as well as future research projects which can be of help to Armenia in dealing with its water quantity and quality problems will be discussed. First, a brief overview of the ideas behind environmental economics and management may be helpful.

## **II. Overview of Environmental Economics and Management**

The primary goal of economic analysis is to balance the costs and benefits of any action taken, due to the inherent scarcity of all resources. In recent years, this fundamental idea has begun to be applied in the area of the environment, since after all the environment is simply the collection of all the natural resources we have. Part of the reason for this has been a growing feeling among economists that the standard practice in preserving the environment has been to set regulations, some of which may be set in a fairly arbitrary manner, without regard to balancing costs and benefits.

This has likely been the case for standards set for acceptable levels of contaminants in the air and water. As will be discussed shortly, regulations which are set for an area as large as the entire United States are likely to be inadequate in some places, and excessive in others, due to regional variations. Economists hope to set standards which are in accord with the risks of the particular contaminant, and which balance the costs of reducing the level of the contaminant with the added benefit from reducing the risk associated with the contaminant.

Another issue in dealing with degradation of the environment is that many resources are not owned by any one individual, but are instead "public" goods, so that no one has any particular interest in preserving them. This creates a situation where the costs to society of some activity are not equal to the cost to the individual engaging in the activity. This is another problem with water as a resource, since while individuals can purchase the right to use of water, they cannot normally "keep" water. Thus watercourses tend to become contaminated by other individuals, since it is the easiest way to dispose of sewage, contaminants, and other hazardous materials. The cost to the individual is zero, but the cost to society of cleaning up the mess is significant.

Keeping in mind these basic problems with water and other natural resources, the remainder of this report will consider some of the specific problems of Armenia's water quality and quantity, but many of the conclusions are readily adaptable to other environmental problems. The setup of the report will be first to consider each report critically, then to suggest alternatives or improvements in the way that studies are performed by the ERM. This is not meant to be a criticism of the ERM's current way of performing reports, just to suggest improvements from an environmental economics point of view.

### III. Review of ERM Reports

#### **Report I Part 1 "Review on Water Supply for the City of Yerevan and Water Quality Control"**

This report begins by stating that "the problems related to water quality in Armenia are no different from what existed in the US 40 years ago", that water pollution has "passed the critical point", "stressed the water bodies" and created "potential public health problems". It then goes on to categorize the sources of drinking water for the City of Yerevan, the methods in which drinking water is treated, and the ways that this water is disposed of after use by the City.

The first part of the report lists the USSR drinking water standards (various acceptable levels of contaminants, standards of smell, taste, etc.), which apparently are still the drinking water standards in place. For the cases in which both areas have standards, USSR drinking water standards compare quite favorably to the US drinking water standards (provided in Report I, Part 2), and there are no instances in which the USSR standard is glaringly different. It is possible that some of the substances for which the USSR does not have standards are dangerous, but overall there is no reason to think that water quality is significantly different in Armenia than in the US, assuming that all standards are enforced.

There is a contradiction between the previous two paragraphs, since the first paragraph paints a picture much different than what the standards would imply. One problem would appear to be the fact that the standards are not enforced to any significant degree, and that either the technology or the will is not there to reach the standards. This is a situation where environmental economics may provide some guidance. When there is a situation where we have a fine system of standards all of which are infeasible given the current situation, it should be considered important to begin by addressing the highest risks first, and working to correct those.

Each standard is set based on some perceived risk level. For instance, the acceptable level of arsenic in drinking water is 0.05 mg/l. Assume that this corresponds to a risk level of 1 in 1,000,000 people dying from consuming this level of arsenic. Assume further that the current level in the water is 0.10, which corresponds to a risk level of 5 in 1,000,000. Then the benefit of reducing the level of arsenic in the water is the reduction in risk from 5 in 1,000,000 to 1 in 1,000,000. For a city the size of Yerevan (assume 1,000,000), this corresponds to approximately four lives saved from arsenic poisoning.

What is proposed then, from an economic standpoint, is to set a standard which corresponds to balancing the increased benefits from reducing arsenic levels with the increased costs associated with reducing the levels to the standard. While this may seem like a cold-hearted way of doing things, it is an observed fact that people take risks every day just by stepping out the door, since there is a certain risk that they will die while walking to the metro, while riding in their car, etc. Several studies have been done which estimate the value of a life by one of several methods the most common of which are: 1)

estimating lifetime wages foregone and 2) determining the risks that people implicitly take by riding on airplanes, in cars, etc.

Once a value for each life saved is determined, and the number of lives saved which can be achieved by a certain standard, then these benefits of reducing substance levels can be compared to the costs associated with doing so. Then a series of provisional standards could be set, which might be considered at least achievable in the short term, until other, possibly more pressing problems are addressed. But in the meantime, money could be spent in the areas where the greatest additional benefits are likely to be achieved.

This would be a valuable start to cleaning up the water supply, but of course if there is no education of the public about the problems associated with pollution, it is likely that the water supply will continue to be contaminated. A public relations campaign may be useful in trying to educate people about the costs to society of using the water supply as a sewer. This may be difficult in the near future, since the sources of water pollution tend to be so diverse, and many of the sources may be institutionalized from years of socialist rule. A discussion of the sources of water pollution is part of the issue discussed below of valuing the various uses of the water supply.

### **Report I Part 2 "Assessment of Environmental Conditions of Surface Waters in the Republic of Armenia"**

The second part of the report includes a summary of the sources and uses of surface water in Armenia, which accounts for the vast majority of its total water. Of the several sources, most of which are rivers from snow runoff and underground waters, Lake Sevan is by far the largest. Among uses of water, irrigation accounts for 73%, municipal and commercial uses account for 17%, and industrial uses account for 7%.

This makes the Armenian situation much like that in the western United States, where most of the available water is surface water, and the vast majority of water is appropriated for agricultural uses. Thus it is not surprising that the western United States should be a good place to look to see what solutions have been proposed and in some cases adopted there. The important thing here is to look at the overall management of a water basin. For instance, water originating in Lake Sevan flows out via the Razdan River, and is used between there and Yerevan for agricultural, hydroelectric, and industrial purposes. Once in Yerevan, it is used by the city for municipal watering and as a sewer for untreated water, before going downstream, possibly to be used for further purposes.

One problem with comparing the Armenian situation to the western United States is the fact that there is an established system of water rights, or rights to the use of a given amount of water for a given period of time, in the United States. The current water allocation system in Armenia is unknown to me, but it is supposed that during the Soviet period water was allocated based on decisions made by a central planning committee. It is

possible that this water allocation system was such that the resource was allocated to the highest-valued uses.

Whatever the case, in a free market system, water must be allocated according to a market mechanism. If water is to be allocated to its highest-valued uses, a system of water rights similar to that in the United States must be established in Armenia. This system could be handled in a manner similar to the privatization of the state enterprises, except that the vouchers would be distributed to the current users of the water in the proportions that they currently use the water, instead of to the population as a whole. These vouchers could then be sold to other users of water who value the vouchers more highly.

In the meantime, since it could take years to establish such a system given the other priorities facing the Armenian government, this makes a good case study in the idea of water basin management, since we have the competing uses of agriculture, hydroelectric and industrial purposes. So for the time being, the uses of water in a particular basin could be analyzed to compare their net benefits.

Water basin management entails considering each competing use of water on a waterway and determining the net benefits produced by that usage. So agricultural for instance uses some percentage of the net flows of the Razdan River. This amount of water is used in a known proportion in the production of a variety of crops. Thus the benefits of that water usage can be determined as the proportion of water use of the value of crops sold. The costs associated with agricultural uses are the additional nutrient load placed on the waterway, as well as any toxic chemicals introduced. The same kind of analysis can be done for hydroelectric and industrial uses, as well as any municipal uses.

The benefits from hydroelectric use can easily be calculated as the cost of providing power through the next best available alternative, whatever that might be. The costs of this use might be the alteration in temperature of the waterway and the effect on water quality and fish that this alteration has, or any other changes to the waterway caused by the hydroelectric production.

In this way, a rough estimate can be achieved of the net benefits of using water in any particular area, and also the additional costs of using that water in that area can be seen as the lost benefits associated with using the water in one of its other uses. This is one of the cornerstones of natural resource management, not that resources should not be used, but that they should be valued, so that the costs to society of their use are well known and can be compared to the benefits of other uses.

One difficulty in estimating the net benefits to society of each use is the question of the value of instream flows, wildlife preservation, recreational uses of water and any other non-market use. A non-market use is any use which cannot be valued directly based on its contribution to production of a commodity which has some market value. For instance, Lake Sevan is used for recreational purposes, which has some value. Water is also a vital resource for wildlife, especially fish. The valuation of these types of uses has been at the

center of a storm of controversy in the United States for the past several years, and continues to be.

So an additional purpose of water basin management can be to value the uses of water in other non-market uses. These competing uses must be balanced in such a way as to preserve the delicate natural balance to the extent that it is still possible, while at the same time addressing some of Armenia's pressing needs. This problem is discussed in the next section, which addresses in particular the Lake Sevan problem below.

## **Report II "Lake Sevan"**

The Lake Sevan report is more of an ecological study, largely concerned with the impact of the lowering of lake levels over the past several decades, which has been dramatically increased in the last few years due to hydroelectric demands. The study categorizes briefly the flora, fauna, fish and wildlife which make their home in Lake Sevan, then proceeds to discuss the two major problems associated with preserving Lake Sevan's present state: inflows of nutrient loads caused by the surrounding municipalities, and outflows of water for various uses. An important, and accurate, statement it makes is that "each type of human economic activity in the water collection basin of the lake contains a great risk to affect directly or indirectly...the lake."

The study concludes by asserting that there are two proposed solutions to the problem. One is to build a sewage treatment plant for the waste water of all surrounding municipalities, and then let the water run into Lake Sevan. The other solution is to treat the waste water and then send it directly into the Razdan River, thus avoiding the question of further contamination of Lake Sevan.

These are valid engineering solutions, but they have nothing to say about the costs associated with such projects, nor of the benefits produced by these projects. Is the primary problem the lowering of the level of Lake Sevan, which reduces the ability of the lake to assimilate substances, or the increasing deposits of such substances into the lake? These projects do absolutely nothing to reduce the outflows from Lake Sevan, and it is further asserted that given the current economic conditions nothing can be done about these outflows.

If the situation is as critical in Lake Sevan as is implied, with "a drop of the lake surface of 18.5 meters over the [past] several decades", then the potentially permanent damage to the lake and its inhabitants should not automatically be considered to be outweighed even by the current economic crisis. Instead, as discussed above, the benefits of the hydroelectric power usage of this water can easily be determined, while the non-market uses of the lake tend to go unnoticed.

Three techniques for valuing non-market uses have been introduced in the field of environmental economics in the past twenty years. One of these is known as a travel cost

study, and would apply best to determining the value that Armenians place on using Lake Sevan as a recreational area. The technique is quite simple, involving surveying travelers to Lake Sevan and finding out how much money they have spent on their trip. The idea is that the benefits to people making the trip must be at least equal to the costs associated with making the trip. If this survey method proves too difficult, an estimate of the average amount spent to make the trip could be made, and this amount multiplied times the number of people who make the trip during some period of time. This would give a rough estimate of the benefits people in Armenia associate with using Lake Sevan recreationally.

The second method is called hedonic pricing, and would be difficult to use in Armenia, because it depends on the value of some non-market use being determined by noting differences in the value of land, housing or wages between two otherwise similar area. Obviously the lack of a developed market structure in Armenia for any of these goods make this technique of little use.

The third technique is called contingent valuation, and is a controversial but promising method of estimating those uses which are the most difficult to get at in other ways, such as the value people place on the existence of a species. The technique consists basically of asking people a series of questions which are designed to elicit from the individual a valuation of the non-market use in question. The controversial aspect has been the problem with designing the survey in such a way that the questions do not bias the answers provided, which has proven very difficult in practice.

While there are problems with the contingent valuation method, it would at least give a very rough estimate of the value that Armenians place on preserving Lake Sevan in such a way that the fish and other wildlife can continue to thrive in and around it. One alternative would be to place no value on preserving the lake, and continue to value the lake only as a source of water supply for hydroelectric and irrigation uses. The other alternative is to place an astronomical value on preservation, and to do so by any means necessary. Both of these methods have been tried in the United States, with predictably disastrous results. The contingent valuation method would seem to be preferable to either of these alternatives, and thus despite its potential problems it is recommended.

### **Summary of Reports**

These reports all have in common that they include the Razdan River in one way or another, and refer to competing uses of water from that river, or its source Lake Sevan. While the first part of the first report focuses on the water quality problems of the City of Yerevan, certainly these are intimately related to the uses of the water upstream from the city which caused the water quality problem in the first place. The second part of the study is more general in that it refers to the sources of pollution into the various waterways of Armenia, and the uses of this water.



The second report on Lake Sevan once again focuses on a specific problem, this time of water quantity, which has been caused by inflows to and outflows from the lake, and thus should be considered as part of the overall situation. It also brings up the subject of valuation of non-market uses of water, such as species preservation, recreational uses and the value of natural scenic beauty.

It should be noted that, as stated earlier, the problems of water quantity and quality are similar to those experienced in the western United States. The experience there has been that, despite a number of studies that show water being used in areas which produce relatively little additional benefits compared to other areas (agricultural instead of municipal, usually), there continues to be extraordinary resistance to change. This has been especially true of valuing environmental benefits, such as increased instream flows and water quality in rivers, although this has begun to change as state and federal governments begin to recognize the value of preserving nature to some extent.

#### **IV. Overall Summary and Recommendations**

This report has discussed how a number of studies which include engineering, scientific and ecological data can and should be integrated into an overall study, which can then balance the competing needs of the environment and the economy in a coordinated way. Important steps to take in planning a study are an understanding of what the goal of the study is, as well as taking advantage of the resources available here in Yerevan, such as World Bank and United Nations expertise. The following steps are recommended for immediate and future implementation:

##### **Water Quality Problems**

##### **Immediate Implementation**

- 1) A study of current levels of contaminants in the water supply, and the risks associated with those levels. These risks can then be compared to the risks associated with levels if established USSR standards are met.
- 2) A study of the net benefits of reducing each contaminant to the level of the USSR standard. This entails determining the costs associated with this reduction, as well as the benefits. If the benefits are assumed to be the number of lives saved by reducing the risk level from the current level to the standard, then the value of those benefits is equal to the number of lives saved times the value per life saved, as discussed earlier in this report. If the costs of meeting these levels seem to far outweigh the benefits, a number of provisional standards could be proposed as realistic goals for water managers to achieve in the near future.

### **Future Implementation**

- 1) Development of a proposal for a public relations campaign aimed at educating the public about the dangers of contaminating the water supply, as well as the high cost to society of cleaning up the water. This could be done in cooperation with students in the marketing and advertising departments, as well as political science people.

### **Water Quantity Problems**

#### **Immediate Implementation**

- 1) A study of the sources and uses of water on a particular watercourse, such as the Razdan River. This would include a rough estimate of the net benefits of each market use, such as agriculture and hydroelectric, as well as discussions of the non-market uses of the water.
- 2) A study of the current market system for water use, which looks into the question of how water is currently divided into its competing uses. If current users are not required to pay for their water usage, it is likely that changing the current system of distribution will be extremely difficult. Suggestions should be made of ways to encourage users to be more conservative in their uses, such as instituting some type of nominal pricing system for water usage.
- 3) A travel cost survey to estimate the value of recreation at Lake Sevan to Armenians, even a very simple one such as that described earlier in which the average cost per trip is estimated. This would then only entail an estimate or an actual count of the number of individuals traveling to Lake Sevan during some specified time period.

#### **Future Implementation**

- 1) A series of contingent valuation surveys which estimate the value of non-market water uses such as species preservation in Lake Sevan, preservation of current or restoration of previous water levels there, and the restoration of high water quality in watercourses in Armenia.
- 2) Development of a proposal for establishing a system of water rights so that current competing industrial, hydroelectric, agricultural and domestic uses can redistribute rights to the highest-values uses. This proposal could be developed with the cooperation of legal, engineering and political science people.

Most of these studies can be done here in Armenia at relatively low cost, with little in the way of additional data gathering necessary. It is also believed that the current personnel in the Environmental Research and Management Center have the connections at various ministries here in Yerevan to get the information called for here. It is also possible that the United Nations, the World Bank or the International Monetary Fund have been involved or would wish to be involved with studies aimed at improving the quality and distribution of water in Armenia.

While the time and resources are not currently available for such a project, essentially what is proposed here is that an overall water basin study be undertaken, which attempts to value each of the competing uses for a specific waterway within that basin. There should be a wide variety of information available on the amounts of water being used for various purposes, even though valuing these uses may be relatively difficult. But even very rough estimates would help make a decision on the ranking of uses by importance much more accurate than the current system.