A Case for Demand-Side Water Management

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Abstract: It is axiomatic that because water is such a complex, pervasive issue, solutions to its problem must be commensurate with its complexity. The key to dealing effectively with the layered intracacies of water is to pay attention to the interlinkages, e.g., approaches that *combine* supply and demand-side policies. Controlling problems of water scarcity and maldistribution in hydrologically marginal regions such as the Middle East require policies that emphasize managing demand and need rather than focussing on increasingly difficult efforts to increase supplies.

When economic and societal development coincide with resource scarcity, particularly scarcity of a shared vital natural resource such as fresh water—as is the case in several arid and semi-arid regions of the Middle East—governing authorities typically behave in ways that tend to deplete the resource, degrade the environment and produce consequent domestic and international tensions. Their perceptions are characteristically—and understandably—anthropocentric, a fact which is reflected in their approach to dealing with development problems, particulary where water is concerned. They often behave in ways analogous to authorities in water-rich countries: their hydro-policies tend to be incremental or inconsistent, and short-term; they treat water as a technical commodity related only to food, agriculture and human settlements; and the emphasis is on increasing supply when problems arise. Such perceptions and strategies, so prevalent among developing and industrialized countries alike, make controlling their harmful impacts on the environment difficult.

Malin Falkenmark put the matter cogently in this way: "In Summary, man is not really capable at the present time to manage or control the environmental impacts of his activities in a broad and consistent way. Problems continue to be approached by decisions makers who address one problem at a time, from a short-term perspective, often in direct response to strong public pressure." [1] The results are often scarcity and evironmental degredation. Jack Goldstone has demonstrated that the consequences of resource depletion can be severe: the legitimacy and stability of governments can be undermined because they would no longer be able to deliver essential services or cope with the social and economic dislocations caused by extreme scarcity.[2]

Water development projects are always an integral part of a nation's larger pattern of social and economic activity and necessitate systemic and coordinated approaches. For example, a water system involves such interlinked elements as chemical treatment plants, equipment together with spare parts, a system of operations and maintenance, training programs for specialized personnel, relevant bureaucratic agencies, a safe and affordable energy supply, a pumping system, cash crops, a transport system, and a ready market; combined with these factors are such ambient components as a stable political system, a functioning economy, sanitation, public health, education, and social acceptance of any given project.[3] To this set of factors must be joined another which may collectively be labeled the "psychological environment" of decision-making. This notion is neither easily measured nor defined. Broadly speaking, the psychological environment is composed of all those elements that go into a decision-maker's conception and evaluation of a given situation that requires action, involving such integrals as power, attitudes, ideology, population, geography, climate, and the resource itself.[4] Associated with the psychological factor is another that I believe must also be taken into account: the "perception gap." This gap reflects the differences in the perceptions of a given issue or problem among the public, the experts, and the policy makers. When perception gaps are wide, as is often the case where issues of resource scarcity are concerned, good policy making or change of policy becomes difficult—particularly if there is a lack of public confidence toward the policy makers and/or experts.

Even this brief litany of factors highlights the complexity of water. It is axiomatic that because water is such a complex, pervasive issue, solutions to its problems must be commensurate with its complexity, and the key to dealing effectively with the multi-layered intracacies of water is to recognize and pay due attention to the constituent interlinkages; this means, to be precise, approaches that *combine* supply and demand-side policies. To attack problems of acute water scarcity chiefly or soley by means of a supply-side policy is not unlike trying to drink out of a seive. I aim to argue here that controlling problems of water scarcity and maldistribution, especially in hydrologically marginal regions such as the Middle East, require an approach that emphasizes managing demand and need rather than focussing on increasingly fruitless efforts to increase supplies.

But, it must be acknowledged that however desireable or necessary managing demand is, the process is very complex and difficult because it involves many actions in combination with other activities that are aimed at increasing supply. Even measuring and forecasting demand accurately is made highly problematic by many difficult-to-control variables: lack of reliable detailed data (characteristic of many parts of the region), high rates of leakage from the distribution system, unmetered supplies or meter cheating, price variations (complicated by subsidies), changes in patterns of water useage, etc. Data is a particularly vexing problem owing to a combination of factors, primary among them being the natural variations in flow and climate. When these are linked to lower riparian position, inability to control source and flow, and the treatment of data as security and political matters, accuracy and accessibility invariably suffer. Thus, planners generally do not have available any truly dependable models for forecasting demand, and must rely on such means as trend extrapolation, component analysis, multiple regression models, or even adapted econometric models, none of which usually yield more than rough approximations.[5]

Managing demand effectively requires such actions as accurate assessments of demand and true need, controlling population growth, economic restructuring, redistribution of supplies, managerial and on-site efficiency, conservation, etc. All of these activities represent very dangerous ideological, symbolic, political, and economic shoals for policy makers. How, then, can political leaders safely adopt a demand management/need based approach to water problems, even if they are inclined to do so? Attitudes towards water—like those towards its cognate, agriculture—are culturally embedded and hard to change. Is it feasible to expect demand management policies to work quickly enough in the midst of a crisis, or, for that matter to expect the necessary courage and will for change from political leaders whose cardinal purpose is, normally, to hold on to power? But, given the realities of water scarcity, maldistribution, population growth, and the requirements of rapid economic development, is there a better alternative?

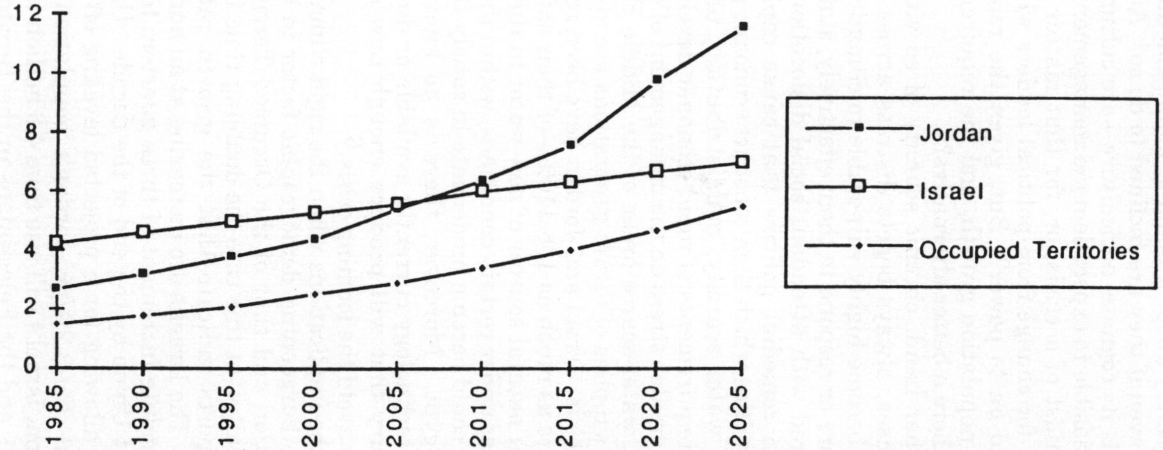
On the other hand, chronic scarcity of so vital a resource as water, whatever its causes, always begets distress across all economic and social sectors: regions become highly vulnerable to climatic events with diminished capacity to prepare or respond to them effectively, states are weakened, people are often displaced with attendant social dislocations, governments tend to adopt short-term remedial policies that cause capital to be diverted into unproductive activities which then constrict economic growth. Given the harsh consequences of water scarcity, maldistribution, unsustainable population growth, and the requirements of rapid economic development, is there a better alternative than greater stress on the management of demand?

In pivotal, water-scarce areas of the Middle East, such as the Jordan basin, the water supplies of future generations are already being consumed to satisfy current needs. Israel and Jordan have been routinely using more than 100%—some years as much as 108-110%—of their safe yield, and there are no known significant natural sources of new water in the basin. John Waterbury has estimated that under certain conditions, within thirty years the entire flow of the Nile River could become inadequate to satisfy the needs of the projected population of Egypt. Moreover, there is no known water technology or combinations of technology currently available or due to come on line by the end of the century that will produce enough new supplies of water at an affordable cost to avoid the looming crisis.[6]

Consider the implications when the rigid climatic limitations on supply are added to the burgeoning demographic factor in a basin like the Jordan: Jordan's population and that of the Occupied Territories are increasing by about 3.6% annually—at this rate the doubling time is only 18 years (in 1992, unconfirmed reports indicate that the growth rate in Gaza reached an incredible 5.8%). The Israelis are increasing at an annual rate of about 2% but anticipate an absolute increment of three quarters to a million emigres from the former Soviet Union by the end of the decade. Using medium, non-linear projections, and allowing for a projected leveling off by the year 2000 to an average of about 3%/-3.2%/yr, Jordan's population will increase from 2.7 million to 7 million, Israel's will rise from 4.6 million to 7 million (including the Russian emigres), and the Palestinians in the Territories will jump from 1.75 million to 4.2 million.

At these rates, sometime between 2015-2020 the Jordan basin's population (excluding Syria and Lebanon) will reach 16-18 million. The basin's known water resources will support a population of between 12.5-14 million.[7] All the commonly proposed solutions to this problem have serious deficiencies. Large-scale out-of-basin transfers involve too many security, political, and legal complications to be sufficiently reliable as an answer; raising the enormous

Population Projections for Jordan, Israel, and Occupied Territories*
(population in millions)



* Soviet immigration not included

Projections on Israel based on *UN World Population Prospects 1989*
Projections on the Occupied Territories and Jordan are based on in-country data obtained by author

Water Supply and Demand in Jordan Basin
(in Mcm/yr)

	1987-1991 Average Supply Non-Drought Conditions	Average Supply Current Drought Conditions	1987-1991 Average Total Demand	1987-1991 Average Deficits Non-Drought Conditions	Average Deficits Current Drought Conditions	Projected Demand 2015–2020
Israel	1950	1600	2100*	150–200	200	2500–2800
Jordan	900	700–750	800	100–125	100	1600–1800
Occupied Territories	650	450–550	600–650	75–125	100	* *

* Includes settlements in Occupied Territories and Golan Heights
** Future status indeterminate

funds necessary to build a sufficient number of desalination plants in time to relieve the crisis is very unlikely owing to the condition of the international financial market and to the exponential increase of new demands on that market from the newly created states following the fragmentation of the eastern bloc—not to mention the vulnerability of desalination facilities to acts of sabotage or hostility; moreover, because desalination requires high inputs of energy, new money and means must be found to create additional energy sources to run the plants. However, there are some imaginative hydropower schemes such as the Dead-Red Canal and more conventional nuclear power proposals for the generation of electrical energy, but problems of inter-riparian cooperation, cost, safety, and time make these somewhat distant solutions.

All basin-wide and cooperative solutions, technical and otherwise, which are essential to solving the basin's scarcity problem, depend on a resolution of the Israeli-Palestinian issue, one of the world's most atavistic, intractable political and ideological problems, whose prospects for a settlement in time to avoid a major water-driven crisis, while improved, do not appear certain in the foreseeable future. In the circumstances, what, then, is to be done with the two or three million additional inhabitants who will need to be provided with water? A strategy of increasing supply alone is patently impractable and could not succeed if attempted. Obviously, solution of the region's water problems require optimal combinations of technology, management, conservation, and efficiency.

The hydrological problems of scarcity and maldistribution in such basins as the Jordan and Euphrates are not unique—they are replicated with local variation in other parts of the globe. Taken together, overall scarcity (assuming water quality to be an integral of scarcity) and maldistribution are the major factors underlying the world's water problems. Only two percent of the world's entire water resources is available as fresh water. When one scans the earth's tiny consumable water resources (exluding oceans, salt seas, frozen glaciers, and ice fields), the poor match-up among supplies, distribution, and population, in most parts of the world becomes apparent, particularly in the Middle East where relatively acute water shortages are common.

Historically, patterns of consumption in this century indicate that the highest annual per capita withdrawals from water resources are associated with nations where both irrigated agriculture and industry are large scale and very advanced (e.g., the U.S. at about 2500 cubic meters). However, it does not follow that the opposite would be true for developing nations where industrialization is low, populations are high, soil quality is poor, and water is scarce. In those countries where need for food production from irrigated agriculture is substantial, the tendency is for proportionately higher per capita withdrawal as, for example, in Egypt at 1852 cubic meters per year. Over the past two decades, the trend has been a rising per capita withdrawal rate globally.[8]

Despite a moderate leveling off among some countries in the late 1960s, the withdrawal rate resumed an upward climb even in those countries where per capita consumption was already high or had overtaken supply, as in the Jordan basin. Furthermore, the world-wide phenomenon of peoples migrating to cities has had a dramatic impact on water supply, use, and quality in urban centers as well. In the last half century, the massive shift of population from rural areas to urban centers, occuring at incredible speed, has resulted in a surge of city water usage as population densities have increased and water uses have multiplied. All of these patterns of behavior typify the Middle East and have been intensifying over the last quarter century.

John Holdren has defined a renewable resource as one that is useable without depletion or its renewal is significantly greater than its depletion, and a non-renewable resource as one that is used in a significantly greater quantity than its renewability or it is not renewable at all; its use is thus a cumulative process.[9] In the Middle East, water stocks in many areas are being depleted faster than they can be replenished; in such diverse places as Jordan, Egypt, and Saudi Arabia, even non-renewable fossil water supplies, which should be held as a strategic reserve, are being used up. Because coping with scarcity by means of technology, social engineering, economics, and education, are inherently lengthy processes requiring considerable lead time, time itself may be running out for the policy makers even faster than the water supply. The supply-side approach, if not a cause of domestic and international tensions and potential conflicts, certainly contributes significantly to their existence and maintenance.

Until now, when water shortages have loomed, the near-Pavlovian response of government authorities has been to try to solve the problem by expanding supply somehow, but without commensurate reductions in demand. This approach remains prevalent. However, as water budgets have dwindled and costs of supply have risen in many countries, particularly where diminishing supply cannot be readily restored and new stocks are very difficult to generate in sufficient quantity—as in the Middle East—the focus of planners must be shifted away from the supply-side to controlling demand. Water management must be directed toward the *needs* of people and managing *demand* rather than on water itself, that is, rather than on finding ways to increase supply.

As stated, the management of demand involves many actions in combination with other activities that are aimed at increasing supply (a major reason why authorities respond to shortages first with efforts to augment supply). Four assumptions underpin the following recommendations: The *will* and gumption for change among the political leadership is the primary requisite; that priority in planning and policy would be given to demand management; that whenever full-scale demand and need management are undertaken by developing countries, considerable outside financial and expert assistance will be required to cushion the attendant hardships; and that whenever possible, basin-wide or region-wide approaches are best. With these qualifications, I would like to offer a few salient steps—proposals I have put forth before on other occasions—that would be necessary for instituting a demand-side strategy; most do not absolutely require a prior settlement of the Palestinian-Israeli-Arab dispute. (Many of these proposals, it will be noted, are reciprocals of one another).

1) Foremost, population growth must be brought to and maintained at sustainable levels.
2) An assiduous, on-going effort to instill in the public consciousness not only the need for reducing demand, but ways

in which this can be done, with a view to changing perceptions, attitudes, and behavior.

3) Economies should be restructured away from heavily irrigated agriculture toward other sectors, such as electronics, service, and industry—a difficult but not impossible task given proper incentives and strictly dedicated financial assistance. The contribution of light industry to GNP is about 30 times greater per unit of water used than the contribution of agriculture.

4) The developed world—the U.S., EC, Japan, the UN, the World Bank, etc.—should make a concerted effort to provide incentives for the transition to demand management together with the necessary assistance.

5) The adoption of appropriate available water-related technologies should be strongly encouraged as should be investments in the development of new technologies while continuously and systematically seeking and selecting useful innovations that come on line, especially in the fields of purification and recycling.

6) Improve the efficiency of the water system in all sectors and, equally, of the bureacracy that administers it.

7) Reduce subsidies and allow the cost of water to rise gradually to its true economic level. The use of market mechanisms for the regulation of water supply and demand should be seriously investigated. In this regard, as Shawki Barghouti of the World Bank has argued, serious thought should be given to making water a commercial commodity to be used profitably, with water banks for storage and later use (as, for example, in California and the Columbia River basin in the U.S.), and to exploring new investment policies, improved management techniques, inter-basin transfers, and the creation of an international water market. (But, the question then arises to what degree can water be treated as a commercial and technical commodity, separated from its ideological, symbolic, and cultural linkages?)

8) Improve data collection and record keeping, and invest in ways to improve on determining and forecasting demand.

9) The shift from farming to industry will be difficult because agriculture is culturally embedded, highly symbolic, political, and militarily significant. Therefore, investment in research and practices oriented toward encouraging the smooth transition would be essential and would yield high dividends.

10) Do all possible to promote inter-and-intrabasin cooperation, coordination, data production and sharing.

11) Since it is unlikely that cooperation can be coerced or induced at the highest political levels, the most promising approach would be to encourage cooperation at a lower but still significant level, among officials and technical experts. If officials and scientists in a given region communicate

sufficiently to develop shared understanding of the water situation, of available technologies, and potential solutions, they could constitute a community of informed specialists throughout the region, and become a strong force for cooperation by pressing for and guiding effective water policies, that emphasize demand management.

12) Promote economic restructuring by making it possible for one country to act as a demonstration model for others—in the Middle East, Jordan would probably be the best candidate for that role. The program would be implemented gradually, with rigorous periodic evaluations, flexible planning, and built-in measures for easing transitional hardships. The undertaking would lend itself to collective endeavor, so many governments and agencies could act jointly thereby spreading the risks.

13) Create a technical infrastructure for hydropolicy that addresses problems at basin and regional levels by creating two types of interrelated water institutes: one for river basins and another for comprehensive regional hydrological issues. These institutes, comprising staff, fellows, trainees, and other personnel from the world's major basins, would perform several functions: provide the expertise, research, educational opportunities, and data necessary to develop entrepreneurial, human, and technical resources presently lacking; generate databases and hydrologic, economic, and other social scientific analytical tools; act as conference settings; serve as centers for accurate record keeping and information dissemination; and foster interaction among basin and regional specialists.

The supply-side approach to solving problems of scarcity and distribution has been the predominant policy of choice because it has traditionally been perceived by decision makers as being less politically painful andcostly than the requirements of demand-side policies, even though the real economic and political costs are often exorbitant. Hence, the consistent preference for short-term resource and environmental planning by political leaders. What politician would willingly choose to tell a group of constituent farmers that in order to reduce demand and conserve water for the nation they must give up profitable but high water consuming crops, or switch over to entirely new cropping patterns, or perhaps even cease farming altogether and try to enter into new a mode of livlihood? What national leader relishes the opportunity to announce that the government is abandoning its ideologically grounded policy of food-self sufficiency and security for the sake of avoiding hydrological bankruptcy and preserving an adequate supply for future generations?

The answers to such questions distinguish the petty politician and demagogue from the statesman. But how they are acted on will in large measure determine whether key nations of the Middle East—and of other parts of the world—will face a future that is stable enough and with enough vital resources to allow their leaders to cope with the environmental and socio-economic problems bearing inexorably down on them; or whether they will be caught up in the vortex of a downward spiral of resource degradation, depletion, environmental disasters, accompanied by inevitable tensions and conflicts.

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1 Malin Falkenmark, "Fresh Water—Time for a Modified Approach," *Ambio* , v. 15, no. 4, 1986, 194.

2 Jack A. Goldstone, "Resource Depletion and the State," unpublished paper delivered at the Academy of Arts and Sciences Conference on the environment, resources depletion, and conflict, Washington, D.C., May 11-12, 1992; and *Revolution and Rebellion in the Early Modern World*, University of California, 1991, Introduction and Chapters 1 and 2.

3 Falkenmark, "Fresh Water," 196.

4 Harold and Margaret Sprout, "Environmental Factors in the Study of International Politics," *International Politics and Foreign Policy*, ed. James N. Rosenau, New York, 1969, 41-56; Elizabeth J. Kirk, "The Greening of Security," *New Perspectives for a Changing World Order*, ed. Eric H. Arnett, AAAS, Washington, D.C., 1991, 50-51.

5 G.G. Archibald, "Forecasting Water Demand—A Disaggregated Approach," *Journal of Forecasting*, Vol. 2, 1983, 189-92.

6 John Keenan, *Water Issues in the Middle East: Review of Technology, Parts I and II, 1987, 1989*, unpublished reports of the AMER Middle East Water Issues Project.

7 Some Israeli scholars have calculated a maximum supportable population of 14 million; my own calculation is that the maximum falls between 12.5-13.5 million.

8 Peter Gleick, "Water and Conflict," paper prepared for the Workshop on Water Resources and International Conflict, American Academy of Arts and Sciences, June 15-16, 1991, 1-29, and "Climate Change and International Politics: Problems Facing Developing Countries," *Ambio*, 18, no. 6, 1989, Table 3; Frederick Frey, "The Political Context of Conflict and Cooperation Over International River Basins," unpublished paper, courtesy of the author.

9 John Holdren, "Resources, the Environment, and Conflict," unpublished paper delivered at the American Academy of Arts and Sciences conference on the environment, resources depletion, and conflict, Washington, D.C., May 11-12, 1992.

Preliminary Draft Proposal

To begin, I'd like to set forth some of the premises on which we will undertake this effort, unless you direct us otherwise (please pardon me if I appear to be stating what I know you've already considered, but this is just to ensure that we start singing from the same sheet of music as early as possible).

1) Demand management is a policy issue difficult to define and implement comprehensively because of its many constituent parts. As a topic of research, demand management *per se* has received relatively little attention in the literature; our searches will probably not turn up a large volume of publications clearly identified as "demand management." Consequently, we will have to deconstruct the concept into it's main components and organize the bibliography accordingly.

2) Because demand management together with its wellspring — scarcity — from which it cannot be separated, are insufficiently defined concepts, anything approaching a definitive categorization of the bibliography would be so broadly guaged as to put it beyond the limits of this project. On the principle that this is no more than a start-up project, we will, consequently, try to limit our categories to about half a dozen and pack as much into them as makes sense. Incidentally, like you, we make a distinction between demand and need.

3) All indications lead to the conclusion that there will be a steady increase in research on demand management with a concurrent growth in the literature. This in turn requires that whatever database is created, it be designed at the outset with a capacity to keep up with develoments in the field and that we design our bibliography accordingly.

4) It is understood that some of the literature we include under such headings as technology, pricing, and management are by their nature not region specific.

In this context then, we will undertake a literature review on demand management, which will include print and electronic sources of quantitative data, from which we will compile a selected bibliography designed to serve as a basis for the creation of a demand management database.

The compilation will be made under the following general topics (in no particular order of importance as they are all related; we would, of course change or add categories in accordance with your directions):

1) **Water Technologies.** Those that are seen to be most clearly related to demand management, e.g., conservation and purification technologies; those that have to do with alternative sources of water and its movement from one basin to another (e.g. desalination, pipe lines, "medusa bags"; technologies that improve on-farm efficiencies and reduce loss and waste in the delivery of water; and technologies associated with the development of new ways to grow cash crops that require a minimum of water or that can use recycled and brackish water.

2) **Water Management.** Management techniques that most clearly promote demand management, including managerial applications of technologies that do the same.

3) **Economic Factors.** Those economic factors that impact on demand and consumption, e.g., pricing, subsidies, water markets, etc. (There is an economic definition of

scarcity/demand, but I think it's too narrow for our purposes: a resource is considered scarce when demand exceeds supply at zero price. So, in these terms, scarcity involves both the amount of water available and how society allocates that amount in relation to demand or need — but that seems to me to leave the factor of value unaccounted for.)

4) **Demographic Factors.** This is one of the most basic but difficult elements of demand management. The establishment of a population growth rate sustainable in relation to water and other resources is essential for a successful demand management policy, but very hard to attain. It's a factor that's clearly related to economics, culture, ideology, and political stability. We will try to select those items that are most clearly relevant to demand management.

5) **Conservation Education.** Effective, long-term demand management is probably not effective without efforts to re-educate the public about the uses of water. As attitudes toward water are culturally embedded, the literature on this topic is likely to be more eclectic than might be assumed.

6) **Data.** Accurate assessments of real need, demand, consumption, and use are essential constituents of demand management. We will collect literature on data collection techniques, their organization, storage, and distribution.

6a) However, the quantitative part of the proposed database is more problematic; how you want to have it handled by us is not altogether clear to me. I would think that, minimally, the kind of numbers you'd want to collect in your database would include for each of the principal basin systems in the region (applied to each individual riparian) a current water balance; separate figures for total average annual supply (safe yield and available) from all sources; total average demand figures/yr; total annual consumption; and, if possible, some ball park figures of actual need (tough to get). We could obtain some of these data for you, and do our best to make them current. Do you want us to try to gather such data? How do you want them handled — as appendices of under some separate, special rubric? In the budget, I have separated the cost of compiling the data, water balances, etc. as a separate item in the event that you prefer have that done by IDRC or WDM.

7) **Bibliographic Sources, Printed and Electronic.** Bibligraphies of bibliographies, web sites, etc. All the print and electronic sources we will have used to collect our sources.