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Koundouri, Phoebe and Pashardes, Panos and Swanson,  
Timothy and Xepapadeas, Anastasios

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**The Economics of Water Management in Developing Countries:  
Problems, Principles and Policies.**

**Charles Howe**

*Institute of Behavioral Science, University of Colorado at Boulder*

**Phoebe Koundouri**

*Department of Economics, University of Reading*

*Department of Economics/CSERGE, University College London*

**A. Introduction.**

The scarcity of water resources is one of the most pervasive natural resource allocation problems facing development planners throughout the world. This scarcity can relate to the quantity of water or the quality of water or both. In arid developing countries this problem is especially acute and is faced each day in the myriad of conflicts that surround water use.

Water scarcity has several causes and dimensions. First, there is growing *demand* for water in residential, industrial and agricultural sectors stemming largely from population and economic growth. Second, *supply* side augmentation options have become increasingly constrained and costly in both economic and environmental terms in most countries. In combination, demand growth and increasingly difficult supply side interventions have stretched current water availability close to hydrological limits. In addition to these *quantity* constraints, the limits to the assimilative capacity of water resources for human and industrial waste have been reached in many places, and the *quality* of freshwater has been degraded, imposing huge human and ecosystem health problems and making great volumes of water unsuitable for many uses.

Water scarcity is widely perceived to be an important constraint on sustainable *economic development*. It is important to identify the conditions under which this really is the case, because in many cases the perceived shortage is due to inefficient use and inappropriate investments, technologies and management. In the post WW II period, development aid became popular among the wealthier developed countries and water development was frequently chosen strategy. However, in most cases the approach taken was to transplant technologies that had been successful in developed countries (although usually heavily subsidized) into the social systems of the developing countries, especially the construction of large dams and advanced style irrigation delivery systems. The potential for success of such transplants rests upon an impressive array of necessary conditions: (a) that water really is the bottleneck to economic growth; (b) that capital is available for the private sector components of the project and for linked input and output activities; (c) that the management skills needed for operation and maintenance of the system be available and motivated to do the work; (d) that the technology fits into the social structure and values of the population and that the local population adopts the project; etc.

Several conditions, alone or in combination, can cause water to be a real bottleneck to economic growth: (a) when water is a controlling factor in human health and productivity; (b) when irrigated agriculture is the primary economic activity; (c) when existing supplies are institutionally tied to historical uses or lands, with little possibility of reallocation. The role of water in human health is probably the critical problem. The classic book *Drawers of Water* (Gilbert White, David Bradley and Anne White, 1972) clearly described the plight of many in East Africa in situations where gathering water absorbed much of the time and energy of the household, while scarcity due to these real costs cut into personal hygiene and collective sanitation. The new follow-up study to the original, *Drawers of Water II* (Thompson et. al, 2001), has found that there has been little improvement, although the nature of the problems has changed somewhat.

Agriculture and animal culture are the initial forms of activity in many countries. If the country is arid or semi-arid, so that irrigation of some type is necessary, water can be a real bottleneck. However, some of the traditional agricultural and animal systems have proven very productive without relying on high tech water control. The practice of flood recession agriculture on the rivers of sub-Saharan Africa has produced high yields per worker, although yields per hectare are low and variable over time due to flood uncertainties (Institute of Development Anthropology, various...). The right combinations of modern water control technologies and traditional systems can be much more productive. The construction of the Manantalli dam on the Senegal River made it possible to produce *reliable* floods so that farmers could count on a regular flooded area and duration and plan their inputs accordingly. Unhappily, the national governments involved looked on flood recession as a primitive system and insisted on the development of irrigated perimeters that required pumping from the river and more complex distribution networks. The outcome was continual breakdown of the irrigation schemes, with lost hectares offsetting the development of new schemes (Institute of Development Anthropology, various...). Some of Kenya's most productive irrigation schemes are small horticultural operations with low tech diversion works that could be locally built and maintained.

The other prominent condition that can make water a real bottleneck to growth is an institutional setting that ties existing supplies to fixed uses or lands. This continues to be a problem in both developing and developed countries where institutions have been slow to adapt to changing water supply and demand conditions. Under the "riparian" system of water law, only lands adjacent to water bodies can take water from the stream for productive uses. If the more productive agricultural or other uses are at some distance, they cannot acquire rights to use water. In other cases, water cannot be removed from the lands traditionally irrigated. Such conditions preclude the development of active water markets that have proven to be socially efficient mechanisms for water allocation flexibility when adequately supervised to assure that weight is given to both monetary and non-monetary objectives of society.

Another way in which water can be a bottleneck in agricultural regions is through the failure of proper drainage. Some problems perceived to be water problems are really drainage problems. Worldwide, more land is going out of agricultural production because of salinization than is being developed in new projects (Postel, 1999, *Pillar of Sand: Can the Irrigation Miracle Last?*; Clawson, Landsberg and Alexander, 1971, *The Agricultural Potential of the Middle East*).

### **B. Some Successful and Unsuccessful Cases of Water-Based Development.**

In the post WW II decades, there have been both successful and unsuccessful attempts to induce economic growth through water development. The Mwea Irrigation Settlement Scheme in Kenya (Howe, 1978) provides an example of successful community development based on irrigated rice agriculture. Located northeast of Nairobi and involving about 30,000 population in 32 settlement villages, it was originally established to relocate detainees during the “Mau Mau” emergency of the mid 1950’s. It has continued the strong control and disciplinary environment established in those days: strict assignment of farm plots; control over planting and irrigation; and demands for good performance. Inputs are provided in proportion to land and outputs are marketed by the Mwea authority, subtracting from revenue the costs of inputs. Income levels of successful participants are high enough that there is a waiting list to get into the scheme, hence pressure to perform well. Malaria and bilharzia control schemes have been successful in the area.

Household incomes have been high enough that there has been substantial investment in local retail and minor manufacturing businesses- a highly desirable multiplier effect. The successes can be attributed to (a) development of previously undeveloped land, (b) recruitment from tribally related (compatible) peoples, (c) strict discipline over inputs, cultivation pest control, timing or irrigation and harvest, and (d) excellent, centralized water control. The success of the scheme was enhanced by rather high protection of the domestic

market for rice. This congeries of conditions is unlikely to be found elsewhere, but the conditions of success may stand as a model for other developments.

The Rio Fuerte River Basin Commission in northwestern Mexico has achieved one of the most successful agricultural developments in Mexico. The Commission was established in 1951 along the lines of the then popular river basin commissions, developing some 230,000 hectares of irrigated agriculture, about half in smallholdings and the other as larger private holdings. The Miguel Hidalgo dam provides water and power, while processing and service industries have been attracted to the region. A railroad to the north early promoted export of winter vegetables to the U.S., grown by the larger private operators due to the risk averting behavior of small farmers. A major reason for success is that the Commission took the initiative to provide a coordinated package of needed inputs: water supply and delivery systems, land levelling, roads and marketing facilities.

The Lake Volta Project in Ghana was one of the earliest post-war large-scale water development schemes (R. Chambers, 1970). Britain sought a source of aluminum within the sterling area. The then “Gold Coast” had excellent bauxite deposits and excellent sites for hydroelectric and port development. The development would involve a major dam, the reservoir of which would cover 1/30<sup>th</sup> of the country, a large new port, an alumina factory and smelter and the resettlement of around 80,000 persons. In 1952, a Preparatory Commission was established for careful project planning with heavy emphasis on issues of resettlement. All displaced populations were to be made as well off as before the project but with a large element of self-help. Planning was completed in 1955 but initiation of the project was delayed because of financing and political issues related to the independence movement. Construction began in 1961 and was completed far ahead of schedule and at a cost \$ 40 million less than budgeted.

Because of the delay, the preparations for resettlement had gotten off track, were revised in major ways and had to be quickly re-started as a crash program. In spite of the rush, great things were accomplished by the end of 1964: 2000 miles of prospective lake boundary

had been mapped; 14,000 acres of land had been cleared for resettlement; 52 settlement sites had been identified; 11,000 houses built and 10,000 families evacuated and resettled. Nonetheless, there were many problems: some resettlement sites were poorly chosen and were resisted by traditional occupants; the provided housing styles were not liked by many; water supplies were bad; and agricultural land was not provided for many. Planned mechanization of agriculture failed through lack of maintenance and livestock programs were decimated by disease. The welfare approach that had been substituted for the initially planned self-help diverted resources away from directly productive assets, while many of the provided inputs could have been developed by the people themselves at lower cost.

More recently, large water development projects have come under close review and, in many cases, severe criticism. The development plan for the Narmada Valley in India centers around the large Sardar Sarovar Project that has inundated many villages while resettlement preparations have been vastly inadequate (Fisher, 1995). The World Bank has been the object of much of this criticism since it financed a large part of the development without putting sufficient pressure on the Indian Government to provide for human needs. The World Commission on Dams has recently completed an extensive review of the strengths and failures of big dams as development initiators (World Commission on Dams, 2000). That Commission concluded that dams have made an important contribution to human development and that there have been substantial net benefits in most cases. However, in too many cases an unacceptable and unnecessary cost has been imposed on the displaced peoples, downstream communities and the natural environment. The lack of equity in the distribution of benefits has often been sufficient to call into question the big dam approach in comparison with alternative water and development alternatives. Future planning must incorporate a comprehensive approach to integrating social, environmental and economic dimensions, while it must guarantee greater levels of local involvement and transparency.

## **B. Current Water Management Issues in the Developing World.**

The consensus today is that greater involvement of local peoples in development planning and water planning in particular is necessary not only from a moral point of view but also to increase the likelihood of needed cooperation and maintenance. From a comprehensive river basin point of view, smaller tributary projects must be considered to reduce negative social impacts and to protect downstream parties and ecosystems. It has also been convincingly demonstrated that protecting water quality at appropriate levels in developing countries is imperative from both social and economic points of view.

A recent study by the Inter-American Development Bank (Russell et al, 2001) makes these points while identifying the data needs and planning tools necessary for identification of appropriate levels of ambient quality and cost-minimizing instruments for achieving these standards. This study, based on the extensive experience of the Bank in Latin America, espouses a river basin approach to water quality planning and development program planning. Traditional approaches have typically been of too narrow a geographical scope, usually limited to the assessment of a single project. In a developing country context, a full-blown systems benefit/cost approach may not be feasible, but establishing that framework as an ideal will help avoid the omission of important downstream and environmental impacts.

A major issue remains the provision of potable water for poor populations. The study *Drawers of Water II* (Thompson, 2001) is the most detailed study of this issue. While that study covered East Africa, its findings are largely applicable to many other parts of the world. In its survey of town and rural household water use, it found a mix of improvements and deterioration compared with the findings of *Drawers of Water* of 30 years ago. Populations have doubled and trebled over those decades. Continued rapid increase in population implies the need for radical changes in water provision practices. Two major findings of the survey were that those households without piped supplies had typically doubled the amount of water used, while those with piped supplies suffered with increasing unreliability of supply.

Of the households using more water, the increases are primarily in hygienic uses: personal cleanliness and cleaning of the household, including eating and drinking utensils.



However, these health benefits can be negated by the absence of hygiene education. Households with unreliable piped supplies face several health threats. Intermittent supplies allow contaminated water to infiltrate into the pipe system. Intermittent supplies imply that water must be stored to meet continuous demands, while *Drawers of Water I and II* both showed that water contamination frequently takes place in household storage through the dipping of unclean hands and utensils and infestation by vectors of malaria and dengue.

What are workable strategies to overcome these problems? Universal access to high quality piped water and sanitation services is not feasible. A focus on this goal may deflect efforts towards improvements that can benefit many more people. More attention is being focused on provision of water by vendors, reducing the waiting time at standpipes and improving ambient water quality in water bodies used by households. Small-scale entrepreneurs and community-based organizations are playing increased roles. Where vended water is both legal and competitive, water prices can be lowered. Some public utilities have been supplying vendors with high quality water for distribution. NGO's are providing standpipes, at times giving franchises to managers who then have an interest in maintaining the facilities. The long-term implications of such "privatisation" are unclear. Optimistically, increased democratisation will lead to more transparent policies and an environment in which private operators can flourish. On the other hand, there is some risk that private operators or even NGO's may link to local elites or come to depend on patronage from the state, diverting them from serving the public good.

#### **E. The Contributions of Parts I and II of this book.**

One of the major points of the studies in Parts I and II is that *perceived* (rather than "real") water shortages frequently result from poor management, the absence of vital information (e.g. estimates of the *in situ* value of groundwater), the absence of a decision framework motivated to pay attention to vital data (e.g. the system-wide effects of low efficiency irrigation water applications), and histories of patronage and outright corruption.

Long histories of subsidies and the resultant vested interests make reform very difficult. Many “text book” economic efficiency analyses of water management in the Third World overlook these complexities.

Experience cited in the papers that follow show that successful pricing reforms are often associated with larger reform agendas, like broad economic reforms that follow crises or occur during the “honeymoon” of a new political administration. Reform at any level must overcome the resistance of the losers from the reform. Losers will rightfully conceive of their losses in terms of their *willingness-to-accept* rather than in terms of their *willingness-to-pay* , a position perfectly justified by the old Kaldor-Hicks compensation principle. It is thus critical to identify the winners and losers. Both equity and politics may justify compensation to the losing groups, particularly when they are poor and politically under-represented.

Objective and balanced public information and education are vital to policy reform. Misleading political propaganda that is often used to justify special interest policies and projects must be avoided. These processes require extensive give-and -take with the communities involved in the reform process. International lender pressures may push this process too fast to be effective.

Many insights can be gained from the Pakistan case study, where many of the points above are clearly illustrated. The Indus Basin irrigation systems were established under British administration and were always in the public domain. Particularly after independence, the subsidies given to these systems increased steadily. In recent years the International Monetary Fund and World Bank pushed for pricing and financial reforms to reduce these subsidies, to decentralize administration to smaller regional units, to increase farmer participation in management, to allow the separation of water from the land and to promote the creation of water markets.

The response of the Government of Pakistan illustrates the difficulties of policy reform noted earlier: the Government resisted because of domestic pressures from the likely losers-namely the centralized bureaucracy that feared loss of power and jobs and the elite farmers who had long colluded with the water officials to get reliable water at low cost. Two

sets of negotiations ensued to try to resolve the impasse: those between the Government and the IMF/World Bank and those between the Government and the domestic interest groups. A complicating factor was that only the Government has the power to negotiate with foreign agencies but (under the constitution) the provinces have jurisdiction over irrigation practices. A see-saw of negotiations followed between the Government and the Bank with the Bank rejecting a proposal that omitted farmer participation, any form of privatization and the de-linking of water and land. Farmers resisted any price increases, naturally preferring that broad land taxes should pay the bills but also fearful that the increased payments would just go to corruption- a reasonable fear.

The Bank “caved in” and sent the first trench of a loan, then held back further payments because of lack of evidence of progress. The asymmetry of information between the Government and the Bank made it very difficult for the Bank to determine compliance. This was also a case in which the payment of compensation to the losers might have reduced opposition to the reforms. In sum, the political complexities resulted in a “third or fourth best” resolution of the conflicts and of the attempted policy reforms.

One of the studies in Part II argues strongly for the establishment of water markets to establish explicit signals of the opportunity cost of the raw water resource. If the legal framework permits the separation of water from particular lands, markets can overcome the inefficiencies of traditional pricing or rationing schemes and lead to an overall increase in economic efficiency. The equity of the market process is called into question, however, since the least efficient water users-namely the small farmers-are likely to sell their water and forego their economic base.

In a Third World setting, market failure may occur in many forms, two of which are illustrated in Part II. The first is the case of wetlands that require scarce water but serve as sanctuaries for migratory waterfowl that are of value to many countries. Without the intervention of international NGO’s, market transactions will be based on only local values and the wetlands are likely to lose water to other water-using groups.

The second case relates to irrigation systems in which large amounts of water are lost through canals and heavy field applications. Much of that “lost” water is not really lost but recharges the underlying aquifers from which many users pump water and which serves to support grazing lands, trees and other non-crop vegetation. In the case study area, 60% of the command area is non-crop land that attracts tourism. If policy formulation is based on too narrow a view of the system so that these indirect benefits are ignored, water may be priced too high from a systems point of view and unwarranted investments in canal lining may be made on the grounds that the water losses are “inefficient”. Resistance to water price reform may be warranted in this case. In a water market setting like this, transfers should be limited to the consumptive use only to protect the indirect beneficiaries.

This situation is not unique to developing countries. Currently there is a major controversy between Mexico and the United States over the proposed concrete lining of the All American Canal that carries water from the Colorado River to the Imperial Irrigation District to the east of Los Angeles. The seepage from this canal has been the major source of recharge for the aquifers in the Mexicali Valley of Mexico and of underground flows for the ecosystems of the Colorado River Delta.

Groundwater systems are tremendously valuable resources because of their natural storage capacities, very low evaporation and ability to substitute for surface supplies during drought. Some groundwater supplies are non-renewable and other renewable over climatic and hydrologic cycles. In both cases, the scarcity value of the water stock must be taken into account to avoid highly inefficient use over time. Two of the studies in Part II present a highly useful technique for estimating the scarcity value of groundwater- the “distance function” approach. Case studies indicate that his approach is likely to yield more accurate estimates of the scarcity value than “willingness-to-pay” or other methods under the imperfect market conditions likely to be faced in many situations. The dominating issue in the first place, however, is to create a decision environment that motivates concern with the scarcity value and long-term optimal use of the resource.

## **F. Contributions of Part III.**

Part III of the book contains a selection of papers demonstrating the manner in which improved water management policies can be developed within a developing country context, using Cyprus as an example. This part titled “Policies: Case Studies of policy making for water management in Cyprus” illustrates possible solutions to the problems laid out in the preceding chapters of the book.

The Cyprus case study proves to be a well-chosen example regarding problems, principles and policies of water management problems in developing countries. Cyprus is an island situated in the northeastern Mediterranean, which is representative of arid and semi-arid developing regions in general, typified by lack of rain, spatial and temporal (mainly seasonal) separation of supply and demand, irrigation-based agriculture, and overuse of groundwater resources. Overall, renewable freshwater resources in the island are highly constrained in terms of both quality and quantity, while the possibilities for additional exploitation of surface water have been largely exhausted. This has necessitated the consideration and/or use of costly unconventional sources such as desalination and recycling. Moreover, the institutional and legislative environment of the island with regards to freshwater resources protection, which is characterised by a highly fragmented approach, should be seen in light of the proposed accession of Cyprus to the EU. Given EU accession, Cyprus will have to adopt the Water Framework Directive (WFD) and repeal some of its own laws. How can Cyprus’s multi-dimensional resource problem be tackled in an integrated and sustainable manner?

A more balanced approach to water resource management must ensure that scarce water resources are allocated among competing demands in a way that maximises their contribution to societal welfare. We further believe that this approach must be constructed in a way that considers its impacts on all of the various groups and interests affected. This requires the integration of various approaches and perspectives into a single systematic framework. We believe that a coherent watershed-based resource allocation methodology is required.

The first chapter of part III, chapter 9, titled “An economic methodology for integrated watershed management: The Cyprus case study” develops such a watershed-based resource allocation approach. This is composed of 2 important stages. In Stage I economic valuation techniques are used to establish the economic value of the competing demands for surface and groundwater, incorporating where necessary an analysis of water quality. The valuation exercise allows the objective balancing of demands based upon the equi-marginal principle to achieve economic efficiency. In Stage II a policy impact analysis is proposed which addresses issues of social equity and the value of water for environmental/ecological purposes. The analysis is undertaken within the confines of the watershed; the most natural unit for the analysis of water allocation and scarcity since it determines the hydrological links between competing users and thus the impacts of one user upon another. The methodology is encapsulated by a case study of the Kouris watershed in Cyprus.

The second chapter of part III, chapter 10, on “Water management in Cyprus through a decision support system” develops a management tool that can be employed by policy makers in an attempt towards integrated and sustainable water management. In particular this tool is a flexible hybrid decision support system that can be used as a tool by the policy maker in making choices that can be justified on the basis of a coherent exploitation of all alternatives. The overall objective is to satisfy water demand using available water resources, while maximising economic return, by providing methods for handling the interdisciplinary nature of water management and the measurement of the effectiveness of the decision taken. The system consists of a number of heterogeneous components, such as databases, statistical models and simulation models, which are integrated, and involved, in different layers of decision-making. The system is to be installed at the Water Development Department of Cyprus within the next few months.

The third chapter of part III, chapter 11, focuses on the “Water framework directive: a critical analysis of its content and implications for Cyprus”. This chapter revisits the institutional and legislative aspects of water management and seeks to establish whether the new European Union (EU) Water Framework Directive (WFD) is likely to bring about

sustainable water policy in EU accessing countries such as Cyprus. It contains a critical review of several key provisions of the WFD, such as the environmental objectives of the WFD, the specific water management measures (including identification of river basins, monitoring programmes, water protection, regulation of discharges of “priority substances” and groundwater protection) and the exemptions available to Member States. The chapter’s conclusion is not an optimistic one, arguing that while the WFD aims at a simplified, rational and effective water regime, the highly sensitive negotiations and political compromises that have preceded its adoption have resulted in a complex legislation, which requires much more integration.

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