# Design and Implementation of an Integrated Water Management Approach

Koundouri, Phoebe

2005

**Design and Implementation of an Integrated Water Management Approach**

Phoebe Koundouri
Department of Economics, University of Reading
Department of Economics/CSERGE, University College London

## 1. Introduction

The scarcity of water resources in both arid and temperate countries alike is one of the most pervasive natural resource allocation problems facing water users and policy makers. In the EU this has been recognised in the recent work on the Water Framework Directive. In arid countries this problem is faced each day in the myriad of conflicts that surround its use. Water scarcity is a fact with which all countries have to become increasingly involved.

Water scarcity occurs across many dimensions. Firstly there is growing *demand* for water in residential, industrial and agricultural sectors stemming largely from population and economic growth. Secondly, *supply* side augmentation options have become increasingly constrained, and restrictively costly in many countries. In combination demand growth and supply side interventions have stretched current water availability to its 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 (Winpenny, 1994).

In turn water scarcity has become an important constraint on *economic development*, that has resulted in fierce competition for scarce water resources between economic sectors that rely upon it (Winpenny 1994, World Bank/EIB 1990). Water scarcity is important for *sustainability* in economic development as well, on account of the many associated environmental/watershed services. In the face of hydrological constraints, the focus of current thinking in water resource management is on the allocation of scarce water between competing demands (Dublin Conference 1992, Winpenny 1994, UKWIR 1999).

How is it possible to allocate water between its many competing uses, all of which depend on water for their existence? Clearly water resources are necessities for many of the most important goals of every society. Firstly, water is a necessity for human existence. The absence of clean drinking water and sanitation leads to health problems, whilst the lack of access to/property rights for water resources *per se* is a significant dimension of poverty (UNDP, 1998). Water is also an important input to economic activities and can be seen as both a production and consumption good (Young, 1996). Furthermore water is a public good contributing to recreation, amenity and general environmental and watershed values as an input to ecosystems and habitats. How can it be possible to balance such crucially important but competing uses?

The fact is that a balancing of these uses must be accomplished, and the mechanism for doing so must be carefully constructed. The existing overlay of complex hydrological, socio-economic and property rights/legal environments (in many if not most jurisdictions) predisposes water resources to open access appropriation within the watershed, and the consequence of negative environmental and economic externalities (e.g. the degradation of wetlands and coastal fisheries, depletion of aquifers, and loss of watershed services). In short, the combination of the *arbitrariness of the prevailing property rights* structure for water resources in most jurisdictions and the *failure of markets* to capture the value of many watershed services necessarily imply that the prevailing distribution of water within most societies is not likely to be the most desirable one.

In what follows a 'watershed economics approach' is proposed which 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.

## 2. Balancing the Demands for Water Resources: The Methodology

In this section we outline the methodology we propose for application to the underlying problem of watershed management. This methodology is based on 1) the identification of the appropriate unit for management; 2) the agreement of the objectives of water allocation 3) the evaluation of the various attributes of water demand within that unit; 4) the identification of optimal water resource allocations relative to objectives; 5) the assessment of the impacts of the proposed reallocation.

### 2.1 The appropriate unit for management

The watershed is a natural unit of analysis for addressing the balance of supply and demand for water, and the issues of efficiency, equity and sustainability for a number of reasons. First, the aggregate availability of water resources, including sustainable yields is bounded by the hydrological cycle of the watershed. Second, the interaction of different water sources (e.g. groundwater and surface water) is confined by the watershed. Third, the demands for water interact within the watershed and the hydrological impacts of one water user upon another and upon environment; that is, externalities are defined by the watershed. For these reasons, an understanding of the hydrological cycle in the watershed area in question is a pre-requisite for the determination of efficient, equitable and sustainable water resource allocation.

### 2.2 The objectives of water allocation

Given the natural water resource constraints there is a clear need to address the pattern and growth of water demands in order to address the imbalance. The methodology proposed provides the policy maker and planner with an objective approach to balancing the competing demands for water subject to the natural constraints. The approach is based on the comparison of the economic value of water in different sectors, in terms of quantity and quality, in comparable units of measurement. The overall objective of public policy is to maximise societal welfare from a given natural resource base subject to those valuations. The key objectives of public policy in the allocation of resources are as follows:

- **Efficiency**: Economic efficiency is defined as an organisation of production and consumption such that all unambiguous possibilities for increasing economic well-being have been exhausted (Young 1996). For water, this is achieved where the marginal social benefits of water use are equated to the marginal social cost of supply, or for a given source, where the marginal social benefits of water use are equated across users.

- **Equity**: Social welfare is likely to depend upon the fairness of distribution of resources and impacts across society, as well as economic efficiency. Equal access to water resources, the distribution of property rights, and the distribution of the costs and benefits of policy interventions, are examples of equity considerations for water policy.

- **Environment and Sustainability**: The sustainable use of water resources has become another important aspect in determining the desirable allocation of water from the perspective of society. Consideration of intergenerational equity and the critical nature of ecological services provided by water resources provide two rationales for considering sustainability. In addition the *in situ* value and public good nature of water resources should enter into water allocation decisions.

## 2.3 The evaluation of water demand

For physical, social and economic reasons, water is a classic non-marketed resource. Even as a direct consumption good, market prices for water are seldom available or when observable, often are subject to biases; subsidies, taxes etc. Similarly, environmental and ecological water values are rarely explicitly marketed and priced. Thus the economic value of water resources is seldom observed directly. The balancing of demands to resolve the resource conflicts described above requires the identification and comparison of the benefits and costs of water resource development and allocation among alternative and competing uses. In addition, water management policies have widespread effects on the quantity and quality of water within a watershed, and the timing and location of supplies for both in- and off-stream uses. In general, these impacts have an economic dimension, either positive or negative, which must be taken into account in policy formulation. Again, the value of these impacts is seldom observed directly.

Fortunately economists have refined a number of techniques to value water resources and address objectively the balance of demands and evaluate the impacts of water management policy. The first step towards the evaluation of economic benefits requires the identification of the demands for the resource. Water is needed for all economic and social activities, so the evaluator is faced with the problem of identifying a multi-sectoral demand curve. The dimensions of demand include municipal and industrial, agricultural, tourism and environmental (recreation, amenity and ecological).

The valuation of each of the identified demands calls for a different approach for two main reasons, a) the specific economic and hydrological context: data availability etc and b) because the use of the resource is sector-specific. The residential and tourist sectors exploit the **use value** of water and use it as a consumption good; the agricultural sector derives use value from water as an input in production. The value of water related environmental goods can be a use value or a **non-use value**, e.g. existence value. The overall evaluation strategy is shown in Figure 2.1 below.

The valuation techniques allow the estimation of the following desirable parameters:

- **Marginal Value of Water**: The efficient balance of demands from a given source is found where the marginal value (benefit) of water is equated across users. In any given context efficiency is achieved where the marginal value of water is equated to marginal social cost

- **Price Elasticities of Demand (PED)**: Measures the responsiveness of demand to price changes. Characterises the demand function and tells the policy maker the extent to which prices must change to cause demand to fall to a particular, e.g. efficient, sustainable, level.

- **Income Elasticity of Demand (IED)**: Measures the extent to which the demand for water varies with income. Tells the policy maker whether water is a necessity or a luxury good and provides one way in which to assess the fairness of pricing policies. In combination with PED can be used to estimate welfare changes resulting from policies.

- **Marginal/Average Willingness to Pay for Public Goods (WTP)**: Estimates the strength of demand for water as an environmental good. This determines in part the efficient environmental allocation of water

- **Marginal Willingness to Pay for Quality Changes of Common Access Resources:** Estimates the value of quality attributes of the resource, which are particularly important, if the resource is used as a productive input.

- **Risk Parameters**: Measurement of preferences towards risk and uncertainty. Useful for establishing policies, which reduce the impacts of risk on consumer groups occasioned by reason of variability in water availability.

### 2.4 Balancing water demands in the watershed

The outputs of the demand analysis allow the determination of the economically efficient allocations of water resources. The first element of an economically efficient allocation is the equi-marginal principle: this provides that each use of the water resource should achieve the same benefit from that water at the margin. In short, if water is more heavily valued at the margin in one sector than another, then it should be reallocated toward that sector until equality is achieved. The second element of the economically efficient allocation is that aggregate water resources are allocated efficiently where the marginal social benefit of their use is equated to the marginal social cost of supply.

One option for achieving an economically efficient water allocation is the use of the instrument of water pricing, where water is uniformly and universally charged at the marginal social cost of supply, which has the following implications. First, competing demands will each make use of the supply until its marginal benefit is equated with marginal social costs of supply (the equi-marginal principle). Note that this implies that every use must receive an equal marginal benefit from water resources. The second implication is that aggregate demand for water will expand until the marginal benefit is equated with the marginal social cost of supply (aggregate efficiency). Note that this implies that demand is endogenous and managed within this model. The third implication is that the key to the success of the policy is the determination of the appropriate marginal social cost of supply and the marginal benefits to environmental uses. Note that this implies that the methodology used for implementing the policy is as important as the method that is used for determining it.

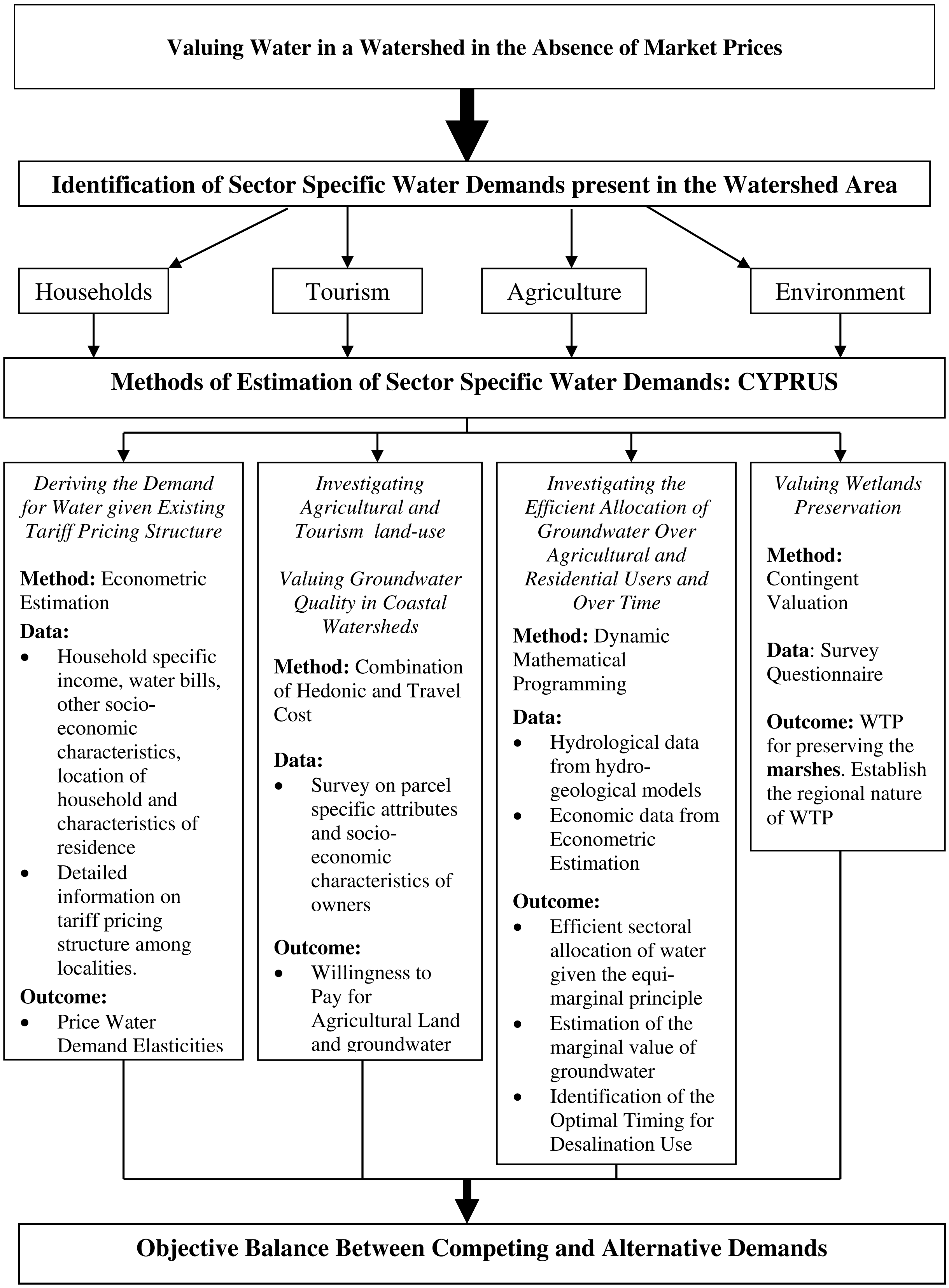
### 2.5 Deriving Policies from the Methodologies – Policy Impact Analysis

There is a second phase to the water allocation methodology that flows from the consideration of the implementation of the conclusions from the first. First, the discussion here has largely been phrased in terms of the use of water pricing as the appropriate allocation mechanism, but this need not necessarily be the best or more appropriate instrument for allocating water in every context. There are many different approaches to enable the efficient allocation of water resources – pricing, marketable permits, even auctions. (Dinar 1996, Winpenny 1994, Easter et al 1999). Ultimately the particular context (watershed) must be considered for the feasibility of the various instruments, and the policy maker must determine the most appropriate allocation mechanism within that context.

Secondly, it is crucial to note that an economically efficient allocation need not necessarily be an equitable or sustainable one. Additional analysis is required to assess the distributional impacts of the allocation recommended by the equi-marginal principle. The hydrological impacts of the allocation need to be assessed, in order to assess whether the various demands are compatible within the existing watershed. Finally, the continued provision of basic environmental services within the watershed needs to be considered. In sum, the watershed needs to be double checked for unforeseen externalities and for missing markets for watershed services to ensure intra and inter-temporal efficiency is achieved and that equity and sustainability considerations are properly considered.

The methodology can be thought of as two complementary stages, the first consisting of an objective approach to ascertaining economically **efficient water allocations** and the latter phase consisting of the **policy impact analysis**.

**Figure 2.1**. **The Methodology for Water Demand Valuation in a Watershed Area: Examples from the Kouris Watershed Case Study**



## 2.6 Summary of Methodology

### STAGE I: Objective Approach to Balancing Water Demands

**Evaluate Demands**. Apply appropriate methodologies to assess characteristics of the demand for water arising from individual, sectoral and environmental uses. Derive the parameters of water demand required for policy purposes: Marginal Value, PED, IED, WTP, and risk parameters for all the relevant dimensions of demand. The evaluation process should be undertaken in accordance with carefully constructed methodologies, and be independent of any prior rights to water resources. This enables an evaluation of water uses according to the benefits that accrue to all of society from them.

**Determine Efficient Allocations**. Evaluate the relative values accruing to society by virtue of differing water allocations. Determine those water allocations that achieve an economically optimal balance. An economically optimal allocation is one in which aggregate demands are balanced with supply according to the equation of marginal social value (benefit) to the marginal social cost of supply, and in which each source of demand is achieving equal value from its marginal allocation of water.

**Ascertain Impacts of Implementing Efficient Allocation**. The policy maker may choose from a wide variety of instruments to effect the desirable allocation (tradable permits, pricing, auctions). Any proposed method of implementation should be considered for feasibility within the relevant watershed, and then evaluated for its broader impacts on the society. This evaluation process leads into Stage II of the Methodology.

### STAGE II: Policy Impact Analysis

**Welfare Distribution.** The impact of the allocation policy options should be evaluated to establish the resulting distribution of the costs and benefits to society. That is, the change in social deadweight loss resulting from resource allocation changes should be determined, together with the actual distribution of this change. This is important both from the perspective of equity and often for reasons of political economy.

**Market Failures and Missing Markets.** Consideration of sectoral demands in isolation may be insufficient to ensure efficient outcomes. Where water users are conjoined by the underlying hydrology of the watershed there are a number of potential impacts/externalities that may arise from the chosen allocation. For example, policies implemented in upstream areas of a watershed will impact upon downstream users where the water resources are conjoined. Ignoring these effects will lead to inefficient allocations of water. In effect all the following facets of water demand should be considered: (a) Sectoral allocation, that is water demands should be balanced between sectors; (b) Spatial allocation, that is spatial variability and the conjoined nature of surface and groundwater; and (c) Temporal allocation, that is conjoined users may impose externalities upon each other relating to allocation over time and the timing of resource use. Other externalities arise from the demand for public goods, which frequently extends beyond the watershed. Global and regional environmental goods for which existence, bequest and option values are held provide an example of this. Furthermore, where water scarcity is extreme, demands for water outside the watershed may induce investments in inter-basin transfers.

**Institutional and Legislative Analysis.** As one of the main obstacles to water re-allocations a review of the legislative and institutional environment required to effect the desired allocation may finally be required.

The methodology described above addresses the problem of water resource allocation at the level of the watershed and provides policy makers and resource managers with a concrete procedure for attaining economic efficiency targets whilst considering equity and environmental sustainability. The methodology proposes that competing demands, including the environment, are traded off against one another and balanced against extant hydrological constraints using the of notion of economic efficiency, the marginal valuation of water and the equi-marginal principle. The valuation exercises are undertaken independently of prevailing property rights regimes for water resources and hence allow the characterisation of efficient/optimal allocations of water, rather than those tainted by property rights uncertainties, open access and missing markets.

However, economic efficiency itself must be traded-off against the contributions to social welfare derived from equitable distributions of resources and policy impacts such as employment. Similarly the complex nature of hydrological linkages requires additional analysis to establish the value of water resources in non-marketed watershed services such as drought mitigation/risk reduction and coastal wetlands. In addition demands for *in situ* environmental services external to the watershed need to be considered along with other potentially subtle market failures. Where not addressed in Stage I, these considerations are captured by Stage II of the methodology. In sum, the integrated water resource management approach attempts to provide a coherent procedure for overcoming the water resource allocation problem addressed at the level of the watershed.

**References**


Aylward B, Echeverría J, Allen K, Mejías R, Porras I. 'Market and Policy Incentives for Livestock Production and Watershed Protection in Arenal, Costa Rica' IIED Gatekeeper Series.No. 82

Baumol, W and Oates W.E, 1988. 'The Theory of Environmental Policy'. Cambridge University Press.

Bishop, J and Allen, J, 1989. 'On Site Costs of Soil Erosion in Mali'. Environment Department Working Paper No.21. World Bank.

Boland, J.J and Whittington, D, 2000. 'The Political Economy of Water Tariff Design in Developing Countries: Increasing Block Tariffs vs Uniform Price with Rebate'. CH10 in Dinar (2000) 'The Political Economy of Water Pricing Reforms'. World Bank.

Boronina, A, Cristodoulides A, Renard P, Balderer W, 2001. 'Hydrogeological Aspects of the Water Supply in Cyprus: KOURIS catchment', Chapter 4 of Cyprus Integrated Water Resource Management Project, CSERGE, UCL.

Brooks, K.N, Gregerson, H.M, Berglund E.R and Tayaa, M, 1982. 'Economic Evaluation of Watershed Projects: An Overview Methodology and Application'. Water Resources Bulletin, Vol 18, No.2.

Chow, V.T, 1964. 'Handbook of Applied Hydrology', New York: Mcgraw-Hill.

Dasgupta P, 1982. 'The Control of Resources'. Cambridge University Press

Deaton, A and Muellbauer, J, 1980. 'Economics and Consumer Behaviour'. Cambridge University Press.

Dinar et al, 1997. 'Water Allocation Mechanisms: Principles and Examples'. World Bank Policy Research Working Paper 1779.

Dublin Conference, 1992. International Conference on Water and the Environment, Dublin: Quotations from the Dublin statement on Water and Sustainable Development.

Easter;K W; Rosegrant, M W; Dinar, A, 1999. 'Formal and Informal Markets for Water'. World Bank Research Observer, Vol 14, No 1.

FAO, 1987. 'Guidelines for the Economic Appraisal of Watershed Management Projects'. FAO Conservation guide No. 16.

Farrington, J, Turton, C and James, A.J (eds), 1999. 'Scaling up Participatory Watershed Development in India: Lessons from the Indo-German Watershed Development Programme: Natural Resource Perspectives 17: 1-6.

Freund F.A, and Tolley, G.S, 1966. 'Operational Procedures for Evaluating Flood Protection Benefits'. CH10 in Economics and Public Policy in Water Resources Development. Smith S.C and Castle E.N. (eds). Iowa State University Press.

Grimeaud, D, 2001. "Reforming EU Water Law: Towards Sustainability?" European Environmental Law Review, February, March and April 2001, p. 41-51, 88-97, 125-135.

Groom, B., Koundouri, P., Nauges, C., and Alban, T., 2002. Stochastic technology and risk attitudes in agricultural production. Paper presented at the Second World Congress of Environmental and Resource Economists, 2002, June 24-27, Monterey, California, USA.

Groom, B., Koundouri, P., and Swanson, T., 2003. The Watershed Economics Management Approach: An Application to Cyprus, in "Economics of Water Management in Developing Countries: Problems, Principles and Policies" (eds. P. Koundouri, P. Pashardes, T. Swanson and A. Xepapadeas), Edward-Elgar Publishers. ISBN: 184376122X}

Groom, B and Swanson, T (2001). 'Missing Markets and Redundant Reservoirs: Dams as a Consequence of Inefficient Groundwater Management Policies'. Forthcoming in Environmental and Resource Economics.

Hadjispirou S., Koundouri, P. and Pashardes P., 2002. Household Demand and Welfare Implications of Water Pricing in Cyprus. Environmental and Development Economics, 7(4): 659-685.

Hanna, S. and Munasinghe, M. 'Property Rights in a Social and Ecological Context' The Beijer International Institute of Ecological Economics and the World Bank.

Howe, C., 2000. 'The Management of Renewable and Non-Renewable Groundwater Resources with observations on the Special Problems of Island Stated and Coastal Areas'. Paper presented to the Cyprus Water Resource Management Symposium, Nicosia September 2000.

Howe, C., and Koundouri, P., 2003. The Economics of Water Management in Developing Countries Principles and Policies*, in "Economics of Water Management in Developing Countries: Problems, Principles and Policies" (eds. P. Koundouri, P. Pashardes, T. Swanson and A. Xepapadeas), Edward-Elgar Publishers.* ISBN: 184376122X

Hufschmidt et al, 1986. In 'Economic Analysis of Environmental Impacts of Development Projects' Dixon, J.A et al. Asian Development Bank Economic Staff Paper No.31.

Koundouri, P., 2000. Three approaches to measuring natural resource scarcity: theory and application to groundwater. Ph.D. Thesis, Faculty of Economics and Politics, University of Cambridge.

Koundouri, P., 2002. Production function estimation with risk and selectivity considerations: an application to crop-choice, mimeo.

Koundouri, P., 2003a. Contrasting different methodologies to deriving natural resource scarcity rents, in “Economics of Water Management in Developing Countries: Problems, Principles and Policies" (eds. P. Koundouri, P. Pashardes, T. Swanson and A. Xepapadeas), Edward-Elgar Publishers.

Koundouri, P. 2003b. A Brief Review of Water Management Research in Cyprus, in "Natural Resource Management: Water Issues" (eds. Petrakis, E., and Xepapadeas, A.), Kluwer: The Netherlands. (forthcoming)

Koundouri, P., 2003c. The Potential for Groundwater Management: Gisser-Sanchez's Result Reconsidered. Water Resource Research. (forthcoming)

Koundouri, P., 2003d. ‘Groundwater and Economics’ in ‘Encyclopædia of Life Support Systems’, EOLSS Publishers and Co. Ltd. (forthcoming)

Koundouri, P., and C. Christou, 2000. Dynamic Adaptation to Resource Scarcity with Backstop Availability. Paper presented at the Tenth Annual Conference of the European Association of Environmental and Resource Economists, June, 2000, Rethymnon.

Koundouri, P., and Pashardes, P., 2002. Hedonic price analysis and selectivity bias: water salinity and demand for land. Environmental and Resource Economics, 23(2).

Koundouri, P., Pashardes, P., Swanson, T., and Xepapadeas, A., 2003. “Economics of Water Management in Developing Countries: Problems, Principles and Policies". Edward-Elgar Publishers. ISBN: 184376122X

Koundouri, P., and Xepapadeas, A., 2003a. Measuring natural resource scarcity: a distance function approach. Water Resource Research, (forthcoming).

Koundouri, P., and Xepapadeas, A., 2003b. A new methodology to measuring groundwater scarcity: theory and application, in ``Economics of Water Management in Developing Countries: Problems, Principles and Policies" (eds. P. Koundouri, P. Pashardes, T. Swanson and A. Xepapadeas), Edward-Elgar Publishers.

MITWRG, 1999. ‘Solutions to Water Scarcity in the Republic of Cyprus- A Proposal for Water Banking’. The Massachusetts Institute of Technology Water Resources Group

NWRMR, 2000. ‘The Namibian Water Resources Management Review’. Report to the World Bank on the Namibian Water Sector.

Ostrom, E., 1995. ‘Designing Complexity to Govern Complexity’. In Property Rights and the Environment- Social and Ecological Issues. Hanna, S. and Munasinghe, M. eds. The Beijer International Institute of Ecological Economics and the World Bank.

Pattanayak, S.K and Kramer R.A., 2001. ‘Worth of Watersheds: a Producer Surplus Approach for Valuing Drought Mitigation in Eastern Indonesia’. Environment and Development Economics Vol 6, Part 1.

Pearce, D., 1997. ‘Demand Assessment in the Water and Sanitation Sector in Developing Countries’. CSERGE. University College London

Pearce, D., and Koundouri, P., 2003. Diffusion pollution and the role of agriculture, in “Water Sustainability and Regulation: The Next Periodic Review and Beyond", (eds. D. Helm) OXERA Press, (forthcoming).

Perry, C J; Seckler D; Rock, M., 1997. ‘Water as an Economic Good: A Solution or a Problem’. Discussion Paper. International Irrigation Management Institute, Colombo, Sri Lanka.

Repetto, R et al., 1989. 'Wasting Assets: natural Resources in the National Income Accounts'. World Resources Institute, Washington DC.

Rhoades R.E. (2001). 'Participatory Watershed Research and Management: Where the Shadow Falls'. IIED Gatekeeper series No. 81.

Swanson, T. Olsen, N, Raffin, V, Lefevre,J and Groom B (2001). 'Wetland Externalities and Water Allocations: The Value of Water Supplied to Migratory Species'. *in "Economics of Water Management in Developing Countries: Problems, Principles and Policies" (eds. P. Koundouri, P. Pashardes, T. Swanson and A. Xepapadeas), Edward-Elgar Publishers.* ISBN: 184376122X

Sinden, J.A (1990). 'The Costs of Soil Degradation on the Northwest Slopes of New South Wales, Australia'. In Dixon, J, James and Sherman (1990): 'Dryland Management: Economic Case Studies'. Earthscan Publications, London.

Turton, C, Groom, B, and Warner, M (1998). 'Scaling up Participatory Watershed Development in India'. Agricultural Research and Extension Paper. Overseas Development Institute, London.

UKWIR (1996). 'Economics of Demand Management: Main Report and Practical Guidelines'. UKWIR and Environment Agency. Report Ref: no. 96/WR/03/1.

Ward R.C. and Robinson M (2000), 'Principles of Hydrology' 4$^{th}$ Edition. McGraw Hill.

Wiggins S.L and Palma, O.G (1980). 'Acelhuete River Catchment Management Project, El Salvador: Cost Benefit Analysis of Soil Conservation'. ODA Land Resources Development Centre, UK.

Winpenny, James (1991). 'Values for the Environment' ODI/HMSO, London.

Winpenny, James (1994). 'Managing Water as an Economic Resource, ODI/Routledge, London.

World Bank (1993), ' Water Resources Management'. World Bank, Washington DC.

World Bank (1995), 'Efficiency and Equity Conditions in Pricing and Allocating Irrigation Water. Policy Research Working Paper 1460.

World Bank/EIB (1990). 'The Environment Program for the Mediterranean'. World Bank.

Young, R.A (1996), 'Measuring Economic Benefits for Water Investments and Policies'. World Bank Technical Paper 338.