Cyprus Economic Policy Review, Vol.3, No. 1, pp. 99-122 (2009) 1450-4561

Irrigation Water Pricing in Southern Europe and Cyprus: The effects of the EU Common Agricultural Policy and the Water Framework Directive

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Abstract

The agricultural policy adopted by the European Union until recently has contributed to economically inefficient, environmentally unsustainable and socially inequitable management of irrigation water in Southern Europe. The Union's willingness to tackle these issues in an integrated manner is evident in the reformed Common Agricultural Policy and the Water Framework Directive. This paper aims to critically assess the potential impact and effectiveness of these new policies on irrigation water in Southern European countries. In this context, issues of economic efficiency, environmental sustainability and social equity as well as practical limitations are addressed. The paper concludes that, although water pricing is potentially a very effective tool in terms of economic efficiency, its environmental effectiveness is not guaranteed thus it may not drastically improve water resource management in Southern Europe. The same holds for Cyprus, where water pricing may only be effective if private groundwater extraction is fully monitored and charged by governmental authorities. Moreover, Cyprus needs to shift to a low water consuming agricultural sector by focusing on the cultivation of crops that are consistent with the changing climatic conditions and the increasing water scarcity of the country.

Keywords: economic valuation, full cost recovery, water resource management.

1. Introduction

Water resources include surface water, groundwater, inland water, rivers, lakes, transitional waters, coastal waters and aquifers (Chave, 2001). These resources are vital for the wellbeing of human and natural environment, and are central to any economy in the world. From an economic perspective, water resources are essential inputs to production in primary, secondary and tertiary sectors, as well as to household consumption

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(UNESCO, 2006). Throughout the years, overexploitation of water resources led to their degradation and depletion globally. As regards water quantity, freshwater use increased six-fold within the 20th century and 50% of global wetlands were lost (UN, 2002).

In European countries, statistical evidence shows worrying pressure on water resources and a decline in their quantity and quality over recent years. An example of the increased stress on water resources is given by the European Commission which states that irrigated land in Southern Europe has increased by 20% since the mid-1980s (SIWI, 2002). Agriculture occupies 44% of the EU territory and is by far the largest water user in Europe (Massarutto, 2003). Due to its geographic orientation, Europe experiences a wide variability of climates, ranging from the temperate climates of the north to the arid climates around the Mediterranean Sea, which implies diverse farming patterns and crops grown. The importance of irrigation thus increases from north to south, being an essential input for farming in most of the arid and semi-arid regions. In Southern Europe irrigation accounts for a large proportion of total water usage (83% in Greece, 69% in Cyprus, 68% in Spain, 57% in Italy and 52% in Portugal) whereas it accounts for less than 10% in the North (Berbel et al., 2007).

The constantly rising demand for water revealed its relative shortage while the absence of integrated policies along with poor management initiated an intensive debate about its sustainable use (Gómez-Limón and Riesgo, 2004). From an economic perspective, water systems were used inefficiently leading to market failure (Karousakis and Koundouri, 2006); private costs and benefits differ from social costs and benefits, resulting to losses in social welfare (Pearce and Turner, 1990). Furthermore, unsustainable farming practices in Europe were associated with extensive use of fertilisers leading to contaminated watercourses. Besides these issues, climate change is expected to put additional pressure on water resources, particularly in the arid and semi-arid regions (EEA, 2007); sustainable water management is therefore an important ingredient of policies for adaptation to climate change.

In response to the deterioration of water resources, the European Commission implemented new policies. More specifically, it reformed the Common Agricultural Policy (CAP) and forwarded the Water Framework Directive (WFD) – "the most important landmark in the history of the EU's water policy" (Berbel et al., 2007: 295) – which aims to protect and achieve a "good ecological status" of water resources by 2015 and contributes to its sustainable, balanced and equitable use (EC, 2000). Among other implications the Directive requires full cost recovery to be the guiding principle for the pricing of water use, including irrigation.

It is the aim of this paper to critically assess the potential impact and effectiveness of the new policy implementations on irrigation water in Southern European Union (EU) countries, with special attention to the island of Cyprus. In this context, issues of economic efficiency, environmental sustainability and social equity are addressed. The rest of this paper is structured as follows: the proceeding section provides an outline of the policies in question, followed by a discussion on the economic rationale (Section 3) and the practical limitations of water pricing (Section 4). Section 5 focuses on some case studies in Southern Europe by consulting empirical estimations regarding the potential outcomes of these policies. Section 6 describes in more detail the situation in Cyprus as regards agricultural water demand and pricing. Overall, the paper concludes that it is unlikely that water pricing will drastically improve water resource management in Southern Europe.

2. Heading towards integrated water resource management: the reformed CAP and the WFD

There are obvious economic factors behind the rising demand for irrigation water in Southern Europe. Irrigation significantly improves soil productivity, ensures consistently fruitful crops and reduces susceptibility of production to climatic fluctuations, which in turn enables more cropping choices (Merrett, 2002). In essence, irrigation is able to give farming a global competitive advantage since it can boost the profitability of crop cultivation by up to 700% (Massarutto, 2003).

In a sense, one could argue that demand for irrigation originates from market forces that are beyond the influence of public institutions yet this is not quite the case for EU countries. Two main drivers have affected water consumption, most acutely in the arid and semiarid regions. First, a significant part of the construction cost of waterworks has been sustained by public funds; water in general and irrigation water in particular often necessitates large initial investments in infrastructure (Johansson et al., 2002; Molle and Berkoff, 2007a). Second, the CAP allowed farmers to purchase irrigation water at subsidised prices leading to contradictory effects in many rural areas (Berbel and Gutiérrez, 2004). On the one hand, the profits generated from irrigated land were significantly beneficial for farmers, yet the absence of incentives to sustainably use and conserve water resources led to negative externalities for the local aquatic system (Baldock et al., 2000).

In contrast to the one-sided water supply paradigm of the past, the EU attempted to tackle these environmental challenges by elaborating demand-side, integrated and cost-effective water management policies. Over time, the CAP has evolved and is gradually reducing the subsidies for agricultural commodities; Table 1 summarises how priorities have changed in the EU. The latest implementation, which started in 2005, "promotes a multifunctional sustainable agriculture with direct payments for specific programmes substituted by a single farm payment (SFP), fully decoupled from crop production" (Varela-Ortega, 2007:329). Furthermore, the reformed CAP aims to preserve natural resources by applying cross-compliance schemes (EC, 2003a; 2003b). Policymakers put their hopes on and underline the potential of the revised CAP for achieving coexistence of agricultural production and water resources conservation; a significant (indirect) impact on irrigated crops and water use is expected. In many areas of Spain and in other member states, for instance, the decoupled SFP will encourage a shift away from highly productive and water-consuming crops (Varela-Ortega et al., 2002; Bennett et al., 2006; Varela-Ortega, 2007).

TABLE 1

Evolving priorities of the Common Agricultural Policy

	Issues and concerns	*Objectives*	*Irrigation water pricing*
Past	Poverty in rural areas	Equity and rural development	Lower prices
	Increasing food demand	Food self-sufficiency	
Future	Water and soil pollution	Sustainable development	Higher prices
	Budgetary constraints	Economic efficiency	

Source: Gómez et al. (2005) cited in Molle and Berkoff (2007a:23).

Agricultural policies are not, however, the only policies that affect irrigated agriculture. In the Mediterranean countries as elsewhere in the EU, the reformed CAP is applied in parallel with the mandatory WFD which incorporates economic, social and institutional aspects, as well as public participation (EC, 2000). In order to achieve the sustainability of water resources and a more efficient use among economic sectors and social groups, the WFD introduces new instruments such as ecological water assessment, river basin planning, public consultation as well as economic tools (Roth, 2001). The latter implies obligatory implications for the way in which water will be priced after 2010, according to Article 9 of the WFD which states that:

> *"Member States shall take account of the principle of recovery of the costs of water services, including environmental and resource costs* […] *and in accordance in particular with the polluter pays principle"* (EC, 2000: 12).

While many authors concur that such integrated policies (particularly water pricing) are effective for the allocation and protection of water ecosystems and overall socio-economic development (Dinar, 2000; Benoit and Comeau, 2005), there is still no consensus as regards the proper means by which to obtain water prices (Kim and Schaible, 2000). Furthermore, many commentators are sceptical about the economic sustainability of a considerable proportion of irrigated farms, especially in the less fertile (and water scarce) regions of Southern Europe, if water pricing is strictly implemented (Gómez-Limón and Riesgo, 2004; Garrido 2005). The economic rationale behind these views and the doubts about water pricing are elaborated in the two following sections.

3. Economic principles for water pricing

In 1992 the Dublin International Conference on Water and the Environment forwarded a set of four principles, the fourth of which stated that (p. 3):

> *"Water has an economic value in all its competing uses and should be recognized as an economic good.* […] *Past failure to recognize the economic value of water has led to wasteful and environmentally damaging uses of the resource. Managing water as an economic good is an important way of achieving efficient and equitable use, and of encouraging conservation and protection of water resource".*

Economic instruments and the economic value of natural resources were also apparent in the Rio Declaration and its Agenda 21 (UNCED, 1992), which postulated that water should be regarded as a finite resource having an economic value and supported the implementation of allocation decisions through demand management, pricing mechanisms and regulatory measures.

The fourth Dublin principle and the Rio Declaration can be considered as milestones in the long-standing debate on water pricing, as the economic characteristics of water usage were now emphasised (Savenije 2002; Molle and Berkoff, 2007b). Treating water as an economic good and incorporating both the "Polluter Pays" and the "User Pays" principles implies that pollution prevention and the costs of environmental damage should be included in water prices and be borne by those who cause them (Correlje et al., 2007). Environmental economists and international institutions have long advocated that when addressing natural capital, both the financial and the external costs should be accounted for (Pearce and Turner, 1990; OECD, 1999; Dinar, 2000).

According to Molle and Berkoff (2007a), charging for water use is not an end in itself, but an instrument for achieving one or more policy objectives: as Table 2 shows, water pricing may be used as a financial, an economic or an environmental tool. Water charging necessitates:

- First, collective understanding and clarification of the underpinning principles and policy goals (e.g. full cost recovery, water security, efficiency, environmental preservation, securing the needs of the poor and the marginalised etc).
- Second, a thorough and methodologically robust analysis of costs and benefits.
- Third, a pricing system that will maximise the policy goals, given the existing socio-economic conditions.

TABLE 2

Water pricing as a tool for different purposes

Financial Tool	*Economic Tool*		*Environmental Tool*
Aims to recover all or part of capital and recurrent costs. Ensures sustainability of the scheme. Increases government revenue.	Conservation - Elicit water savings - Crop shifts - Technological change	Raise economic Productivity - Shift to high-value crops - Sectoral reallocation	Sustainability - Water quality and pollution control

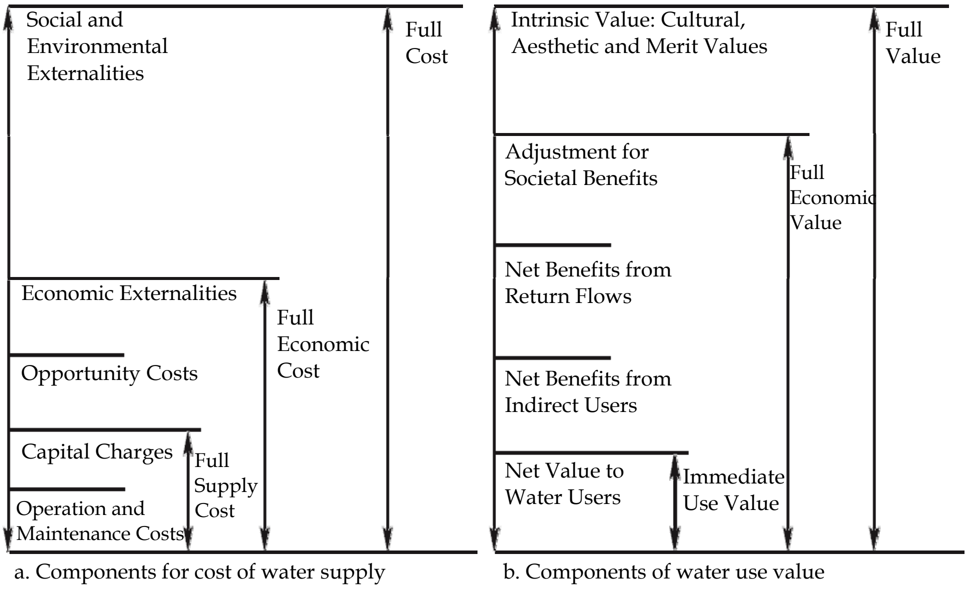
Source: Molle and Berkoff (2007a).

In order to understand the role of economic tools in water resource management, it is particularly important to understand the distinction between the value, the cost and the price of water. Figure 1 illustrates this distinction by showing the different components that add up to the total value of water use and the total costs of water supply. According to Rogers et al. (1998), the full cost of water is made up of three major components: i) the full supply cost, which consists of capital charges and operation and maintenance costs; ii) other economic costs, which include economic externalities as well as opportunity costs that are associated with alternate uses of scarce water resources; iii) social and environmental externalities, which express the monetary equivalent of damages to human health and ecosystems due to unsustainable water consumption.

As regards the value of water use, apart from the immediate value of water to its users, expressed e.g. as the willingness of domestic consumers to pay for using water, the full economic value includes three additional components: i) net benefits from indirect uses of water, e.g. when irrigation schemes also provide water for domestic use in places with bad water quality; ii) net benefits occurring when return flows of water that is diverted e.g. for agriculture also improve the state of groundwater resources; iii) additional societal benefits due to water use – for example, assisting the agricultural sector through irrigation schemes can contribute towards poverty alleviation, food security or rural development. Finally, to obtain the full value of water use one has to account also for the intrinsic value of water, however difficult it is to measure.

FIGURE 1

Comparison between the cost and the value of water



Source: UNESCO (2006).

Hence it is evident that the value of water refers to the socio-cultural significance of the resource (determined by demand or willingness to pay) and to the direct and indirect benefits it provides. Many techniques have been developed to obtain the total economic value of environmental services – i.e. to attach a monetary metric to natural resources – which also apply in the case of water (Birol et al., 2006; Birol et al., 2008).[1] This total value includes both monetary (direct) and non-monetary (indirect, option and non-use) values. Table 3 provides an overview of valuation methods. In the context of selecting appropriate management strategies, valuation is not applied to water itself, but rather to the consequences of proposed policies. The application of valuation techniques is thus quite important when comparing the outcomes and trade-offs between different policy options. Nonetheless economic valuation is not a panacea to water issues, and both policymakers and managers need to recognise the advantages and limitations of these methods and be cautious when interpreting the results of such analyses.[2]

The cost of water on the other hand, usually refers to the direct expenses in providing water to farmers, i.e. the supply costs, which include operation and maintenance, capital depreciation and replacement costs. Apart from these costs, however, the notion of full (or total) cost of water, as it appears in the WFD, also includes opportunity costs, resource (scarcity) costs, social costs, environmental damage costs and long-run marginal costs (Roth, 2001).[3] It should be noted that the cost to an individual farmer (equal to the price of water) will be very different from the full cost to society, based upon the full value of water. As Dasgupta and Mäler (2004) note, many non-specialists tend to incorrectly equate the observed charge to the user (i.e. the price) with the economic value or cost of water. While the price needs to reflect both the full cost and the full value of water, it should be kept in mind that the upper pricing level is limited by willingness to pay, rather than being defined by it.

Economic theory assumes that the optimum allocation of water will be achieved according to society's preferences in a perfectly competitive (free) market system, provided that the full value is equal to the full cost of water and is reflected in the price. If the market is disordered and the price of water is below its full cost – which is the *status quo* for irrigation in Southern Europe – society will bear the remaining cost. In general, under-valuing or under-pricing water resources will most likely result in

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[1] Whether the economic valuation of environmental resources is appropriate from an ethical perspective is a long-debated and never resolved issue in environmental economics which is beyond the scope of this paper.

[2] See e.g. Birol et al. (2006:114) for a detailed list of advantages and disadvantages of each valuation method.

[3] See Roth (2001) for a definition of these terms. For a more technical interpretation of full cost recovery see Massarutto (2002a).

misallocation of the resource and can potentially bias the direction of technological development. Thus in theory, full cost recovery (FCR) justifies its adoption as a means to deliver economic efficiency, fairness in distribution (equity) and environmental sustainability.

TABLE 3

Components of total economic value of water resources and appropriate economic valuation methods

TEV Component	Valuation methods[1]
Direct use values	
Irrigation for agriculture	PF, NFI, RC, MP
Domestic and industrial water supply	PF, NFI, RC, MP
Energy resources (e.g. hydroelectric)	MP
Transport and navigation	MP
Recreation/amenity	HP, TC, CVM, CEM
Wildlife harvesting	MP
Indirect use values	
Nutrient retention	RC, COI
Pollution abatement	RC, COI
Flood control and protection	RC, MP
Storm protection	RC, PF
External eco-system support	RC, PF
Micro-climatic stabilisation	PF
Reduced global warming	RC
Shoreline stabilisation	RC
Soil erosion control	PF, RC
Option values	
Potential future uses of direct and indirect uses	CVM, CEM
Future value of information of biodiversity	CVM, CEM
Non-use values	
Biodiversity	CVM, CEM
Cultural heritage	CVM, CE
Bequest, existence and altruistic values	CVM, CE

Note: [1] Acronyms refer to Production Function (PF), Net Factor Income (NFI), Replacement Cost (RC), Market Prices (MP), Cost of Illness (COI), Travel Cost Method (TCM), Hedonic Pricing Method (HP), Contingent Valuation Method (CVM), and Choice Experiment Method (CEM).

Source: Birol et al. (2006).

4. Limits to the application of irrigation water pricing

In reality there are economic, practical and political constraints that limit the applicability of FCR (Berbel et al., 2007). The existing irrigation pricing structure in Southern Europe varies widely both within and across countries. As Table 4 shows, tariffs and quotas are the main economic tools used, where water charging is based either on irrigated area (price per hectare applies) or more rarely on volumetric usage (price per cubic metre of water consumed).[4] Such variability in price structure implies different incentives to save water, which are determined by many factors including political (e.g. national water policy) and site-specific variables (e.g. irrigation method) (Chohin-Kuper et al., 2003).

TABLE 4

Structure of agricultural pricing systems and price levels in South European countries

Price Structure	**Country**	**Price**		**Incentive to save water**
		US$ per hectare	*US$ per cubic metre of water*	
Area Pricing (per ha)	France Greece Spain	136 95-220 40-250		Low
Area pricing depending on crop	Italy (and by soil type)	30-250		Low
Volumetric (Uniform)	Spain (rare)		0.03-0.08[1]	Low
	Cyprus		0.12	Moderate
	France (ASA[2])		0.06-0.07	Moderate
	France (SAR[3])		0.06-0.3	Moderate to High
Optional	France (SAR)	40 or 25	0.07 or 0.17	Moderate

Notes: [1] Only the volumetric component of a two-part tariff
[2] Associations Syndicales Autorisées d'irrigation (ASA) = water user associations
[3] Sociétés d'Aménagement Régional (SAR) = regional water companies
Source: Chohin-Kuper et al. (2003:2).

Economic theory suggests that the optimal price should be reflected in the long-run marginal cost. This forward-looking component ensures that

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[4] This applies both to surface and groundwater resources, however the method and the level of water pricing differs among regions and countries.

water prices include (or capture) both investment costs and potential environmental damage costs; users should bear the additional cost (deterioration) that their demand causes to the service operation. This is difficult and complex to calculate. Individual metering/monitoring of underground water extraction, for instance, is very costly and almost impossible to implement (Massarutto, 2002a). Moreover, Roth (2001) points out that even if the economic valuation techniques manage to quantify environmental costs they cannot be transformed into a price or they cannot always identify all possible damages (e.g. potential bio-diversity loss as a result of damaged wetlands) due to uncertainties in the estimation variables. Thus the pricing system might not be sufficient to achieve the environmental sustainability objectives.

Therefore, there are limits to the application of FCR: unlike pure economic goods, water has environmental and social characteristics in addition to its function as a productive input (Roth, 2001). In fact many water services include components with the characteristics of a public good, in the sense that they are non-rival and non-excludible (Savenije, 2002). Irrigation farming, for example, could be considered as a historical or traditional characteristic of the countryside or a water reservoir might provide flood defence besides its pure economic function. Massarutto (2002b) notes that most new projects for water resources in Europe (dams, desalination plants etc) do not pass the cost-benefit test if a public good dimension is not considered in the appraisal; in these cases marginal cost is absent, thus the full cost is higher than long-run marginal cost. Given that access to water is a "social right" with no possible substitutes, the optimal solution is to provide the service through public funds.

Furthermore, even if it is feasible to consider all external costs, FCR may lead to immense regional variations in the price level (Roth, 2001). Empirical work in Southern Europe shows that the variation in the price of water is high and depends primarily on the availability of water (i.e. the magnitude of scarcity cost) among other site-specific variables (Massarutto, 2002a). Thus a rigorous application of FCR implies that farmers whose irrigated fields are proximate to sensitive areas will face even higher water prices than the current ones. To this extent, Massarutto (2003) estimates that while in countries such as France and Northern Italy a 30-50% increase in water prices will achieve FCR, in some parts of Spain this will require actual prices to increase by five to ten times.[5] From an

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[5] Massarutto (2003:104) also notes that "*cost recovery ratios are not necessarily correlated with absolute water prices [since] areas with very low water supply cost are already close to FCR despite*

environmental perspective this seems legitimate; when considering the social and economic aspects though, it is safe to assume that such market reallocation will lead to conflicts between regions, associated with equity issues.

5. Policy impacts and effectiveness: evidence from the literature

Having considered the economic theory for and the practical and ethical limitations against the FCR for irrigation prices, the discussion would be incomplete without consulting some empirical estimations regarding the potential impact and effectiveness on agriculture and water resources from such applications. Many researchers studied the farmers' response to water price increases in Mediterranean regions using various methodologies. In theory, water demand should be appraised on a case-by-case approach since it is essentially determined by site-specific variables such as cost and pricing methods of water and its availability, size and technology of the farm, prices of crops and farmers' income, previous subsidy levels etc. However, in order to holistically evaluate the impact and effectiveness of the new water pricing policies, it is appropriate to consider these studies as they cover a wide range of agricultural practices in Southern Europe, which allows for useful conclusions to be drawn. Note that, since the WFD and the reformed CAP had not yet been fully realised at the time of these studies, the models employed provide a simulation and not the actual responses of farmers.

Varela-Ortega et al. (1998) applied a dynamic optimisation programming model whereby the farmers' profit maximisation is subject to pre-defined constraints. The model examined under which circumstances water consumption would decrease by 10, 25 and 50 percent in three Spanish regions (Castille, Andalucía and Valencia). The selected regions had differences in the size of farms, crop mix, technology, water scarcity and irrigation methods which resulted to different responses. Areas where farms are large, technologically advanced and flexible in terms of crop variety (Andalucía) will readily change farming patterns to less water demanding crops after a minor increase in the price of water. On the contrary, in areas with smaller farms and/or more specialised and high-irrigated crops (e.g. fruits), demand for water is inelastic due to the limited capacity and ability to switch between crops. Similar results were obtained

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the very low price, while in other areas the cost of supply is much higher and cannot be fully recovered even if the water price is substantially higher".

by Varela-Ortega (2007) in the Castilla-La Mancha region in Southern Spain using a non-linear static programming model. Bazzani et al. (2005) on the other hand found different responses concerning fruit crops. This study applied scenario analysis with a multi-criteria programming model to examine economic, social and environmental sustainability issues concerning the WFD and the CAP by comparing the fruit cultivations in Emilia-Romagna (North-East Italy) with cereal cultivations of Lombardia (Northern Italy). Fruit cultivations are not likely to have a severe impact on employment or improvement on water management, at least under a reasonable water price increase due to higher profitability of crops as opposed to cereals– traditionally sustained through CAP – whereby farmers will potentially face decreased incomes and employment, yet better water conservation.

Another recent study is that of Pujol et al. (2006) who compared the Catalonia (Northwest Spain) region which specialises in corn and fruit-trees (high-cost and high-income crops) with Puglia (South Italy) which grows tomatoes on an industrial basis. Using a mixed-integer Linear Programming (LP) model at basin level, they concluded that between the 'with' and 'without' water market scenarios, the former is more economically efficient in terms of water management. Creating a market for water could potentially result to more specialised farming in both regions – even with limited water availability – and higher farmer income.

Berbel and Gómez-Limón (2000) also applied LP with profit maximization and focused on three Spanish regions (Seville, Palencia and Cordoba). Demand for water was found to be highly inelastic, so that a 40% reduction in farmers' income was necessary in order to achieve significant water savings. They predicted catastrophic social consequences to these regions, which specialise on high water-demanding crops such as cotton, sugar beet, onions and corn; high water prices will directly affect farmers' employment and will indirectly affect labour involved in the processing of these crops. In terms of environmental consequences, benefits could potentially arise as a result of reduced fertilisation. Gómez-Limón and Riesgo (2004) concur with these findings, using a multi-criteria programming and cluster analysis which focused on the Duero Valley in central Spain. Employment on the one hand is likely to decrease as farmers are expected to withdraw from agriculture but on the other, ceasing of the cultivation of crops that are highly demanding both in water and nitrogen fertilisers will be beneficial for the environment.

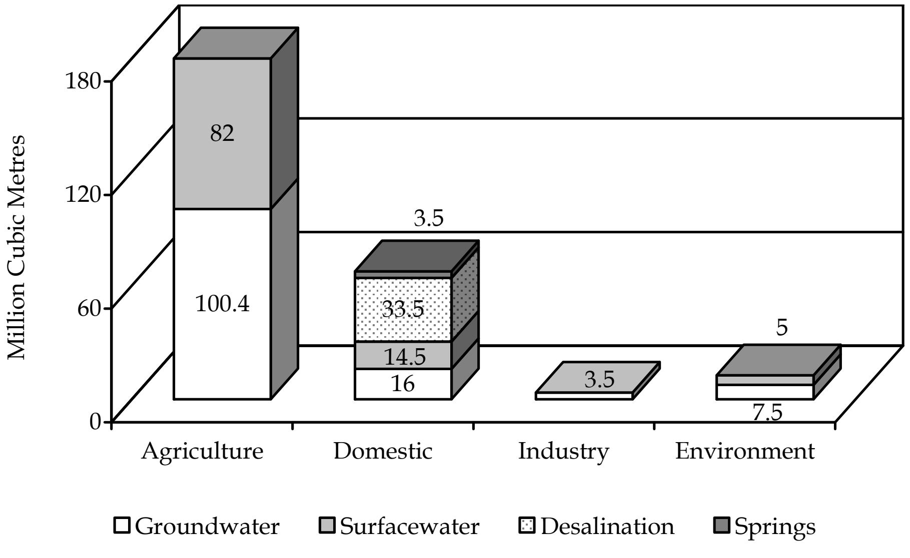
The last study to consider is that of Massarutto (2003) who examined the potential effects of the CAP and the WFD in eight regions (three in Italy, three in Spain and two in France) using LP. In the short-run, the implementation of the new policies will have a limited impact in most regions since water demand is inelastic. In the medium-and-long-run however, although demand for irrigation continues to be inelastic, there is time for the larger farms to shift cultivation to high value and less water demanding crops (e.g. horticulture). The smaller farms are expected to soon reach their threshold (exit price) and will inevitably withdraw from agriculture to other farming activities (e.g. pasture) or other sectors (e.g. agrotourism).

6. Agricultural water demand and pricing in Cyprus

Since the independence of Cyprus in 1960, the agricultural sector has been supported by various forms of subsidies in an effort to improve and sustain rural livelihood, provide food security and minimise soil degradation and desertification. Agriculture was considered as the backbone of the economy during the 1960s and 70s, reaching 18% of GDP and 20% of total employment in the mid-1960s; however, as Cyprus gradually became service-dominated, the contribution of agriculture has decreased dramatically, and currently accounts for about 2% of GDP and 7% of the total workforce. Despite such decreases, Figure 2 shows that agriculture still remains the dominant water user in the country.

FIGURE 2

Water consumption in Cyprus by sector and source of supply



Note: The 'Environment' sector includes water use in special ecological areas as well as landscape irrigation in municipal areas.

Source: Savvides et al. (2001).

Agricultural water supply is provided either through government irrigation schemes (55%) or through private boreholes (45%). While domestic water supply is provided by the government to all municipalities at a universal price that covers the full operating costs[6], farmers purchase water at subsidised prices. During dry years when water availability is low, the government prioritises domestic to agricultural water demand. Under such circumstances, farmers tend to extract irrigation water from illegal boreholes at an unsustainable rate, which over time deteriorates the quality of underground water (Iacovides, 2005); it is estimated that most aquifers are overexploited by 40% of their natural (sustainable) replenishment rate (Demetriou and Georgiou, 2004). In general, water use efficiency in private irrigated land is lower precisely because control and monitoring of groundwater exploitation is difficult or deficient.

Currently irrigation water is priced at €0.17 per cubic metre and covers about 77% of financial costs (WDD, 2004). Low water prices are thought to give incentives for sensible use via water-efficient irrigation methods. However the low cost of water encouraged the cultivation of high-value and water-demanding crops. Prior to the country's accession to the EU, the Parliament examined the possibility of revising irrigation prices upwards; however this was not ratified. Such political unwillingness stems from economic and social considerations including domestic food security, preservation of rural landscapes, avoidance of low-skilled labour unemployment and urbanisation. The issue becomes even more complex if one considers the traditional two-tiered policy towards water allocation and pricing. While farmers receiving water from public systems are charged, those who have rights for private extraction of groundwater do not face any costs apart from the operating cost of water pumps. Having in mind these price inequalities, an increase in the price of water will give an incentive for further mismanagement and consequent depletion of groundwater resources (Iacovides, 2005).

The accession of Cyprus to the EU implies that by 2010 water needs to be charged at its full cost. Based on 2005 estimates, this will raise irrigation prices to €0.53 per cubic metre (Socratous, 2005). The increase in the price of water will have different repercussions depending on a variety of factors. First of all, without subsidised water there will be a two-

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[6] All end-users pay the full supply cost of water, however there are great disparities among the charges applied by each municipality, varying from €0.39/m^3 in the south – where groundwater is in general cheaply available – to €1.00/m^3 in central Cyprus (Socratous, 2005).

dimensional loss in competitiveness of some crops (Markou and Kavazis, 2006), domestic competition between crops and competition from foreign markets as regards exported agricultural products. Other factors may include scale of farming (i.e. small compared to large scale farming), labour costs and profitability of crops.

Nonetheless most farmers are driven by the net economic benefit of agricultural products rather than the cost of water, which is only one of the many variables that determine the existence of specific crop patterns. Figure 3 compares the cost of water to other farming costs (labour, fertilisers, fuel costs etc.) and the net benefits per hectare and crop for a number of selected crops on the basis of a detailed survey carried out periodically by the Agricultural Research Institute of Cyprus (Markou and Papadavid, 2008).[7] For comparative purposes, Figure 3 displays also the water requirement[8] for each crop under the climatic conditions of Cyprus as calculated by Eliades et al. (1995). It is evident that for none of these cultivations water cost is substantial. For instance, compared to the very high total cost of greenhouse cucumbers and tomatoes, water cost is very low and net benefits are relatively high. This is also the case for water-greedy crops such as colocasia and bananas. Probably the crops that are on average sensitive to water price fluctuations are the open-field watermelons and potatoes – yet these are crops which generally experience high, and most probably inelastic, demand in Cyprus; this means that an increase in costs of such crops will most likely pass to consumers.

One could reasonably question how a country with limited water availability has specialised in water-intensive agricultural products. As discussed above, such trends in cropping patterns can be explained by:

- Subsidies in the price of water supplied to farmers from surface or groundwater sources though public schemes;
- Reallocation of agricultural water to areas with limited water availability through government irrigation schemes (e.g. via the South Conveyor Project);

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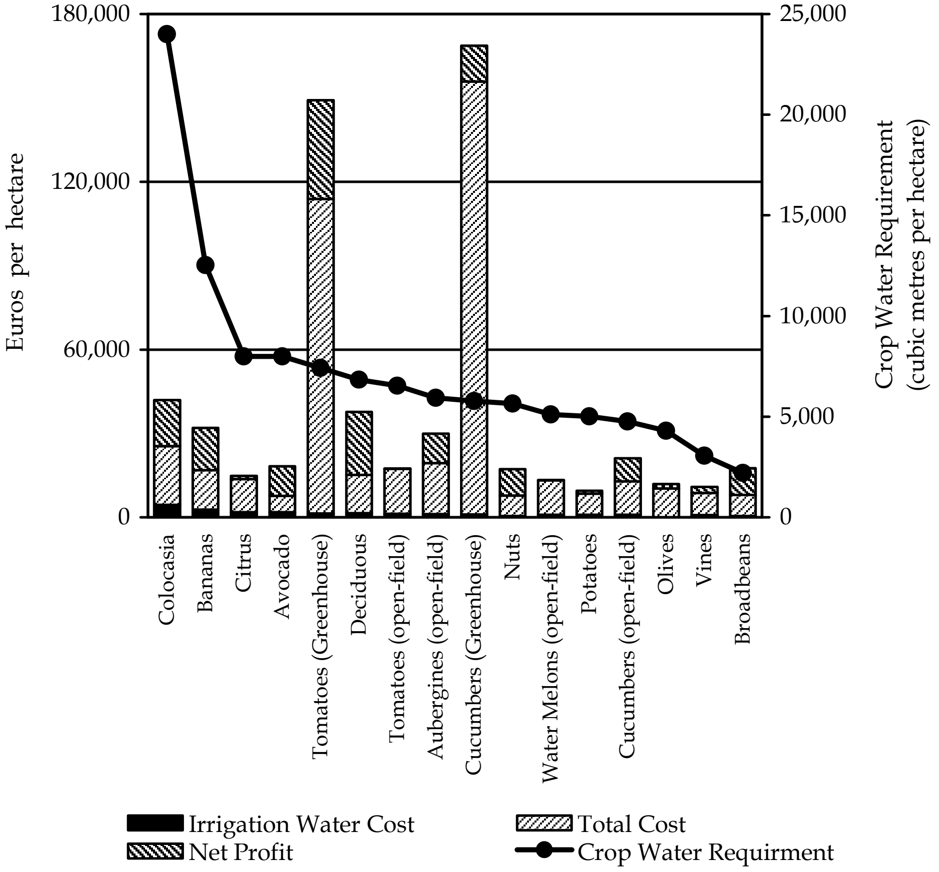
[7] It should be noted that values shown in Figure 3 (including irrigation costs) provide an average of cost from fields irrigated both from public waterworks and private boreholes.

[8] Crop water requirement (expressed in cubic metres of water per hectare) is defined as the total amount of water needed throughout the lifespan of a given crop under a specific climatic regime, in order to allow normal plant growth or crop yield. This adequate water quantity can be obtained through precipitation and/or irrigation.

- Over-pumping of groundwater from private boreholes with farmers bearing on average very low costs; either licensed or unlicensed these boreholes are effectively unmonitored.

FIGURE 3

Farming costs and benefits in Cyprus for selected crops



Source: Markou and Papadavid (2008).

Having these arguments in mind, an increase of water prices at full cost – only for those quantities of water that are currently metered and charged – is unlikely to bring about more efficient and sustainable agricultural water use, due to the low elasticity of water demand (particularly for permanent crops) and the seemingly small water cost that farmers face, compared to all other costs. In other words, full cost recovery for only a portion of the total water that is actually consumed might not be enough to discourage the unsustainable cultivation of crops with high water requirements that are not suitable for the existing semi-arid climatic conditions of Cyprus.

7. Policy implications and conclusions

The agricultural supply-side policy adopted by the EU until recently has been the source of economically inefficient, environmentally unsustainable and socially inequitable management of irrigation water, particularly in Southern Europe. The Union's willingness to tackle these issues in an integrated manner is evident in the reformed Common Agricultural Policy and the Water Framework Directive. Through the above analysis, some interesting outcomes can be drawn as regards the potential effectiveness of these new policies.

In terms of economic efficiency, water pricing is potentially a very effective tool, at least in principle since farmers are expected to take into account the marginal and opportunity costs and eventually to shift to the next best alternative farming practice. In reality, the case studies mentioned in Section 5 converge towards the view that higher irrigation water prices will most likely lead to shifting irrigation water to the most productive and profitable uses. Yet full economic efficiency, as expected in a laissez-faire system, is improbable to occur due to the highly inelastic nature of irrigation demand. This means that shifting cultivation to a more productive and profitable use does not necessarily imply less demand for irrigation water and improvements in water conservation. It is often the case that highly profitable crops are also the most specialised ones and experience the most inelastic irrigation demand, and are at the same time usually high water-demanding crops hence water conservation will not be realised as such. Therefore, in terms of environmental sustainability, the new policies might not be as effective. When some environmental improvements occur, it will be because of decreased fertilisation due to changes in the crop mix. Most likely though, environmental improvements will arise at the expense of smaller farms which had been traditionally sustained through subsidies and will now withdraw from the market due to higher water costs. The potential outcome of the new policies will therefore have a significant negative effect as regards fairness in the distribution and the cost allocation of water resources among social groups. The adverse impacts of irrigation pricing will be more realised in smaller and least advanced farms or in regions with greater water scarcity, less fertility and crop availability. In such a case where these predictions turn into reality, the EU will be faced with the problem of high unemployment of unskilled labour in rural areas.

As an EU Member state, Cyprus has to comply with the Water Framework Directive and charge water at its full cost by the year 2010. This means that irrigation prices may have to rise by three times or even more. Such an increase in the price of water will affect the scale of farming (probably to the benefit of large scale farming), labour costs and profitability of crops. Under the current pricing policy, Cypriot farmers are faced with water prices way below the real cost of their water use thus even a three-fold price increase might be small compared to other farming costs for most crops cultivated in Cyprus. Moreover, the rise in irrigation prices is likely to give an "incentive" for further mismanagement and depletion of groundwater resources since farmers – either with or without groundwater rights – might prefer to rely on a relatively cheap (and uncontrolled) water source rather than paying for more costly irrigation water.

For the full cost recovery principle to be effective in promoting sustainable agricultural water management, a holistic approach is required. From an economic, ethical and environmental perspective, private groundwater extraction needs to be fully controlled and monitored by governmental authorities. An optimal solution would be the metering of all boreholes (licensed and illegal ones) which will enable the application of water pricing at full cost for all water consumed in the agricultural sector. Although reasonable, such a policy cannot be easily implemented and requires both strong political willingness and the cooperation of farmers.

In the context of growing water scarcity, water charging at full cost and evolving EU policies that phase-out subsidies, Cyprus needs to shift to a low water consuming economy in general and agricultural sector in particular. In terms of the latter, a different cropping matrix is necessary based primarily on the water criteria of crops and considering the climatic conditions and the diminishing water availability of the country. This can be achieved by strategies that foster agronomical research and address the diversity and suitability of crops. Particularly for small-scale farming, targeted marketing can focus on reducing the undertaken risks and improve crop planning by promoting the cultivation of high added-value and low water-consuming products. Apart from improving water use efficiency, such measures will also enhance the role of farmers and rural population in protecting environmental resources.

In general, and considering the arguments for and against the implementation of water pricing, it can be concluded that such policies, although justifiable in theory, may not be able to effectively deliver simultaneous improvements in water management, socio-economic development and environmental sustainability in Southern Europe. Yet it remains to observe the actual outcomes from such applications in the coming years. Since each agricultural region behaves differently, these policies are likely to yield more benefits if they are adjusted according to local circumstances – rather than applying a "one-size" policy to fit all.

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