

MPRA

Munich Personal RePEc Archive

Water Resources Allocation: Policy & Socioeconomic Issues in Cyprus

Phoebe Koundouri and Ekin Birol

2011

Online at <http://mpa.ub.uni-muenchen.de/38262/>

MPRA Paper No. 38262, posted 14. October 2012 11:59 UTC

Metadata of the chapter that will be visualized online

Series Title	
Chapter Title	Introduction
Chapter SubTitle	
Copyright Year	2011
Copyright Holder	Springer Science+Business Media B.V.
Corresponding Author	Family Name Koundouri
	Particle
	Given Name Phoebe
	Suffix
	Division Department of International and European Economic Studies
	Organization Athens University of Economics and Business
	Address 76 Patission street, GR-104 34, Athens, Greece
	Email pkoundouri@aueb.gr
Author	Family Name Birol
	Particle
	Given Name Ekin
	Suffix
	Division Department of Land Economy and Research
	Organization Fellow at Homerton College, University of Cambridge
	Address London, United Kingdom
	Division
	Organization International Food Policy Research Institute (IFPRI)
	Address 2033 K St, 20006-1002, NW, Washington DC, USA
	Email e.birol@cgiar.org
Abstract	This chapter aims to communicate the two main reasons d'être of this book, namely: (1) to present and analyze the Cyprus experience in water resources management policies (2) communicate this experience to other countries that can inform, develop and improve their water resources policies by understanding the strong and weak elements of the Cyprus experience. Moreover, the chapter introduces the specific themes and issues that are analyzed in the consecutive chapters of the book.
Keywords (separated by '-')	Water scarcity - Water resources management - Sustainable development - Sustainable policies and politics

Chapter 1

Introduction

Phoebe Koundouri and Ekin Birol

Abstract This chapter aims to communicate the two main reasons d'être of this book, namely: (1) to present and analyze the Cyprus experience in water resources management policies (2) communicate this experience to other countries that can inform, develop and improve their water resources policies by understanding the strong and weak elements of the Cyprus experience. Moreover, the chapter introduces the specific themes and issues that are analyzed in the consecutive chapters of the book.

Keywords Water scarcity • Water resources management • Sustainable development • Sustainable policies and politics

Water management is an important problem in the island of Cyprus.¹ Cyprus is representative of arid and semi-arid regions, typified by lack of rain; spatial separation of water supply and demand; irrigation-based agriculture, and overuse of groundwater sources. Water scarcity in the island occurs across many dimensions. Firstly, there is growing demand for water in residential, industrial and agricultural sectors, stemming largely from economic growth. Secondly, supply side augmentation options have become increasingly constrained, and restrictively costly. The combination of

¹See Fig. 1.1 below, for a map of Cyprus with major cities and locations of rivers.

P. Koundouri (✉)

Department of International and European Economic Studies, Athens University of Economics and Business, 76 Patission street, GR-104 34 Athens, Greece
e-mail: pkoundouri@aueb.gr

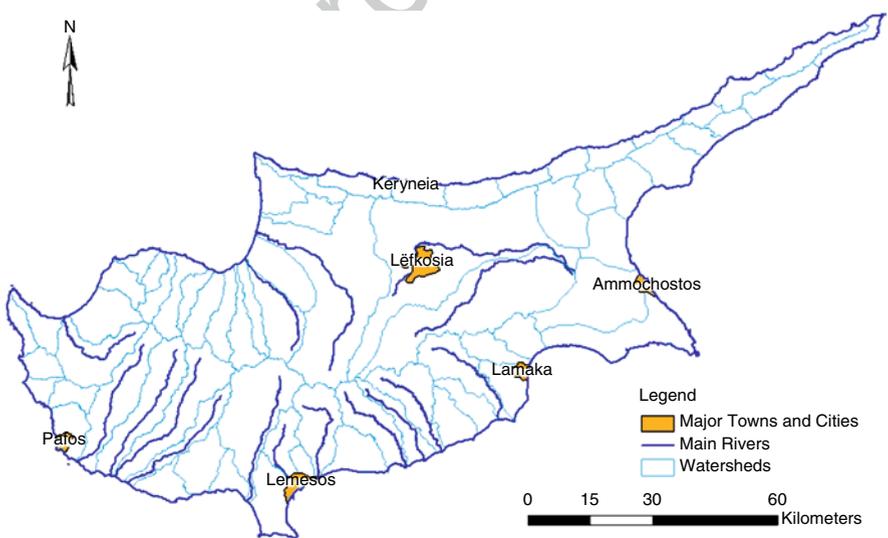
E. Birol

[AU1] Department of Land Economy and Research, Fellow at Homerton College,
University of Cambridge, London, United Kingdom
and
International Food Policy Research Institute (IFPRI), 2033 K St, NW, Washington DC
20006-1002, USA
e-mail: e.birol@cgiar.org

20 demand growth and supply side interventions has stretched current water availability
21 to its hydrological limits. In addition to these quantity constraints, the limits to the
22 assimilative capacity of water resources for human and industrial waste have been
23 reached in most of the regions of the island, and consequently the quality of fresh-
24 water has been degraded. In turn, water scarcity has become an important constraint
25 on the economic development of Cyprus, and resulted in fierce competition between
26 economic sectors that rely upon scarce water resources. Moreover, the sustainability
27 of the island's economic development is threatened as a result of the many threats
28 on the ecological services of the water resources. This led Cyprus to invest both
29 resources and 'hopes' in the implementation of cutting edge water producing technologies,
30 such as desalination and wastewater reuse policies (Fig. 1.1).

31 Cyprus is certainly not unique in the water resources management challenges it
32 faces. These challenges are typical of almost all arid and semi-arid regions of the
33 world and certainly relevant for the whole of the Mediterranean coast; hence the wider
34 regional and international interest for this book. Moreover, the recent accession of
35 Cyprus to the European Union (EU) in May 2004 enhances the relevance of the
36 management approaches considered in this book, as they now become potential
37 solutions for the wider European area. Along with the other EU directives and
38 regulations, Cyprus is now required to implement the EU Water Framework
39 Directive (WFD, 2000/60/EC); not an easy task by any means. This challenge is
40 one of the central issues considered in the book.

41 One other interesting characteristic of Cyprus, relevant for many other countries,
42 is that the administration of the island is divided, due to political reasons, between
43 the area controlled by Cypriot Government and the Turkish-Cypriot adminis-
44 tered area. This book represents one of the first attempts to co-ordinate resource



This figure will be printed in b/w

[AU2] Fig. 1.1

management between the two administratively separated parts of the island. 45
In particular, the book includes joint contributions from representatives of both 46
parts of the island, in order to discuss some of the management issues and sociopo- 47
litical complexities that arise due to the separation of the island. It is argued that the way 48
forward for sustainable and efficient management of water resources on the island 49
should not be fragmented and region-specific. This argument is in alignment with 50
the requirement of the EU WFD that spells out that the whole of the island should 51
be treated as a unique river basin. The problems that arise from the incompatibility 52
of political boundaries with geo-hydrological ones are not unique to Cyprus: hydro- 53
logical boundaries of rivers, aquifers and wetlands do not usually coincide with 54
political boundaries, due to either historical or current political complexities. Hence 55
regions that face such issues could benefit from following the experience of Cyprus 56
as far as common water resources management is concerned. 57

Overall, Cyprus is an interesting case study that can inform water resources 58
management in water scarce, arid and semi-arid regions, characterized by (1) a long 59
history of supply-side management while ignoring demand management, (2) growing 60
pressures on water resources supply, both in terms of quantity and quantity, deriving 61
from economic development, (3) incompatibility between hydrogeological and 62
political boundaries due to political disputes and (4) an eminent need to implement 63
the sophisticated and demanding water related directives of the EU. These four 64
themes constitute the international motivation for writing this book (the Cyprus- 65
specific motivation is, I hope, explicit and obvious) and are central its structure. 66
Chapter 2 presents the supply-side of water resources in Cyprus, while Chapter 3 67
describes the demand-side. These two chapters set the geo-hydrological background 68
of the book. Chapter 4 introduces the main current challenge of water resource 69
management in the island: the implementation of the EU WFD, which in effect 70
calls for an integrated water management approach that can balance water demand 71
and supply in an environmentally sustainable (good ecological water status), economi- 72
cally efficient and social equitable allocation. Chapter 5, presents a thorough review 73
of the evolution of water resources administration in Cyprus and identifies recent 74
administrative responses to the implementation of the WFD and more general 75
harmonization with the EU. Chapter 6 identifies and analyzes the political complexities 76
of policy-making and policy-reforming in Cyprus' water sector, with particular 77
emphasis on its capital, Nicosia. Chapters 7–10 focus on the socio-economics of water 78
resources management in the island, given the geo-hydrological, political, adminis- 79
trative and legal background presented in the first six chapters of the book. The 80
concluding chapter proposes a holistic way forward for water resources manage- 81
ment in Cyprus, given the climatic, hydrogeological, historical, political, ethical 82
and socio-economic, dimensions of this interesting resource allocation problem. 83

In Chapters 2 and 3, Iacovos Iacovides presents a holistic ecosystem-based 84
assessment of the natural water systems availability, and water use in the main 85
water management regions of the island. He first investigates in Chapter 2 the 86
supply-side of water resources, including inter-annual characteristics of precipitation 87
and its geographic distribution; surface catchments and runoff; groundwater basins 88
and their current water balance; surface water impoundment works; inter-basin 89

90 transfers; treated municipal wastewater reuse; water ecosystem services and support
91 of the diversity of plant and animal species, and desalination. Given that desalination
92 is an important parameter for the situation of water resources in Cyprus, this chapter
93 highlights the island's experience in this supply-side enhancement method, and
94 explains its advantages and disadvantages. The author concludes by presenting the
95 water policies and projects planned to regulate and manage water shortages and
96 assessing their adequacy.

97 Chapter 3 assesses the demand-side of the island's water resources, and presents
98 a detailed picture of current water use by each sector, as well as an extrapolation of
99 water use by each sector into the future. More specifically, the author describes
100 water allocation and use by different economic sectors and geographical areas, with
101 special emphasis on the main water user in the island: the agricultural sector. The time
102 profile of the population-water resources equation; the impact of the seasonality of
103 tourism, as well as the value-in-use of water in various economic sectors are also
104 examined in detail in this chapter. Demand management measures are finally
105 addressed and the author discusses their potential to safeguard conservation and
106 future sustainability of water resources.

107 In Chapter 4, Ekin Birol, Phoebe Koundouri and Kyriaki Remoundou, provide a
108 critical review of the aspects of water management in Cyprus related to the imple-
109 mentation of the WFD.² The water allocation problem, and the need for an integrated
110 management approach for sustainable use of European water resources, have been
111 recognized by the EU policy makers, and resulted in the development and implemen-
112 tation of the WFD. This chapter presents the main provisions and deadlines of the
113 WFD, and reviews the various measures that Cyprus has already undertaken, and is
114 currently undertaking to implement the Directive. The authors also discuss several
115 challenges Cyprus faces during the WFD implementation process, especially those
116 that arise due to regional and/or local situations and conditions that are specific to
117 Cyprus. The issue of creation of a single basin on the island is also discussed.
118 Finally, the possible future socio-economic benefits of the WFD implementation
119 are reviewed, and the affordability of water by different water users is examined in
120 the light of the WFD's requirement for cost recovery of water services.

121 In Chapter 5, Iacovos Iacovides provides a concise review of the evolution of
122 water resources administration in Cyprus, and documents the current changes
123 in water resources related legislation and institutions within the context of EU
124 harmonization. Moreover, the author highlights the inherited problematic insti-
125 tutional arrangements for water resources management in Cyprus. In particular,
126 he focuses on previous legislation, which divided the responsibility for water
127 resources administration between several ministries that exercised overlapping
128 jurisdictions, caused duplication of efforts, and occasionally lack of action.
129 These weaknesses and deficiencies have been targeted and corrected through
130 the development of the new and unified legislation in accordance with the

²The consecutive chapters of this book contain more details with regards to the effects of the WFD implementation on the specific water issue dealt within each chapter.

requirements of the EU WFD. The new legislation is also explained in detail in this chapter. 131 132

In Chapter 6 Anthi Dionissia Brouma and Cahit Ezel identify and analyze the political complexities of policy-making and reforming policy in Cyprus' water sector, with particular emphasis on its capital, Nicosia. The Nicosia case-study was selected primarily for three reasons: (1) it is the island's capital, and therefore the center of the policy-making, as well as the decision-making apparatus; (2) it is the last divided capital in the world, which raises an international interest besides the national and regional one, and (3) the old Nicosia district already demonstrates forms of bi-communal co-operation, with regards to the drinking water distribution system, the sewage system, and the Nicosia 'Master Plan' for the rehabilitation of the within-the-walls city. 133 134 135 136 137 138 139 140 141 142

These three existing areas of collaboration seem to follow the logic of policy networks, and if appropriately supported, can encourage the rapprochement of the two communities. The academic and ethnic background of the authors of this chapter facilitated the collection and analysis of the related data. The chapter argues that policy networks are a new form of governance for water resources, one that may lead the island out of its political and resource impasse. Policy networks provide a non-hierarchical arena for non-strategic, communicative interaction to overcome deadlock situations and problems related to collective action. Policy networks reflect a changed relationship between state and society. They signal a real change in the structure of policy making, along with the European orientation of Cyprus. They represent an alternative form of governance that has been studied extensively in the context of European integration, and transferring this framework into the water sector may prove effective. Cyprus' accession to the EU in May 2004 has signaled the beginning of a new era for water policy, which will, through the implementation of the WFD require the mutual co-operation of the island's divided communities. Besides leading to a more rational and integrated water management, policy networks can also plant the seeds for co-operation and engagement between the two Cypriot communities. This is because the negotiations for water management need to be based on multi-stakeholder communication, mutual trust and voluntary bargaining. By examining the three joint policy areas, the Nicosia case-study presented in Chapter 9, reveals the potential for transition from water management to water governance for the whole island, with the EU harmonization being the target for, as well as the leading force of this change. 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165

In Chapter 7, Ben Groom and Phoebe Koundouri critically review, from an economic perspective, the gap between the current status of water management in Cyprus and the requirements for the implementation of the WFD. Moreover, the authors propose a socio-economic approach for eliminating this gap, and apply this approach to the Kouris watershed, the main watershed in Cyprus, to illustrate in practical terms the way forward for the implementation of the WFD implementation. The proposed approach is composed of two stages. In the first stage, economic valuation techniques are used to estimate the economic value of the competing demands for surface and groundwater, by incorporating, where necessary, issues pertaining to water quality and ecosystem sustainability. This valuation exercise allows for the objective 166 167 168 169 170 171 172 173 174 175

176 balancing of demands based upon the equi-marginal principle to achieve economic
177 efficiency. In the second stage, a policy impact analysis is proposed. This analysis
178 addresses social equity issues, as well as the value of water for environmental and
179 ecological purposes.

180 In Chapter 8, George Socratous argues that the impressive development of the
181 conventional water sources that was achieved in Cyprus after the independence in
182 1960, has proved to be insufficient for tackling of the extreme droughts of the last
183 decade. The new water policy, or 'Master Plan' (Demetriades 1998), presented in
184 this chapter is flexible and safeguards sustainability. Its objectives include the balance
185 of supply and sector-specific water demands; the maintenance and enhancement of
186 the water quality, and the integrated management of the water resources. The measures
187 to be undertaken and the actions to be implemented are in harmony with the
188 requirements of the EU WFD. In essence, these measures and actions, which will
189 be undertaken in a holistic manner, will secure additional sources of water supply,
190 including desalinated seawater; introduce "demand management" strategies, especially
191 economically efficient water pricing; modify the current crop/water allocation
192 matrix; curtail the irrigated land area wherever possible; recover the aquifers; maintain
193 and enhance the quality of the water and the environment, and establish a 'Water
194 Entity' for effective and efficient management of water resources. To safeguard
195 sustainability, the analysis in this chapter deals with matters discussed in previous
196 chapters, and explains the measures and actions, which will be implemented to
197 achieve the required reorganization; the improved reallocation of resources; the
198 correct pricing of raw water, and the protection and monitoring of water quality.

199 As discussed in previous chapters, the challenge facing Cyprus, and in fact all
200 water deficient areas, is that of limited water supplies in the face of steadily increasing
201 water demand. The problem is expected to reach crisis levels within a few years
202 unless there is a shift from water policies based on water supply management
203 towards new policies that favor water "demand management". Too often, conservation,
204 demand management and least-cost planning are viewed as separate from conven-
205 tional urban water planning and management, rather than as an integral part of it.
206 In Chapter 9 George Socratous investigates water "demand management" policies
207 in conjunction with management practices in urban water supply, before and after
208 the accession of Cyprus to the EU. As discussed in Chapter 5, previously the water
209 sector in Cyprus was largely fragmented, and lacked a single institutional body able
210 to exercise overall control and monitoring over the whole water cycle. In this chapter
211 institutional aspects related to urban water supplies are reviewed, and suggestions
212 are made for harmonization with the requirements of the EU WFD. Water "demand
213 management" policies discussed in this chapter include water pricing and cost
214 recovery; efficient and effective use of water in all water use sectors; economies and
215 diseconomies of scale associated with larger autonomous regional water authorities;
216 reduction of water losses from the distribution networks based on active leakage
217 management policies; water conservation with emphasis on quality maintenance
218 and enhancement, and finally, public awareness. Moreover, specific water-saving
219 measures and programs are identified and evaluated, alongside the role of watershed
220 protection and management in meeting urban water drinking needs. These policies

discussed in this chapter are in accord with the requirements of the WFD. Although, 221
special emphasis is given to the pricing and costing policy, which is widely regarded 222
as the most immediate and effective measure in promoting efficiency and conservation 223
in water use, this chapter also discusses in depth water conservation and efficiency 224
measures beyond pricing incentives. 225

Chapter 10 focuses on the importance of sustainable management and conservation 226
of wetlands, as a crucial component of integrated management of water resources. 227
Wetlands are a crucial component of water resources, providing several ecological 228
functions and services, including groundwater recharge and water quality mainte- 229
nance. Consequently, the role and importance of sustainable management and 230
conservation of wetlands in integrated management of water resources cannot be 231
overlooked. Wetlands also generate various other ecological functions and services, 232
such as conservation of biodiversity and provision of recreational activities, all of 233
which benefit the society. In Cyprus wetlands have been degraded and drained due 234
to increasing intensity of the agricultural production; water pollution, and the failure 235
of policies to efficiently and effectively manage them. On the other hand, the 236
demand for wetland amenities has, as in other developed countries, increased with 237
the increase in per capita income. 238

In this chapter Ekin Birol, Phoebe Koundouri and Yiannis Kountouris argue that 239
in order to be able to design and implement efficient and effective policies for wetland 240
management and conservation, the total value of the benefits generated by their 241
several services and functions need to be realized and captured. Emphasis is given 242
to the use of non-market valuation methods to capture wetland values, since most 243
of the values that wetlands generate are public goods, which are not traded in markets. 244
In this chapter we employ a non-market valuation method, namely a contingent 245
valuation survey, to capture the value of the economic benefits generated by the 246
Akrotiri wetland. The chapter proposes how the results of this survey can be 247
employed to design and implement efficient and effective wetland conservation 248
policies, as a part of integrated water resource management in Cyprus. 249

The concluding chapter by Phoebe Koundouri, Ekin Birol and Cahit Ezel, proposes 250
a holistic way forward for water resources management in Cyprus, given the climatic, 251
hydrogeological, socio-economic, historical, political and ethical dimensions of this 252
interesting resource allocation problem. Moreover, the beneficial effects of WFD 253
implementation on water management are identified, and the potential of treating the 254
whole of the island (both the area controlled by the Cypriot Government and the 255
Turkish-Cypriot administered area) as one management unit are discussed. 256

In closing this chapter I want to re-emphasize that this book does not only aim to 257
present and analyze the Cyprus experience in water resources management policies. 258
This book also opts to communicate this experience to other countries that can 259
inform, develop and improve their water resources policies by understanding the 260
strong and weak elements of the Cyprus experience. The dilemma facing Cyprus – that 261
of limited water supplies in the face of steadily increasing water demand – is char- 262
acteristic of most arid and semi-arid countries, not only those located in the southern 263
European and Mediterranean regions, but also regions in the US, Middle East, 264
Africa, Asia and Latin America. Water scarcity has become one of the major problems 265

266 the world is facing today with rivers running dry, aquifers depleting and lakes
267 disappearing worldwide. World Bank reports demonstrate that Near East and North
268 Africa are the most water-short regions in the world. Jordan, Yemen, Israel and
269 Saudi Arabia are few examples of countries withdrawing more water from rivers and
270 aquifers than is being replenished. Meanwhile, large countries such as China, India
271 and United States also report severe water shortages and depleted groundwater
272 reserves. According to the European Environmental Agency (EEA 2005) nine
273 European countries can be considered water stressed (Cyprus, Bulgaria, Belgium,
274 Spain, Malta, FYROM, Italy, UK, and Germany). Further, information from member
275 states reporting under article 5 of the Water Framework Directive provides addi-
276 tional evidence that many EU regions suffer from water scarcity (COM (2007)
277 128 final). The available data show that at least 10.4% of the EU territory has been
278 affected so far by water scarcity situations. Since the primer cause of the serious
279 water crisis the world is enduring is unsustainable management of water resources
280 and not water availability as such, lessons from the Cyprus' experience towards
281 sustainable water resources management could provide useful guidance to policy-
282 makers worldwide. Valuation techniques that are presented in Chapter 7 of the current
283 volume as well as their application to selected case studies in Cyprus (Chapter 10)
284 also provide useful tools for decision-making in other arid and semi-arid areas.
285 Given that water resources are public goods and hence do not have readily available
286 monetary values attached to them, valuation methods allow researchers to capture
287 the social benefits associated with sustainable water resources management and
288 provide resources managers and policy-makers with valuable information about
289 public preferences for many states of the aquatic environment. Indeed, the case studies
290 under this book do not only provide area-specific valuation results but intend to
291 inform the implementation of environmental policies and provides methodological
292 and practical insights water resources management in other parts of the world.

293 In addition, the fact that water scarcity becomes more acute due to the existence
294 of point and non-point source pollution, as well as over-abstraction from renewable
295 groundwater aquifers, is not unique to Cyprus. Many European countries and US
296 regions, as well countries of the Middle East, face these problems and are currently
297 using or contemplating the use of desalination, water reuse and/or water recycling,
298 in order to overcome them. Moreover, the current fragmented structure of the water
299 sector in Cyprus and the lack of a single institutional body able to exercise overall
300 control and monitoring over the whole water cycle, is the status quo in most
301 European and in general water deficient, countries. Hence the way Cyprus is dealing,
302 either successfully or unsuccessfully, with these management and policy problems
303 can inform and guide similar efforts in other countries. Further the book reviews all
304 the administrative and institutional reforms undertaken to facilitate efficient water
305 resources management in Cyprus. The implications for other countries experiencing
306 institutional failures and inefficiencies are straightforward. Another very interesting
307 characteristic of Cyprus is that the water management administrative boundaries do
308 not coincide with the hydrological ones while there is considerable lack of collaboration
309 between the two administrations (the Cypriot Government and the Turkish-Cypriot
310 administered area). This results in inability to manage the whole of the island as a

1 Introduction

unique basin, which is highly inefficient. Similar situations that sometimes resulted 311
even in wars, have been arising throughout history and all over the world, due to 312
the importance of water resources for the development of communities and states. 313
Hence, the experience of Cyprus can add to the knowledge of how to manage water 314
resources owned in common by non-cooperative governments. Finally, Cyprus' 315
way towards the implementation of the EU WFD can be very instructive for the 316
newly accessing EU countries. 317

[AU3]

References

- Charalambous CN (2001) Water management under drought conditions. *Desalination* 138:3–6 319
Demetriades L (1998) The Nicosia Master Plan. *J Mediterr Stud* 8(2):169–176 320
European Commission (2000) Directive 2000/60/EC of the European Parliament and of the 321
Council of 23rd October 2000 establishing a framework for Community action in the field of 322
water policy, Official Journal 22 December 2000 L 327/1, European Commission, Brussels 323
Commission of the European Communities (2007) Towards sustainable water management in the 324
European Union. First stage in the implementation of the Water Framework Directive 2000/60/EC. 325
Accompanying document to the Communication from the Commission to the European 326
Parliament and the Council. COM (2007) 128 final 327
European Environmental Agency (2005) European environment outlook. EEA Report No 4/2005 328
Georgiou A (2002) Reassessment of the island's water resources and demand – assessment of 329
groundwater resources of Cyprus. WDD/FAO TCP/CYP/8921, Nicosia, Cyprus 330
Socratous G (2001) Management of water in Cyprus, speech presented at the 1st Congress Balears 331
2015. Water, perspectives for the future, available at [http://www.pio.gov.cy/wdd/eng/scientific_](http://www.pio.gov.cy/wdd/eng/scientific_articles/archieve2001/article01.htm) 332
[articles/archieve2001/article01.htm](http://www.pio.gov.cy/wdd/eng/scientific_articles/archieve2001/article01.htm). Last accessed November 2008 333
Tsiourtis NX (2001) Seawater desalination projects. The Cyprus experience. *Desalination* 334
139:139–147 335

Author Queries

Chapter No.: 1 0001191809

Queries	Details Required	Author's Response
AU1	Please check if this affiliation can be deleted from the text.	
AU2	Please provide fig caption for Fig. 1.1.	
AU3	<p>Following references are not cited in text:</p> <p>Charalambous CN. Water management under drought conditions. Desalination. 2001;138:3–6.</p> <p>European Commission (2000) Directive 2000/60/EC of the European Parliament and of the Council of 23rd October 2000 establishing a framework for Community action in the field of water policy, Official Journal 22 December 2000 L 327/1, European Commission, Brussels.</p> <p>Georgiou A (2002) Reassessment of the island's water resources and demand – assessment of groundwater resources of Cyprus. WDD/FAO TCP/CYP/8921, Nicosia, Cyprus.</p> <p>Socratous G (2001) Management of water in Cyprus, speech presented at the 1st Congress Balears 2015. Water, perspectives for the future, available at http://www.pio.gov.cy/wdd/eng/scientific_articles/archieve2001/article01.htm. Last accessed November 2008</p> <p>Tsiourtis NX. Seawater desalination projects. The Cyprus experience. Desalination. 2001;139:139–47.</p>	