

C. GIANANTE,\* M. AGUILAR,\* L. BABIANO,\*\*  
A. GARRIDO,\*\*\* A. GÓMEZ,\*\*\* E. IGLESIAS,\*\*\*  
W. LISE,\*\*\* L. MORAL,\* B. PEDREGAL\*

# Institutional Adaptation to Changing Risk of Water Scarcity in the Lower Guadalquivir Basin\*

## ABSTRACT

*Historically, the Spanish water management model's predominant goal has been resource augmentation. This mindset has had important consequences for the system's capacity to cope with droughts. It has impacted the system's overall vulnerability, the discourse of scarcity, the conceptualisation of risk, and the stakeholders' interests and their approach to risk. The aim of this article is to present the traditional hydraulic paradigm, and its current crisis and implications for present and future risk management, and to explore stakeholder and institutional reactions and adaptation to changing risk scenarios. The adaptation process will be framed within the wider context of macro-trends, such as marketisation and re-scaling of institutions and global warming.*

## INTRODUCTION TO DROUGHT AND SPANISH SOCIETY

This article will explore the management of water scarcity and drought in the Lower Guadalquivir Basin within the broader framework of the societal and institutional responses to climate change and to the increased possibility of extreme hydrological events in Europe. The first

---

\* Department of Human Geography, Facultad de Geografía e Historia, University of Seville, Spain; e-mail: giansante@terra.es.

\*\* Department of Anthropology, Facultad de Geografía e Historia, University of Seville, Spain.

\*\*\* Department of Agricultural Economics, E.T.S. Ingenieros Agrónomos, Universidad Politécnica de Madrid, Spain.

\*\*\*\* Institute for Environmental Studies (IES), Vrije Universiteit, Amsterdam

♣ This paper is part of the research project *Societal and Institutional Responses to Climate Change and Climatic Hazards: Managing Flood and Drought Risks (SIRCH)*, which has been funded by the Environment and Climate Change Research Programme of the European Commission (Contract no. ENV4-CT97-0447).

Due to the uniquely European location of some of the sources cited in this article, the *Natural Resources Journal* was not in a position to verify some of the sources cited. Nonetheless, it is thought that the information and perspectives will be of interest to the reader and of importance in the ongoing dialogue regarding transboundary resources. For questions regarding the articles or the source materials, please contact the authors.

important factor to note is the marked spatial and temporal climatic variability of the Spanish climate. In Spain, the traditional water management model, "hydraulic paradigm," has been resource-oriented.<sup>1</sup> As a result, the overall spatial development model of the country, including agricultural, urban, and industrial sectors, is based on the social reconstruction of the water environment.<sup>2</sup> This model has had important consequences for the water system's capacity to cope with risk. It has impacted the system's overall vulnerability, the discourse of scarcity, the conceptualisation of risk, and the stakeholders' interests and approaches to risk.

The system has become more vulnerable or, at best, maintained its level of vulnerability after each drought episode in the past few decades.<sup>3</sup> The current strategy, which favours resource augmentation, has caused the increased vulnerability. Encouraged by the misplaced perception of greater security, abundance, and access, water "demand" has risen as additional water supply has been made available.<sup>4</sup> The socio-economic impacts of the 1990's drought demonstrate the strain on the water system. Several million urban Andalusian consumers experienced service cuts of a maximum of 12 hours per day and thousands of irrigation farmers went without any irrigation water for three consecutive years.<sup>5</sup> The lack of irrigation water caused direct losses of 3 to 4.2 billion Euros and also caused losses to the 20,000 farm workers who lost their jobs.<sup>6</sup>

Due, in part, to the water crisis brought on by the 1990's drought, current water management practices have been intensely debated over the last decade. Furthermore, the idea that the water system is in crisis is gaining acceptance among both water managers and stakeholders.<sup>7</sup> But, the traditional paradigm still has institutional inertia and social support behind it. The tension between the view that the water system is in crisis and the institutional inertia and steadfast social support has resulted in an "unstable stagnation" in Spain's water policy.<sup>8</sup>

This article examines the current water management paradigm's ability to cope with present and future risks and explores the process of

---

1. Leandro del Moral & David Saurí, *Changing Course: Water Policy in Spain*, THE ENVIRONMENT, 12-15, July-Aug. 1999.

2. For the definition of social construction of the water environment, see Erik Swyngedouw, *Modernity and Hybridity: The Production of Nature: Water and Modernisation in Spain* 97-112 (1997) (unpublished report, on file with authors).

3. Monica Aguilar et al., *Drought Risk in the Lower Guadalquivir Basin: Social and Institutional Responses to Climate Change and Climatic Hazards*, in SIRCH PROJECT FINAL REPORT (Feb. 2001).

4. *Id.*

5. EMASESA, *CRÓNICA DE UNA SEQUÍA 1992-1995* 49-50 (1997).

6. *Id.* at 105.

7. Aguilar et al., *supra* note 3, at 5.1.

8. *Id.* at ch. 3.

institutional adaptation to changing risk scenarios. We tested the traditional paradigm's ability to adapt by modelling different risk scenarios. These scenarios incorporated the possible impacts of climate change on the overall availability of water resources and on the frequency of extreme events.<sup>9</sup> They also incorporate other macro trends that generate future uncertainty.<sup>10</sup>

## THE INSTITUTIONAL LANDSCAPE

Institutions, previously defined as regularised patterns of behaviour that can be formal, informal, strategic, or operational,<sup>11</sup> are difficult to capture because of the difficulty of defining clear boundaries and separating different operational levels at the global, national, regional, river basin, and local levels.<sup>12</sup> Therefore, the description of water management institutions in this section will not be systematic. Instead, we will provide an institutional landscape upon which it will be possible to observe the process of institutional adaptation and change. At the formal, legal institutional level, the cornerstone of Spanish water policy is the 1985 *Water Act*, which established the current water management framework and conferred a key role to hydrological planning.<sup>13</sup> The two main aspects of this legislation are the water planning framework and the financial and economic public water framework.

### The Water Planning Framework

The main instruments of water management and planning established by the 1985 *Water Act* are the national water plan, *Plan Hidrológico Nacional* (PHN), and the river basin water plans, *Planes Hidrológicos de Cuenca* (PHCs), for Spain's 17 river basins.<sup>14</sup> Through the technical services of the Ministry of Environment, Department for Water

---

9. The Spanish climate change debate is still in an embryonic stage, but, if it has merit, its implications for Spain's water system could be enormous. Francisco J. Ayala-Carcedo, *De la política hidráulica a la política de aguas sostenible*, 90 *TECNOAMBIENTE* 5-9 (1999).

10. Leandro del Moral et al., *Global trends and management of climatic water risks*, in SIRCH FINAL REPORT, *supra* note 8, at ch. 14.

11. This means that institutions/rules of behaviour can influence the general strategy/perspective that should be adopted to tackle a problem (in this particular case, natural resources management) or, alternatively, can mandate the operational rules that should be applied.

12. See generally SIRCH, *Societal and Institutional Responses to Climate Change and Climatic Hazards: Managing Changing Flood and Drought Risk* (Karen Bakker ed., 1998). Institutions can also be described as regularised patterns of behaviour, which are socially constructed, both formal and informal, and relatively stable.

13. *Ley De Aguas*, B.O.E., 1985, 189.

14. *Id.* art. 38.2, 71.1.

and Coasts, the central government is in charge of drawing up the national hydrological plan. The river basin water plans (PHCs) are drafted by the river basin authorities. According to water legislation, the main goals of these documents are to forecast future water demands, to design plans to meet those demands (generally ten and twenty-year planning horizons are used), as well as to establish qualitative objectives for the basin's surface water.<sup>15</sup>

The legal framework also asserts that Spain's water policy should coordinate with other planning policies that may affect hydrological plans.<sup>16</sup> The other major planning policies that affect water management plans are agricultural policy<sup>17</sup> and energy policy.<sup>18</sup> The legal framework also requires that national water policy not only coordinate with but must be compatible with environmental conservation policies.<sup>19</sup>

The process of drafting, discussing, and approving national and regional river basin water plans is an extremely long, complex, and continuous process. A first draft of the national water plan was presented in April 1993.<sup>20</sup> This draft was premised on the notion that the national hydrological imbalance between water-rich and water-poor regions should be corrected and proposed re-distributing water resources between basins via a national water grid, *Sistema Integrado de Equilibrio Hidraulico Nacional* (SIEHNA).<sup>21</sup> The 1993 draft also projected considerable increases in water demand based on a projected increase in irrigation surface of 600,000 ha by 2012.<sup>22</sup>

This draft was widely criticized by various administrative sectors and by the public.<sup>23</sup> In addition to the numerous and varied environmental objections, the Ministry of Finance criticised the plan for its lack of financial rigour and for its failure to coordinate with related sectors.<sup>24</sup> Agricultural

---

15. Real Decreto de 29 de Julio, art.79.1, R.C.L., 1988, 927.

16. *Id.* art. 95; Ley De Aguas, B.O.E., 1985, 189, art. 38.4.

17. Through the regional competence within the framework of the national economic objectives and the EU Common Agricultural Policy (CAP).

18. The use of large volumes of water for energy production purposes (hydropower dams and cooling systems) can generate conflicts with other use sectors, such as irrigation and urban supply.

19. Ley De Aguas, B.O.E., 1985, 189, art. 40(d).

20. MINISTERIO DE OBRAS PÚBLICAS Y TRANSPORTES, PLAN HIDROLÓGICO NACIONAL MEMORIA (1993).

21. *Id.* at 100-10.

22. 46 percent in domestic supply, 14 percent in irrigation agriculture and 25 percent in industry for the year 2012.

23. Ministerio de Medio Ambiente, Libro Blanco del Agua 19-20, at [http://www.mma.es/rec\\_hid/libro\\_b/sintesis.pdf](http://www.mma.es/rec_hid/libro_b/sintesis.pdf) (Dec. 4, 1998); VÍCTOR PÉREZ-DÍAZ ET AL., POLÍTICA Y ECONOMÍA DEL AGUA EN ESPAÑA 42-51 (1996).

24. PÉREZ-DÍAZ ET AL., *supra* note 23, at 57.

experts, who criticized the Plan, were also concerned because this draft had completely overlooked various macro-economic factors such as the General Agreement on Tariffs and Trade (GATT) treaty.<sup>25</sup> At the same time, regional governments in "water deficit" river basins were clamouring for higher transfer volumes.<sup>26</sup> Meanwhile, outcry in water-rich river basins against the transfer plan grew. In fact, one of the "water-rich" regions, Aragón, where most of the reservoirs of the Pyrenean mountainous region for the nationwide water transfer system would be located, has campaigned vigorously against the PHN project. As a result of the extensive criticism, the Ministry of Public Works and Transportation prepared a scenarios analysis document that slightly modified the criteria for future water demand scenarios while maintaining the general priorities of the 1993 draft.<sup>27</sup> Most importantly, the Spanish Parliament decided that approval of the PHN should be conditioned on the approval of both a national irrigation plan and on all the river basins' hydrological plans.<sup>28</sup>

The years following the publication of these two official documents were characterised by instability and stagnation. During this period, which coincided with the long and severe 1991–1995 drought, the water debate became a high profile political issue.<sup>29</sup> The planning process had reached an impasse.<sup>30</sup> The main opposition party at the time, the *Partido Popular* (PP), blamed the planning impasse on the PSOE's<sup>31</sup> inappropriate water management approach.<sup>32</sup> In April 1996, a new government, led by the conservative opposition party, *Partido Popular*, was elected with high expectations.<sup>33</sup> Representatives of the newly created Ministry of the Environment, MIMAM, promised rapid approval of the PHN during their term. The mechanism for the approval was supposed to be enhanced

---

25. *Id.*

26. See, for example, discussion of the Andalucía regional government's demands for higher transfer volumes in Joan Corominar, *El Plan Hidrológico Nacional en Andalucía y la Directiva Marco sobre política de aguas in* NUNO GRANDE, PEDRO ARROJO, & JAVIER MARTINEZ GIL, *IL CONGRESO IBÉRICO SOBRE PLANIFICACIÓN Y GESTIÓN DE AGUAS* 313-18 (2000), available at [www.us.es/ciberico](http://www.us.es/ciberico).

27. SECRETARÍA DE ESTADO DE POLÍTICA TERRITORIAL Y OBRAS PÚBLICAS, MINISTERIO DE OBRAS PÚBLICAS, TRANSPORTE Y MEDIO AMBIENTE, *PLAN HIDROLÓGICO NACIONAL, ANÁLISIS DE ESCENARIOS* (1994). This document maintained the notion of national hydrological imbalance, SIEHNA, and the priority given to large-scale infrastructure versus demand management and control and water saving.

28. Ministerio de Medio Ambiente, *supra* note 23, at 410.

29. VÍCTOR PÉREZ-DÍAZ ET AL., *supra* note 23, at 59-67.

30. *Id.* at 69-71.

31. The PSOE is the Spanish socialist party.

32. *Borrel modifica el Plan Hidrológico ante las críticas al Anteproyecto: El PP exige la retirada del proyecto*, *EL PAIS*, Mar. 23, 1994.

33. *El gobierno desliza en el BOE sin debate un miniplan hidrológico de 216.000 millones*, *EL PAIS*, Sept. 8, 1998, at 22.

dialogue.<sup>34</sup> The enhanced dialogue was to be supported by a white paper on water. The white paper would be designed to reach consensus on what criteria and priorities should guide the subsequent elaboration of water plans.<sup>35</sup> But, at the same time, the *Partido Popular* was arguing that the very nature of the water-planning framework needed to become more flexible to allow for more room for economic management of the resource.<sup>36</sup>

The *Partido Popular* never implemented the former approach.<sup>37</sup> In August 1998, before the white paper on water was published<sup>38</sup> and before the national irrigation plan was adopted,<sup>39</sup> the government approved each and every river basin water plan.<sup>40</sup> As approved, the plans were virtually the same as the drafts from the early 1990s.<sup>41</sup> The new government justified its surprising decision by characterizing the water plans as non-binding lists of possible projects.<sup>42</sup> This characterization implied a significant change in the role of hydrological planning, a change unsupported by any legislative reform.

A few months later, in February 2000, the Ministry of Agriculture, Food and Fisheries, MAPYA, tabled the national irrigation plan after a brief round of informal contacts and consultation with the regions' and users' associations.<sup>43</sup> Since the water basin plans were approved, there has been a striking decrease in planned irrigation surface: the 1998 river basin water plans envisioned 1,200,000 ha of new irrigation surface, but the national irrigation plan of 2000 reduced this to 250,000 ha of new irrigation surface

---

34. *Borrel modifica el Plan Hidrológico ante las críticas al Anteproyecto: El PP exige la retirada del proyecto, supra note 32.*

35. *Id.*

36. *Id.*

37. *Id.*

38. The White Paper on Water, that was only released by the Ministry of the Environment (MIMAM) at the end of the same year (December 1998) after an extensive conceptual and historical revision, still held as valid the high projections for future irrigation water demand and surfaces included in previous water planning documents. In addition, it failed to provoke the announced open and public debate, especially because it came too late to be really relevant in the discussion on the river basin water plans. See generally MINISTERIO DE MEDIO AMBIENTE, LIBRO BLANCO DEL AGUA EN ESPAÑA (1998).

39. Actually, a first National Irrigation Plan was tabled by the former government in February 1996 and did not become operational due to the change in government in spring of 1996.

40. Real Decreto 1664, July 24, 1998.

41. They had been previously discussed and endorsed by the National Water Council (CNA) in April 1998, with the only negative votes from the representatives of the environmental organisations.

42. Personal communication with José Luis Blanco, Water State Secretary (Mar. 1999).

43. This document was meant to comply with the March 22, 1994, decision of the Spanish Parliament, which urged the government to present a National Irrigation Plan before the National Hydrological Plan could be approved, although the discussion in Parliament occurred after the approval of the river basin water plans.

by 2008.<sup>44</sup> Furthermore, the new 250,000 ha figure includes 138,365 ha of previously planned and partially implemented irrigation surfaces (*regadíos en ejecución*); 79,426 ha of irrigation surfaces justified on social grounds (*regadíos sociales*); and 25,000 ha of private initiative irrigation surfaces.<sup>45</sup>

The Ministry of Environment tabled a new draft of the PHN in September 2000. This draft had substantially reduced the planned volume of inter-basin transfers and concentrated the water transfer burden on one "donor" basin, the Ebro river basin.<sup>46</sup> The 1993 draft of the national water plan had originally envisioned a nation-wide inter-basin transfer network that would have transferred a total of 3768 Mm<sup>3</sup>. The 2000 PHN draft eliminates transfers from the Tagus and Douro basins, which are shared with Portugal, to Mediterranean basins.<sup>47</sup> The only transfer the 2000 PHN draft contemplates would be from the Ebro river basin to the Mediterranean basins.<sup>48</sup> According to the terms of the 2000 PHN, the Ebro basin would have to transfer 200 Mm<sup>3</sup> to the Catalonia basin, 400 Mm<sup>3</sup> to the Segura basin, 300 Mm<sup>3</sup> to the Júcar basin, and 100 Mm<sup>3</sup> to the Sur basin, most notably to the Almería irrigation surfaces.<sup>49</sup> The total transferred volume in the 2000 PHN is just over half of the transfer volume set out in the 1993 draft.<sup>50</sup> Even so, the proposal has reopened old inter-regional wounds and has aroused considerable political opposition from the regional government of Aragón, the Ebro basin's largest region.<sup>51</sup>

### The Economic Framework of Spain's Water Policy

The economic framework of Spain's water policy has traditionally been based on two main features: a generous subsidy system and a water rights regime. The subsidy system has allowed the proliferation of extensive state-funded water regulation schemes and the water rights regime requires

---

44. Ministry of Agriculture, Food and Fisheries, *Plan Nacional de Regadíos 2000*, at <http://www.mapya.es/indexa/busca.asp?sitio=http%3a%2f%2fwww%2emapya%2ees%2fdesarr%2fpags%2fprn%2frega%2ehtm> (last visited Oct. 28, 2002).

45. *Id.*

46. Ministry of Environment, 2000, at [http://www.mma.es/rec\\_hid/plan\\_hidro/planhidro.htm](http://www.mma.es/rec_hid/plan_hidro/planhidro.htm).

47. *Id.*

48. *Id.*

49. *Id.*

50. The 1993 draft planned on transferring 1855 Mm<sup>3</sup>, 1.5 million acre-feet, of water to water-poor basins, see MINISTERIO DE OBRAS PÚBLICAS Y TRANSPORTE, *supra* note 20, the new draft only plans to transfer 1000 Mm<sup>3</sup>, 0.81 million acre-feet, of water solely from the Ebro basin. See Ministry of Environment, *supra* note 46, at 102-08.

51. Aragón lideró el "no" al transvase que inundó la Puerta del Sol, EL HERALDO DE ARAGÓN, Mar. 12, 2001, available at <http://www.heraldo.es>.

all users of the public water domain<sup>52</sup> to apply for a license to use water that governs the terms of that use. The river basin authority<sup>53</sup> can grant licenses for a maximum of 75 years and can only grant licenses for the uses set out in the licensing document.<sup>54</sup> Both the subsidizing and the licensing system have been debated and partially revised in recent years.<sup>55</sup>

Traditionally, Spanish economic water regulation has been in line with the principles of flexible supply and the belief that generous state subsidies were necessary to overcome the serious economic and social deficits affecting Spain at the beginning of this century.<sup>56</sup>

The 1985 Water Act established storage charges and rates, the *canon de regulación y tarifas*.<sup>57</sup> The income from these fees is designed to help the government recover the cost of its investments on dams and other hydrological works, mainly canals,<sup>58</sup> as well as to cover their operation and maintenance costs.<sup>59</sup> Despite attempts to revise the old system of subsidies, the 1985 Water Act only succeeded in maintaining it; the end result of the charges and rates is to subsidise bulk water by about 40 percent of total investment.<sup>60</sup> In general, these charges have been hard to apply and difficult to collect.<sup>61</sup> Furthermore, the funds they generate are manifestly insufficient

52. The 1985 Water Act established that all renewable freshwater—both surface and groundwater—is part of the public domain.

53. The river basin authority grants licences based on a general order of preference established by the Water Law: public supply (including industries connected to municipal supply networks); irrigation and agricultural uses; electric supply; other industrial uses; fish farming; recreational uses; navigation and river transport; and other uses.

54. Ley De Aguas, B.O.E., 1985, 189, art. 57.4.

55. 1999 Water Act, B.O.E., 1999, 298.

56. The cornerstone of this policy was the Large Hydraulic Works Act of 7 July 1911, which defined four possible avenues for carrying out hydraulic works: (1) execution by the private sector, with a state subsidy of up to 30 percent of the cost of large-scale hydraulic works in addition to a premium payment (by the state) "per litre per second" for irrigation water used; (2) execution by associations of irrigators, with a subsidy of up to 50 percent of the cost; (3) execution by the state, with the support of the irrigators affected, with a subsidy of up to 50 percent and low interest loans of up to 40 percent (most common choice); (4) executed entirely by the state.

57. In addition, the 1985 Water Act also established the water domain occupation charge (*canón de ocupación*) for the physical occupation of parts of the water domain (river beds and banks) and the water pollution charge (*canón de vertido*) for the protection of those watercourses receiving polluting discharges.

58. Ley De Aguas, B.O.E., 1985, 189, art. 106.1 (*canon de regulación*).

59. *Id.*, art. 106.2 (*tarifas de utilización*).

60. All water facilities supplied by waterworks (dams, channels, etc.) are built and run with public subsidies. This subsidy rises to 90 percent when the conditions of the Act of 1911 are applied.

"Bulk water" refers to all water that is transported in large-scale networks, before it enters the end-user distribution networks. In the case of drinking water, this is before it is treated for drinking water purposes.

61. Ministry of the Environment, 1998, *supra* note 38, at 556.



to cover the amortized cost of investment in and operation of hydraulic systems.<sup>62</sup>

In addition to the charges applied to bulk water, urban and agricultural end-users have to pay operation management and distribution costs to water companies or to irrigation communities.<sup>63</sup> In most irrigated zones, water prices are not assessed on the basis of the volume of water used, but as a per hectare charge.<sup>64</sup> Rates range from 6 to 198 \$/ha.<sup>65</sup> Due to this variability in prices in each geographical area and the fact that each farmer applies different volumes of water per hectare, the average price of water, including bulk water and irrigation association charges, is difficult to calculate. Based on the average consumption of about 7000 m<sup>3</sup>/ha, a rough estimate of the price per cubic meter is 0.0158 \$/m<sup>3</sup> (0,0167 Euro/m<sup>3</sup>); however, this figure varies with crop differences.<sup>66</sup>

In the various drafts of the amendment to the 1985 Water Act (1997–1999), several proposals were made to modify different aspects of the water tariff system.<sup>67</sup> But the only change in the final text of the amendment approved in 1999 was one that introduced the obligation to meter water and a system of incentives and penalties for users that deviate from a baseline volume of water use.<sup>68</sup> The opposition of business organisations, agricultural associations, and particularly of powerful hydropower interest groups prevented the introduction of more radical changes, such as full-cost recovery or a non-renewable resource/environmental impact surcharge for water use.<sup>69</sup> While the tariff system has not significantly changed, the mechanisms for financing public hydraulic works are likely to be affected

---

62. Ministry of the Environment, 1998, *supra* note 38, at 557. The amount is fixed and updated annually, taking into account operation costs, 4 percent of the value of investments made by the State—the technical amortisation of the works and installations—and the depreciation of the currency. The total period of technical amortisation for investments is set at 50 years for reservoirs and at 25 years for canals.

63. These costs, and the way they are calculated, vary greatly. In domestic uses, for instance, prices vary greatly from one place to another, depending on several factors: water municipal policy, bodies in charge of administration, costs of the service, level of waste water treatment, and others.

64. JOSÉ MARIA SUMPISI ET AL., *ECONOMÍA Y POLÍTICA DE GESTIÓN DEL AGUA EN LA AGRICULTURA*, at 148, 148-51 (1998).

65. *Id.*

66. *Id.*

67. Consuelo Giansante et al., *L'évolution des modalités d'allocation de la ressource en eau en Espagne*, 48 *REVUE D'ECONOMIE MERIDIONALE (REM)* 235, 235-48 (2000).

68. *Id.* at 240.

69. So far the prices paid for water use are only aimed at recovering—partially or completely—the costs of provision, transportation, or treatment, but never to pay for the resource itself; the access to which, though regulated by a water right system, is considered to be free of charge.

by the creation of private-public partnerships (*Sociedades Estatales*)<sup>70</sup> that are expected to increase user participation in the payment of waterworks.<sup>71</sup>

The licensing system has also undergone changes. According to the system established by the 1985 Water Act, transactions between different license-holders or changes in the use of water were not allowed except in special circumstances such as droughts or other emergencies.<sup>72</sup> Even then these use changes required direct involvement of the administrative body.<sup>73</sup> The amendment of the 1985 Water Act, which was approved in December 1999, increases the system's flexibility and facilitates the transfer of water rights by way of water markets and water banks.<sup>74</sup>

The legal possibility to establish water banks—although they have not been created yet—was introduced by the 1999 amendment, largely drawing on California's experience with water banks in 1991.<sup>75</sup> Water banks in Spain were inspired by the three general principles of the California water banks: (1) urban users are the main beneficiaries; (2) urban supply should not be guaranteed to the detriment of irrigation farmers, who should be compensated; (3) water banks can be used to store volumes of water as a preventive measure in case of a long-lasting drought. The water banks are designed to be "centres of exchange of water rights" in cases of drought or other exceptional circumstances.<sup>76</sup> These exchange centres would be set up by agreement of the Council of Ministers pursuant to a proposal by the Minister of the Environment.<sup>77</sup> In this case, the relevant river basin authority would be in charge of making public offers for the acquisition of water rights that may later be ceded to other users at the price established by the river basin authority itself. Although the idea remains untested, water banks are one way to encourage more efficient, voluntary transfers between users.

---

70. The *Sociedades Estatales* were created within the auxiliary regulation of the General State Budget of the year 1997 (Law 13/1996, art. 158).

71. Giansante et al., *supra* note 67, at 243-45.

72. Ley De Aguas, B.O.E., 1985, 189, art. 56.

73. Ley De Aguas, B.O.E., 1985, 189, art. 61.

74. Giansante et al., *supra* note 67, at 238-39; 1999 Water Act, B.O.E., 1999, 298, art. 61 bis.

75. Water management schemes in California and Spain have often been compared due to their geographical and climatic similarities. Furthermore, the positive results derived from the experience with water banks (regulated markets, limited in time and space) in California, compared with more controversial experiences with water markets elsewhere, such as Chile, may have reduced the social opposition to this type of measure. Water banks in California were, therefore, perceived as a model to follow, in order to enhance the flexibility of the water rights' system (especially to cope with droughts), without necessitating the need to privatise water resources. Ministry of the Environment, 1998, *supra* note 38, at 757-58.

76. 1999 Water Act, B.O.E., 1999, 298, art. 61.bis. 11.

77. *Id.*, art. 61.bis. 11.

A more controversial form of temporary exchange of water rights between users, not necessarily limited to drought situations, was introduced by the 1999 Water Act: water markets. These formally maintain the public water domain institution, but they also establish the possibility of water transfers by means of the temporary surrender of rights from one right-holder to another within a set of limitations. The first limit is that the licensees may only cede water to other right-holders of equal or higher priority in the river basin's plan.<sup>78</sup> For example, an irrigator can sell his water to another farmer or to an urban supply but not to a recreational or industrial user unless the temporary transfer is in the public interest.<sup>79</sup> The second limit on the transfers is that the licensees of non-consumptive water uses, such as hydroelectric power, are not allowed to transfer their water rights.<sup>80</sup> Finally, the state must be informed of the content of the contract and is entitled to assert the right of first refusal, as well as to cancel contracts contrary to planning goals or contrary to public interests.<sup>81</sup>

### KEY STAKEHOLDERS INTERESTS AND APPROACH TO RISK

Stakeholders, individuals, organisations, as well as decision and policy makers, who determine resource use and exposure to hazards,<sup>82</sup> provide a prism into the institutions that govern water management. Stakeholders create the rules, the norms, and the shared strategies<sup>83</sup> that constrain their responses to hydrological risk<sup>84</sup> events. For this reason, a description of the actors, as well as an analysis of their interests, values, and approaches to risk is necessary to understand their relationships to water and risk management institutions.

In Spain, the governmental responsibility for water management lies with river basin authorities (*Confederación Hidrográfica*).<sup>85</sup> These organisations have a relatively long historical tradition (since 1926) and, according to the 1985 Water Act, are responsible for the control of public waters; for granting licenses and permits for its use; for elaborating the basin water plan; and for the design, development, and management of

---

78. *Id.*, art. 61.bis.1.

79. *Id.*, art. 61.bis.12.

80. *Id.*, art. 61.bis.1.

81. *Id.*, art.61.bis.2 & art. 61.bis.3.

82. See generally KAREN BAKKER ET AL., ADAPTIVE RESPONSES TO HYDROLOGICAL RISK: AN ANALYSIS OF STAKEHOLDERS, SIRCH WORKING PAPER NO.6 (Consuelo Giansante ed., 2000).

83. See generally SIRCH, *supra* note 12.

84. Here risk is considered to be both a physical reality and a social construction, as well as a central locus for de/construction of institutions within society. For a comprehensive review of the approaches to risk, see generally SOCIAL THEORIES OF RISK (Sheldon Krimsky & Dominic Golding eds., 1992).

85. Ley De Aguas, B.O.E., 1985, 189, art. 19-20.

hydraulic works.<sup>86</sup> The decision-making process of the river basin authorities allows for some participation by user groups and representatives of different central and regional government bodies through a complex internal structure.<sup>87</sup> This structure is made up of several advisory and consultation committees such as the water release commission and the water management board.<sup>88</sup> Additionally, the Spanish state has a complex territorial structure with autonomous regions that have a wide spectrum of decision-making powers.<sup>89</sup>

In *inter-regional basins*, those whose territory is shared by two or more autonomous regions, the river basin authority is directly dependent on the central government, particularly on the Ministry of Environment (MIMAM).<sup>90</sup> On the other hand, the river basin authorities in *intra-regional basins*, whose territory is completely confined within one autonomous region, should be transferred to the regional government.<sup>91</sup> Both from an institutional and from a political perspective, the dynamics between central and regional government responsibilities are a crucial issue in the Spanish water debate.<sup>92</sup>

Although general water management in *inter-regional basins* is the responsibility of the river basin authorities and, thereby, the central government, regional governments still have some residual control over some aspects of water management. For example, they control urban water supply, sewage collection, and wastewater treatment.<sup>93</sup> Also, the Autonomy

---

86. *Id.*, art. 21.

87. See generally Consuelo Giansante, In-Depth Analysis of Relevant Stakeholders: The Guadalquivir River Basin Authority (Mar. 18, 1999) (unpublished paper, on file with authors).

88. Ley De Aguas, B.O.E., 1985, 189, art.24-37. At the national level, the National Water Council (*Consejo Nacional del Agua*), headed by the Minister of the Environment, with representatives of central and regional governments and water users, is in charge of examining and approving (although its opinion is not binding) the proposals for both the National and the River Basin Water Plans before they are submitted to the government (Council of Ministers).

89. Spanish Constitution, C.E. Título VIII.

90. Ley De Aguas, B.O.E., 1985, 189, art 15(c), (d).

91. The 1985 Water Act establishes that *intra-regional basins* can be managed and controlled by the regional government. *Id.* art.16. However, this option must be implemented with the agreement of both the central government and the region involved, which would then approve the decree at the central and regional level, respectively. This has not yet been the case for all *intra-regional basins* in Spain.

92. See generally Leandro del Moral, *Problems and trends in water management within the framework of autonomous organization of the Spanish State*, in LIVING WITH DIVERSITY, XXIX IGU CONGRESS: SEOUL 2000, at 617-36 (2000).

93. Real Decreto Ley 11/1995 establishes the general guidelines and quality objectives for wastewater treatment. Since 1984, Andalusia has been responsible for technical and economic assistance to the municipalities, including urban supply. As a result, in 1991 the Andalusian regional government approved the *Reglamento del Suministro Domiciliario de Agua*, establishing

Act (*Estatuto de Autonomía*) gives regional governments responsibility for agricultural, environmental, and land use planning policy, which are indirectly related to water management.<sup>94</sup> Although the regional government (Andalusian Department of Public Works and Transportation) has coordination functions, the ultimate responsibility for urban and drinking water supply, sanitation, and wastewater treatment lies with local councils.<sup>95</sup> Water services may be managed directly by the local council or indirectly via mixed enterprises, concessions, and leasing.<sup>96</sup>

In recent years, several water supply systems have been transferred to private management, causing a heated debate largely over the transfer's pricing effects.<sup>97</sup> In Seville, urban water management is in the hands of three public companies and a private concession-holder. The three public companies are *Empresa Municipal de Aguas de Sevilla, S.A. (EMASESA)*, *Aljarafe S.A.*, and the *Consortio del Huesna*.<sup>98</sup> EMASESA supplies 12 municipalities, including the city of Seville, and the Water Company Aljarafe, S.A.<sup>99</sup> The *Consortio del Huesna*, a consortium of 13 municipalities, has granted a 25-year concession for urban water supply to the private concession-holder, *Aguas del Huesna*.<sup>100</sup>

---

general criteria for urban water supply.

94. The Andalusian Autonomy Act was approved in the *Ley Orgánica de 30 de diciembre 1981*. Presently, the main departments involved with water management within the Andalusian government are the Departments of Public Works and Transportation; Agriculture; Environment; and Health. In July 2000, a specific Secretariat for Water Affairs, directly under from the Presidency of the Andalusian regional government (*Consejería de Presidencia de la Junta de Andalucía*), was created with the mandate to co-ordinate the water-related responsibilities of the departments of Public Works, Agriculture, and Environment.

95. *Ley 7/1985, de 2 de abril, Reguladora de las Bases del Régimen Local*.

96. Daniel Fernández Pérez, *Financiación de los Servicios Urbanos del Agua* (Dec. 18, 1994) (unpublished paper, on file with authors).

97. The level of participation of private companies in the Spanish water sector (urban water supply) currently represents 10 percent of the towns and 36 percent of the population.

98. Luis Babiano, *Discursos sobre naturaleza y conflictos entorno al agua en situaciones de "escasez."* *El caso del abastecimiento de Sevilla*, in IX Congreso de Antropología, Barcelona, (Sept. 4-7, 2002), at <http://www.ub.es/ica/congreso>; Consuelo Giansante, *Metodología para la evaluación socioeconómica y medioambiental de diversas opciones de gestión del agua. Aplicación a tres casos de estudios*, in DG OBRAS PÚBLICAS, JUNTA DE ANDALUCÍA 108-09 (1999); Consuelo Giansante et al., *El sistema de abastecimiento de Sevilla: análisis de situación y alternativas al embalse de Melonares*, in SERIE INFORMES, NUEVA CULTURA DEL AGUA (Leandro del Moral ed., 1998).

99. Babiano, *supra* note 98; Giansante, *supra* note 98; Leandro del Moral, *supra* note 98.

100. Babiano, *supra* note 98; Giansante, *supra* note 98; Leandro del Moral, *supra* note 98.

## Policy Community

Beyond the statutory organisations responsible for different aspects of water management, water stakeholders can also be studied as a policy community.<sup>101</sup> The water policy community is a close-knit, cohesive network of actors who believe in the interests and values that have traditionally controlled Spanish water policy.<sup>102</sup> It is made up of the road, canal, and port engineers' corps; agricultural organisations; construction companies; electrical companies; and key members of the hydraulic administration.<sup>103</sup> Some actors and approaches to water management have been included in the water policy community, while others have not.<sup>104</sup> A sector that has traditionally been excluded and, to a large extent, remains excluded from the water management and planning process is the groundwater sector, most notably the Spanish Institute for Technology and Mining (ITGE).<sup>105</sup>

The economic and environmental analysis of water development projects has traditionally been excluded from consideration by the water policy community because augmenting available water resources has been considered a good in and of itself that did not need economic or environmental justification.<sup>106</sup> In general, user participation has been limited to select user groups, mostly comprised of irrigation farmers, who participate in the consultation-only committees of the river basin authorities, which have little decision-making power.<sup>107</sup>

Nonetheless, the irrigation farmers are one of the most important groups of water users.<sup>108</sup> Within this sector, the irrigation communities (*Comunidades de Regantes*) are responsible for water management at the single irrigation district level under the supervision of the river basin authority.<sup>109</sup> They also participate in the consultation bodies of the river

---

101. See generally POLITICS OF CLIMATE CHANGE: A EUROPEAN PERSPECTIVE (Tim O'Riordan & Jill Jager eds., 1996); PÉREZ-DÍAZ ET AL., *supra* note 23.

102. PÉREZ-DÍAZ ET AL., *supra* note 23, at 40-41.

103. *Id.* at 51-56.

104. Leandro del Moral Ituarte et al., *Actores, normas, prácticas y discursos en la asignación del agua en sequías. Aplicación al Guadalquivir*, 94 REVISTA DE LA REAL ACADEMIA DE CIENCIAS EXACTAS, FÍSICAS Y NATURALES 287, 291 (2000).

105. Some developments can be observed in this field, such as the inclusion of the ITGE (which formerly belonged to the Ministry of Industry) within the responsibility of the Ministry of the Environment, established in 1996.

106. Pedro Arrojo, *El Plan Hidrológico Nacional*, in ECOLOGÍA POLÍTICA 20 (2000). Augmentation is achieved by increasing storage facilities and public works construction to make more water available for consumption.

107. BAKKER ET AL., *supra* note 82, at 27.

108. See generally del Moral Ituarte et al., *supra* note 104.

109. BAKKER ET AL., *supra* note 82, at 11.

basin authorities and other interest groups.<sup>110</sup> For example, a large portion of the Guadalquivir basin's irrigation communities is represented by the Guadalquivir Irrigation Farmers Union (*Federación de Regantes del Guadalquivir*).<sup>111</sup> The *Federación* was created in 1995, in the wake of the 1990's drought, and brought voting unity and internal cohesion to the sector.<sup>112</sup> Farmers' unions are also active interest groups in water policy, both at the regional and at the national level.<sup>113</sup> More recently, in 1994, an umbrella organisation, *Plataforma por el Guadalquivir*, was created in the Guadalquivir basin.<sup>114</sup> *Plataforma por el Guadalquivir* gathers together a wide variety of actors such as farmers' organisations and unions, local and county councils, trade unions, and political parties who actively support the construction of more dams as the main solution for the Guadalquivir basin's "structural water deficit."<sup>115</sup>

The formation of the *Federación* and of the *Plataforma* is an expression of the traditional water policy community's resistance to new processes that include new actors and new water management approaches in the water policy arena. The new processes have begun to undermine the strong internal cohesion of the community as well as its basic social values. For example, environmental organisations are gaining momentum and, although consumers are still largely excluded from formal decision making in the field of water allocation, a limited number of representatives of environmental organisations have been recently admitted to river basin consultation committees.<sup>116</sup> The European Union's responsibility for coordinating agricultural policy and increasing responsibility over water-related issues is also making the water policy community more diverse.<sup>117</sup> Finally, the recent trend of using economic criteria to evaluate water policy has begun to weaken one of the pillars of the traditional hydraulic paradigm, the provision of abundant water at nearly no cost to the users demanding it.<sup>118</sup>

Another threat to the irrigation communities' traditional views came in 1996 when the government paved the way for the creation of mixed-capital, public/private companies (*Sociedades Estatales*) that will be

110. *Id.* at 9, 12.

111. FEDERACIÓN DE COMUNIDADES DE REGANTES DE LA CUENCA DEL GUADALQUIVIR, DOSSIER INFORMATIVO (n.d.).

112. del Moral Ituarte et al., *supra* note 104, at 295.

113. BAKKER ET AL., *supra* note 82, at 12; del Moral Ituarte et al., at 294-95.

114. del Moral Ituarte et al., *supra* note 104, at 295.

115. <http://www.sevsigloxxi.org/plataforma>.

116. BAKKER ET AL., *supra* note 82, at 8-9.

117. José María Sumpsi, *Gestión del agua y política agraria*, in PLANIFICACIÓN HIDROLÓGICA Y POLÍTICA HIDRÁULICA: EL LIBRO BLANCO DEL AGUA 257, 258-59 (1999).

118. Arrojo, *supra* note 106.

responsible for assisting the river basin authorities with the construction and management of public water works.<sup>119</sup> The creation of such companies at the river basin level is based on a contract (*convenio*) between the state administration and the mixed capital company.<sup>120</sup> The contract governs construction and management conditions for waterworks as well as financial contributions made by the state and private sector. Several of these mixed capital companies have already been created; for example, the *Aguas de la Cuenca del Guadalquivir S.A.*<sup>121</sup> was set up in the Guadalquivir basin in 1999. This legislation reflects the impact of global changes that will be explored further in the next section.

### THE WIDER CONTEXT OF CHANGE

The ongoing and likely future changes in the drought management practices in the Guadalquivir basin are embedded in the general processes occurring at the global scale, the macro trends that affect the basin in different ways.<sup>122</sup> Out of the general landscape of change, five macro trends that are particularly relevant for the field of water management can be identified.

The first macro trend, which is observable both in Spain as well as in other countries, is a building atmosphere that favours solutions that incorporate "scarcity indicators," market instruments, and gives private business a larger role, what could generally be defined as marketisation.<sup>123</sup> These solutions include economic analysis of water uses and full cost recovery, both of which would change the current concept of water deficit and would also change how drought coping mechanisms are prioritised.<sup>124</sup> These solutions have important consequences for infrastructure, which is

---

119. Art.158, Law 13/96 (auxiliary regulation of the General State Budget of 1997) of 1996; Karen Bakker, *From state to market?: Water mercantilización in Spain*, 34 ENV'T & PLAN. A 767, 777-79 (2002).

120. BAKKER ET AL., *supra* note 82, at 8.

121. The statutes of the company establish as one of its objectives the "management of works and water resources, including environmental management of aquifers, lagoons, reservoirs, rivers and stretches of river, as well as the preparatory or complementary activities, derived from the former ones," thus opening the field of water management to private regulation.

122. Following the structural theory of A. Giddens, *locale* is a consubstantial factor in the constitution of social action. It is not just a mere spatial parameter, a physical environment where interactions happens, it is formed by all the elements mobilized as part of the interaction. See generally del Moral et al., *supra* note 10.

123. Bakker, *supra* note 119.

124. Arrojo, *supra* note 106.



presently stagnating due to financial cutbacks.<sup>125</sup> At the same time, market instruments are gaining legitimacy, although the Spanish people still have strong objections to treating water just like any other commodity.<sup>126</sup>

As a second general trend, decision-making powers are being transferred in two different directions. They are moving towards the regional scale and towards the international scale. This process has been defined as re-scaling.<sup>127</sup> The increasing political role of the regions makes water policy a flashpoint for confrontation between regional and central governments.<sup>128</sup> Meanwhile, increasing international interaction is also impacting Spanish water policy. First, the global trend towards liberalising the economy affects agriculture and water policy decisions and has consequences for the local economy.<sup>129</sup> At the same time, international political power centres like the European Union have become key local actors.<sup>130</sup>

The EU has two primary water management responsibilities. Its first task is to grant subsidies that partially cover the costs of large water works.<sup>131</sup> But it has also made a general commitment to sustainable use of natural resources and is responsible for protecting the environments of designated sites that may be adversely affected by such waterworks.<sup>132</sup>

---

125. The reduced willingness and ability of the state to fund waterworks is part of a general trend to reduce public sector spending and to de-invest in strategic sectors. Bakker, *supra* note 119.

126. *Rechazo unánime a la reforma de la Ley de Aguas propuesta por Isabel Tocino*, LA TIERRA, July-Aug. 1997, at 22; *Diario de Sesiones del Congreso de Diputados*, 17 junio 1999 (no. 247: 13157-13176); 30 de septiembre 1999 (no. 263:13988-14003).

127. E. Swyngedouw, *Neither global nor local: globalisation and the politics of scale*, in *THE GLOBAL AND THE LOCAL: MAKING THE CONNECTION* (K. Cox ed., 1997).

128. This is exemplified by the contrast between the expansive approach of the river basin water plans—where regional governments and local stakeholders are most influential—and the conservative national irrigation plan, which is more conditioned by the logic of market liberalisation.

129. Sumpsi, *supra* note 117.

130. Asger Olsen, *The New Water Framework Directive for the European Union—Main principles and obligations. Prospects for a sustainable water policy for the coming decades*, in *O'PORTO, UNA CITA EUROPEA CON LA NUEVA CULTURA DEL AGUA: LA DIRECTIVA MARCO*, 25 (2001).

131. The economic and social cohesion between the regions of the European Community was one of the objectives included in the Treaty of Rome in 1986. As a complement to the Treaty's single market, opening up frontiers would expose the most disadvantaged countries to further problems. This is pursued, among other instruments, through European Regional Development Funds (ERDF)—75 percent EU and 25 percent member state contributions—which are limited to less-favoured regions (such as Andalusia) and are focused mainly on productive investments and infrastructure.

132. Article 6 of the Treaty of Amsterdam of the European Union states that environmental protection requirements must be integrated into the definition and implementation of community policies. Consequently, the European Commission must ensure that projects developed under regional policy are respectful of the environment. An assessment of their

The third macro trend relates to ongoing, worldwide changes in how nature is represented, particularly representations of the cultural and symbolic value of water.<sup>133</sup> These changes are crucial in Spain and in the Guadalquivir basin because these values are the cornerstones of the traditional hydraulic paradigm.<sup>134</sup> The traditional paradigm is founded on a system of deeply rooted values about the relationship between nature and society,<sup>135</sup> which views the natural water environment as a hostile setting whose splendour and beauty is enhanced by human intervention.<sup>136</sup> Another cornerstone of the traditional hydraulic paradigm is the notion that nature is an obstacle to social and economic progress and must be transformed to achieve modernisation.<sup>137</sup> Hence the fascination with inter-basin water transfers; the traditional view sees these transfers as a way to progress by overcoming hydrological imbalances, a natural obstacle to socio-economic modernisation.<sup>138</sup>

The fourth macro trend is increased participation in the water policy arena.<sup>139</sup> In particular, the transition to democracy (in 1977–1978) had major impacts on the political, social, and institutional characteristics of Spanish life.<sup>140</sup> While this trend has allowed a greater number and variety of actors to feel involved in the water debate, the inclusion/exclusion process is dynamic and some stakeholders continue to be excluded.<sup>141</sup>

Finally, there is an observable attempt to better coordinate different sector and governmental department policies—at least at the discursive level, both in Spain and in Europe as a whole.<sup>142</sup> For example, the need to

environmental impact must be conducted by the member states concerned. Additionally, DGXI (Environment) of the European Union is responsible for the drafting and implementation of a number of Directives on environmental protection and water, such as the Water Framework Directive.

133. Del Moral, *supra* note 10, at 4, 12.

134. *Id.*

135. Babiano, *supra* note 98, at 11-13.

136. This is how human-built water landscapes associated with irrigation (orchards and domesticated water) come to be valued as ideal and positive images of development, overriding the possible negative impacts on the wider natural environment.

137. E. Swyngedouw, *Modernity and Hybridity: Regeneracionismo, the Production of Nature and the Spanish Waterscape, 1890–1930*, 89. ANNALS ASS'N AM. GEOG. 443, 443-65 (1999); Babiano, *supra* note 98.

138. *Id.*

139. Del Moral, *supra* note 10, at 5, 19.

140. RAYMOND CARR & JUAN PABLO FUSI, *ESPAÑA: DE LA DICTADURA A LA DEMOCRACIA* (1979); VÍCTOR PÉREZ DÍAZ, *LA PRIMACÍA DE LA SOCIEDAD CIVIL* (1993).

141. BAKKER ET AL., *supra* note 82, at 27.

142. At the European level, a number of initiatives are underway aimed at the coordination of environmental protection with other development and sectoral policies. See EUROPEAN CONSULTATIVE FORUM ON ENVIRONMENT & SUSTAINABLE DEV., *THE EUROPEAN SPATIAL PERSPECTIVE* (1999), at [http://www.europa.eu.int/comm./regional\\_policy/sources/docoffic/](http://www.europa.eu.int/comm./regional_policy/sources/docoffic/)

horizontally integrate water policy and agricultural policy is an important issue in Spain.<sup>143</sup> Integration is important enough that in 1994 parliament asked the Spanish government to set out a national irrigation plan before parliament made any decision about a holistic national hydrological policy.<sup>144</sup> Of course this is not the only way to achieve policy integration; political and academic discourses often cite spatial planning as another means of achieving this goal.<sup>145</sup>

## PHYSICAL AND SOCIO-ECONOMIC BACKGROUND OF THE BASIN

### Physical Characteristics of the Lower Guadalquivir Basin

The Guadalquivir Basin has a total catchment area of 57,071 km<sup>2</sup> and the river itself is 640 km long. The source and estuary of the river are both located within the Spanish region of Andalusia, but a small part of the catchment area (about 10 percent) is located in three other Spanish regions, Extremadura, Castilla-La Mancha, and Murcia (Figure 1). In its last stretches, the Lower Guadalquivir Basin (LGB) covers an area of 17,085 km<sup>2</sup> that includes the Andalusian capital, Seville (Figure 1).

The mean annual precipitation in the Guadalquivir basin is 596 mm, which is relatively high compared to the central Spanish mesetas or to southeastern Spain. However, the main feature of Andalusia generally and of the LGB is spatial and temporal irregularity. The mean annual precipitation ranges from about 1500 mm in the mountainous areas to 400–600 mm in the Guadalquivir depression.<sup>146</sup> The lowlands in the eastern part of the basin receive less than 400 mm of mean precipitation a year.<sup>147</sup>

---

official/reports/pdf/p32\_en.pdf; Cohesion Funds and the environment, at [http://www.europa.eu.int/comm/regional\\_policy/sources/docoffic/official/communic/envir/home.en.htm](http://www.europa.eu.int/comm/regional_policy/sources/docoffic/official/communic/envir/home.en.htm)). At the Spanish level, the White Paper on Water, see Ministerio de Medio Ambiente, *supra* note 22, can be interpreted as an effort to coordinate different expertises and policy fields related with water. Finally, in Andalusia the creation of the *Consejo Andaluz del Agua* in 1996, Decreto 202/1995, de 1 de agosto, and, more recently of a specific Secretariat for Water Affairs, directly dependent from the Presidency of the Andalusian regional government (*Consejería de Presidencia de la Junta de Andalucía*) are seen as efforts to coordinate the water-related responsibilities of the departments of Public Works, Agriculture, and Environment.

143. Irrigation agriculture uses about 80 percent of the total water resources in Spain; therefore, the agricultural policy will necessarily greatly affect water use. Ministry of the Environment, *supra* note 38, at 384–419.

144. *Id.* at 410.

145. Federico Aguilera Klink, *Hacia una nueva economía del agua: cuestiones fundamentales*, at <http://habitat.aq.upm.es/boletin/n8/afagu1.html> (May 16, 2002).

146. Aguilar et al., *supra* note 3, at 13.

147. *Id.*



This variability is aggravated by the fact that the region's mean potential evapotranspiration is inversely proportional to mean annual precipitation with extremely high values in the dry lowlands (sometimes more than 1000 mm) and lower values in the wetter mountainous regions.<sup>148</sup>

Temporal irregularity has two components, seasonal or intra-annual variability and inter-annual variability, and is similarly distributed both in the dry and in the humid areas of the Guadalquivir basin.<sup>149</sup> The intra-annual variability of precipitation is typical of the Mediterranean area.<sup>150</sup> The seasonal pattern includes a dry season of five to six months when evapotranspiration exceeds precipitation and a rainy winter season, which brings most of the annual precipitation.<sup>151</sup> The range, persistence, and extreme values of inter-annual variability are also extremely high. According to long series of data from meteorological stations, the precipitation values can range from 800 mm to 1100 mm from one year to another.<sup>152</sup> While precipitation can vary widely from year to year, it is also true that years with extreme (either low or high) precipitation values tend to be concentrated over time. This concentration aggravates the effects of droughts. Lastly, torrential precipitations can be extremely intense:<sup>153</sup> in most of the Lower Guadalquivir basin it can rain up to 150–200 mm in twenty-four hours (between one-third and one-half of the total annual precipitation).<sup>154</sup>

The mean annual renewable or natural water resources<sup>155</sup> are estimated at about 7000 million cubic meters/year (5.6 million acre-feet/year).<sup>156</sup> But this varies widely from year to year and can range from 1 to 17,000 million cubic meters/year (13.6 million acre-feet/year).<sup>157</sup> Furthermore, the spatial and temporal climatic variability mean that only a portion of these natural resources are actually available at the time and in

---

148. *Id.*

149. *Id.*

150. *Id.*

151. *Id.*

152. *Id.* at 19.

153. Tormentality is defined as the total precipitation in a year (mm) divided by the number of days of rain. *Id.*

154. *Id.*

155. For surface water, *annual renewable or natural water resources* can be defined as the long-term average freshwater volume supplied naturally by the hydrological cycle, derived from the total run-off (surface and underground) resulting from rainfall over a river basin territory minus evapotranspiration.

156. CONSEJERÍA DE OBRAS PÚBLICAS Y TRANSPORTE DE LA JUNTA DE ANDALUCÍA, PLAN DIRECTOR DE INFRAESTRUCTURAS DE ANDALUCÍA 43 (1998).

157. *Id.*

the place required.<sup>158</sup> These available resources (*recursos disponibles*) are obviously affected by technological constraints, as well as by socio-economic and institutional considerations.<sup>159</sup> Most of the available water resources in the Guadalquivir Basin<sup>160</sup> are derived from surface water,<sup>161</sup> while only a small portion comes from groundwater.<sup>162</sup>

In order to deal with its irregular precipitation, the Guadalquivir River is regulated through a network of reservoirs throughout its basin.<sup>163</sup> The reservoirs help to partially control the naturally erratic Mediterranean precipitation regime by storing winter flows for later use. With more than 60 reservoirs, the basin's reservoir capacity totals 6833 million cubic meters/year (5.5 million acre-feet/year).<sup>164</sup> About one third of this volume (2255 million cubic meters/year<sup>165</sup> or 1.8 million acre-feet/year) is available as average annual regulated flow.<sup>166</sup> Most of the reservoirs are located in the Sierra Morena area, whose impermeable soils and topographic conditions make it ideal for water storage.<sup>167</sup>

### Important Water-Users in the Lower Guadalquivir Basin

The most important factor in the water resources use and planning in the Guadalquivir basin is the prime importance of irrigation agriculture, both in terms of water use<sup>168</sup> and in terms of contribution to the Final Agricultural Production (PFA) of Andalusia.<sup>169</sup> Data on the basin's irrigation

158. Available water resources, or the average annual regulated flow, can be defined as the average water volume stored in the reservoir in a year. It is determined by the reservoir capacity, its goals and management pattern, including the level of guarantee of the use for which it is aimed and the hydrological regime of the river basin in which it is located, taking into account the pre-existing reservoirs and other human modifications.

159. That is, availability depends on the technical capacity to build dams and inter-basin transfer systems as well as on the socio-economic and institutional factors (legal provision, financial support, agreements between regions, etc.) that allow for the actual implementation of these technical measures.

160. A total of 2700 million cubic meters/year, equivalent to 2.1 million acre-feet/year is usually available.

161. 84 percent or 2255 million cubic meters/year, equivalent to 1.8 million acre-feet/year is available from surface regulation.

162. 16 percent or 437 million cubic meter/year (0.35 million acre-feet/year) comes from groundwater abstraction.

163. CONSEJERÍA DE OBRAS PÚBLICAS Y TRANSPORTE DE LA JUNTA DE ANDALUCÍA, *supra* note 156, at 44.

164. *Id.* at 43.

165. *Id.*

166. *Id.*

167. *Id.* at 44.

168. 85 percent or 2847 million cubic meter/year, equivalent to 2.30 million acre-feet/year.

169. With an irrigation surface that represents 19 percent of the total agricultural land, this sector contributes about 53 percent of the Andalusian PFA (*Producto Final Agrícola*).

surface is disparate. Official estimates have been about 668,000 ha, but another 20 percent of the surface might be used for unlicensed irrigation.<sup>170</sup> Within the basin's irrigation system, the irrigation of rice paddies in the Guadalquivir river estuary (about 35,000 ha) is crucial: its importance arises from its high unitary water use (9.6 acre-feet/ha) and its location in the lower stretches of the Guadalquivir River, which is affected by the tides.<sup>171</sup> From April to September, the rice irrigation period, large volumes of water must be released from the upstream reservoirs of the basin to lower the salinity in the estuary.<sup>172</sup> During droughts, this release of water creates conflict between the rice growers and the rest of the basin's irrigation farmers.<sup>173</sup>

Although the urban sector demands less water (12 percent of total demand) than the irrigation sector, its needs are also critical to planners because it requires a guaranteed supply of high quality water year-round. Three water companies, EMASESA, *Aljarafe S.A.*, and potentially the *Consorcio del Huesna*, supply the 1.3 million occupants of the Seville metropolitan area with 130–150 million cubic meters of water/year or 0.10–0.12 million acre-feet of water/year.<sup>174</sup> The Seville water system has experienced serious water shortage problems during each of the 1972–1974, 1981–1983, and 1991–1995 droughts. During the last drought, in addition to severe water rationing measures (between 6 and 12 hours a day), Seville had to use low-quality water from the Guadalquivir River.<sup>175</sup> While the river water was mixed with varying proportions of better quality reservoir water or groundwater, its use still had a negative impact on the quality of potable water.<sup>176</sup>

The importance of accurately anticipating changes in demand is underscored by the pace of increased demand over the past few decades.<sup>177</sup> While industrial demand represents only a minor proportion of total water use, there has been a considerable increase in agricultural and domestic demand over the past few decades.<sup>178</sup> These demands have been met by the

---

170. Moral Ituarte et al., *supra* note 104, at 207, 210. The illegal irrigation surface can be derived from the difference between the irrigation surface cited in water management documents (668,000 ha) and the 1999 Andalusian Inventory of Irrigation Agriculture, which estimates the total irrigation surface at 815,000 ha, thus including illegal (*i.e.* unlicensed) irrigation surfaces.

171. CONFEDERACIÓN HIDROGRÁFICA DEL GUADALQUIVIR, PLAN HIDROLÓGICO DEL GUADALQUIVIR 50 (1995).

172. *Id.* at 50.

173. del Moral Ituarte et al., *supra* note 104, at 211.

174. Giansante et al., *supra* note 98, at 6.

175. BAKKER ET AL., *supra* note 82, at 28.

176. *See id.* (discussing flexibility in water quality standards during times of drought).

177. Ministry of Environment, *supra* note 38, at 339–42, 385.

178. *Id.*

resources in the Basin's extensive network of reservoirs.<sup>179</sup> The total available water resources in the Guadalquivir basin represent as much as 40 percent of the total natural water resources.<sup>180</sup> (See Table 1.) But, this is still insufficient to meet present demand.<sup>181</sup> Present demand outpaces available resources in the Guadalquivir river basin by 241 million cubic meters (0.2 million acre-feet/year) according to the Andalusian Department of Public Works and Transport.<sup>182</sup> Furthermore, draft national and river basin hydrological plans, and other strategic planning documents, project significant increases in domestic, agricultural, and industrial water demand both in the Guadalquivir river basin and in the rest of Spain.<sup>183</sup> Unsurprisingly, demand projections are the most controversial aspect of the water resources planning debate in Spain.

**Table 1. Basic Data on Water Resources in the Guadalquivir Basin**

Natural water resources	5.6 million acre-feet/year
Total available water resources	2.1 million acre-feet/year
- Surface water	1.8 million acre-feet/year
- Groundwater	0.35 million acre-feet/year
Total number of reservoirs	60
Reservoir capacity	5.5 million acre-feet/year

### Modelling the Economic Impact of Drought and Current Water Management Strategies on the LGB

The LGB region's remarkable variability has historically had important implications for the institutions that must try to manage the irregularity and deal with the risk of water scarcity.<sup>184</sup> But so far, few evaluations of the socio-economic impacts of droughts exist. Furthermore,

179. CONFEDERACIÓN HIDROGRÁFICA DEL GUADALQUIVIR, *supra* note 171, at 72.

180. CONSEJERÍA DE OBRAS PÚBLICAS Y TRANSPORTE DE LA JUNTA DE ANDALUCÍA, *supra* note 156, at 43.

181. *Id.* at 61.

182. *Id.* These estimates are part of the political debate on water and vary according to the circumstances. For example, in a recent document the Andalusian regional administration accepts the estimate of the Guadalquivir River Basin Plan, according to which the water deficit in 1992 was 602 million cubic meters or 0.5 million acre-feet. CONSEJO ANDALUZ DEL AGUA, ANDALUCÍA Y EL PLAN HIDROLÓGICO NACIONAL (2000).

183. CONFEDERACIÓN HIDROGRÁFICA DEL GUADALQUIVIR, *supra* note 171, at 51-63.

184. Aguilar et al., *supra* note 3, at 51-52.



other than some partial analyses of the urban supply service failures and drought impacts on the irrigation sector, no comprehensive effort has been made to completely evaluate the economic impact of the 1991–1995 drought.<sup>185</sup> For the lower Guadalquivir basin, however, a mathematical programming model was recently developed to evaluate the economic impacts of the drought.<sup>186</sup> The model is based on realistic assumptions about farmers' ability to anticipate water shortages and labour and capital market rigidities.<sup>187</sup> It also makes assumptions about how farmers revise their production plans as new information becomes available.<sup>188</sup> In Table 2<sup>189</sup> we summarise the results of the simulations carried out for representative farms in two irrigation districts of the lower Guadalquivir basin.

The relationship between social droughts, failures in the water system that impact society, and meteorological droughts, precipitation irregularity, is non-linear and depends on social, institutional, and physical processes.<sup>190</sup> Run-off derived reservoir inflows largely depend on soil moisture and rainfall regimes.<sup>191</sup> Table 3 shows the complex links between purely meteorological processes and hydrological outcomes. A simple comparative analysis of the data regarding the conversion of one unit of rainfall into units of reservoir inflows between the year 1989–1990 and the year 1992–1993 shows a sharp contrast.<sup>192</sup> In 1989–1990, 1.41 units of rainfall generated one unit of reservoir inflow, but during the first year of the 1991–1995 drought 32 units of rainfall were required to generate a unit of

---

185. EMASESA, *supra* note 5.

186. See generally Eva Iglesias et al., Evaluation of drought management in irrigated areas, (Oct. 19, 2000) (unpublished paper, on file with authors).

187. Ministry of the Environment, 1998, *supra* note 38, at 345.

188. *Id.* at 340.

189. As used in Table 2, "stock" stands for the percentage of stored volumes over storage capacity of the reservoir(s) that service each irrigation district at the beginning of February; "water allowance" is the per hectare irrigation water volume supplied in each irrigation season. Whereas the previous two variables are derived from actual data on the decisions made (water allowance) by water managers in the Guadalquivir basin based on specific reservoir levels (stock)—the following variables are calculated by the model. "Shadow price" represents the dual value associated to the water availability allocated to farmers each season, "gross margin" is the difference between total revenues and variable costs, "net benefits" are defined as the difference between total revenues and variable costs, and "value of production" stands for the market value of the agricultural output. Finally, "hired labour" is the amount of person-days per hectare generated by external workers.

190. Ministry of the Environment, 1998, *supra* note 38, at 167, 250.

191. Ministry of the Environment, PLAN HIDROLÓGICO NACIONAL, ANÁLISIS DEL SISTEMA HIDRÁULICOS 210 (2000).

192. EMASESA, *supra* note 5, at 53.

Table 2. Aggregate Results for El Viar and Bajo Guadalquivir Irrigation Districts

	1991	1992	1993	1994	1995	1996	1997	1998
<b>El Viar</b>								
Stock	60%	43%	27%	35%	10%	96%	93%	94%
Water Allowance (ac-feet/ha)	5.88	4.60	0.62	3.80	0	5.80	5.90	5.90
Shadow p. (\$/m <sup>3</sup> )	0.07	0.08	0.46	0.10	1.22	0.04	0.01	0.04
Gross mar. (\$/ha)	1438	906	131	1319	261	1896	1289	1522
Net bens. (\$/ha)	1278	744	-31	1103	99	1668	1060	1356
Vprod. (\$/ha)	4206	3541	1750	3878	1655	4721	4204	4442
Hired lab. (man-day/ha)	16.90	16.20	7.30	15.70	5.30	16.50	17.00	16.90
Financial costs (\$/ha)	160	162	162	216	162	227	229	166
<b>Bajo Guadalquivir</b>								
Stock	27%	21%	15%	18%	12%	36%	89%	87%
Water Allowance (ac-feet/ha)	4.90	1.90	0	0.91	0	4.70	6.90	6.90
Shadow p. (\$/m <sup>3</sup> )	0.03	0.13	3.39	0.46	0.99	0.07	0.00	0.06
Gross mar. (\$/ha)	1178	1461	149	969	239	1292	1445	1337
Net bens. (\$/ha)	966	1222	-90	730	0	1054	1207	1099
Vprod. (\$/ha)	4467	3102	1021	2434	1010	2970	3526	3509
Hired lab. (man-day/ha)	16.90	7.10	0.60	4.50	0.10	8.80	9.20	9.30
Financial costs (euros/ha)	213	238	238	238	238	238	238	238

Source: Iglesias et al. (2000)

reservoir inflow. Knowledge of these differences can help planners address the socio-economic impacts of droughts. (See Table 3.)

**Table 3. Rainfall and Reservoir Inflows in Rivera de Huelva**

	1988-1989	1989-1990	1990-1991	1991-1992	1992-1993	1993-1994	1994-1995	1995-1996
Rainfall (mm)	554.5	1028	511	464	396	518.6	291.9	844.6
Reservoir inflow (Hm <sup>3</sup> )	146.5	727.5	106.4	33	12.4	109.1	13.3	581.3
Rainfall/Reservoir inflow	3.79	1.41	4.82	14	31.9	4.75	21.9	1.45

Source: EMASESA (1997).

### Parameters and Results of Water System Reaction to Hypothetical Risk Scenarios

In order to better understand the enormous impact that water management strategies and climate changes can have on the possible availability of water in the Lower Guadalquivir Basin, we designed simulations that model their effects. The simulations examine the possible benefits of employing a water-saving strategy as well as the possible risks associated with failing to plan for climate change. The results of these simulations are discussed below.

The simulated 1991–1998 period has three identifiable stages. The first stage corresponds to the beginning of the meteorological drought (1991).<sup>193</sup> The second stage corresponds to the most severe hydrological drought (from 1993 to 1995).<sup>194</sup> The third stage corresponds to a very wet period that resulted from abnormally high rains during the autumn of 1995 (from 1995 to 1998).<sup>195</sup> Although the drought had a significant impact on the farming sector, the magnitude of its effects on farmers, farm workers, and

193. Meteorological drought occurs if rainfall is significantly less, during a certain time period, than the average amount in a specific area. Aguilar et al., *supra* note 3, at 22.

194. Hydrological drought relates to shortages in the flow of water, which then fails to meet the existing demand for water. Hydrological drought may be delayed with respect to the onset of the meteorological drought, mainly due to the existence of storage facilities and depending on the current water management rules. *Id.*

195. Iglesias et al., *supra* note 186, at 15.

the regional/national economy varied in different degrees.<sup>196</sup> For instance, in 1993 and in 1995, farmers in the El Viar irrigation district (EV) experienced greater reductions in net benefits than hired labourers did.<sup>197</sup> The largest reduction, 50 percent, in the market value of production occurred in 1993 and in 1995.<sup>198</sup> Farmers fared worst in the 1995 season when they could only grow rain-fed crops but remained responsible for the financial obligations acquired in that and the previous two seasons.<sup>199</sup> (Table 2)

In the *Bajo Guadalquivir* (BG) irrigation area, farmers experienced even greater difficulties with negative net benefits in 1992 and in 1993, but they broke even in 1995.<sup>200</sup> External farm workers were almost completely idle in both 1992 and 1993,<sup>201</sup> although the hired labour levels recovered slightly from 1993 to 1994.<sup>202</sup> However, the reduction in the market value of production was smaller than the reduction in net benefits and hired labour.<sup>203</sup> (Table 2)

The 1994 season, in which both districts received some irrigation water, deserves closer attention.<sup>204</sup> The El Viar district, which had its water allowance reduced by 36 percent, performed as well in 1994 as in any wet season with respect to the three most significant variables, net benefits, value of production, and hired labour.<sup>205</sup> In the Bajo Guadalquivir district, where water allowances were reduced 81 percent, the net benefits only fell 50 percent, the market value of production only fell 60 percent, and labour demand only fell 75 percent as measured against 1990–1991, the best year of the sequence.<sup>206</sup> These relatively positive results can be partially explained by that season's high commodity prices, particularly for cotton.<sup>207</sup> In this instance, lower, drought-level production drove prices up, and the relatively high seasonal hiring rate for horticultural crops, on which

---

196. *Id.* at 17.

197. *Id.*

198. *Id.*

199. *Id.*

200. *Id.*

201. *Id.*

202. *Id.*

203. By differentiating between net benefit and value of production, we seek to highlight the differential impacts of drought on the farming economy and society in general. The market value of the agricultural output provides a better indication of how the processing sector and the food demand may have been hurt by limited water resources for irrigation.

204. Iglesias et al., *supra* note 186, at 17.

205. *Id.*

206. *Id.*

207. *Id.*

irrigators concentrate their limited resources, helped reduce the impact on hired labour during 1994.<sup>208</sup>

These simulations also demonstrate that choosing excessive water releases over saving water causes significant benefits to vanish. The low shadow value of water during the 1990 to 1991 pre-drought period reveals that saving water for a possible future drought would have cost very little.<sup>209</sup> Meanwhile, the decreasing volumes of water left in the reservoir during these same periods probably signalled an imminent hydrological drought and indicated that a water saving strategy could produce significant benefits. The potential benefits of saving water would have vanished only if torrential rains filled up the reservoir to the point where water had to be released to prevent flooding. That scenario was highly unlikely since the Bajo Guadalquivir reservoirs were at 27 percent of their capacity in February of 1991.<sup>210</sup> At that moment, one unit of water saved had an opportunity-cost of 0.13 Euros/m<sup>3</sup>, but reached a shadow value of 0.43 Euros/m<sup>3</sup> in the next season.<sup>211</sup> These results clearly show the economic irrationality of past management of water stocks and suggest that different water management approaches could reduce the regional impact of meteorological droughts.

### Global Warming

The current vulnerability of the water system would definitely be exacerbated by global warming, which would increase the present levels of uncertainty. According to the 1995 projections of the national meteorological institute (INM), global warming will cause an increase of two to 2.5° C in temperature by mid-century and concomitant decreases in precipitation in different Spanish regions.<sup>212</sup> So far, the INM's temperature projections have been confirmed by the statistically significant upward trends (about 1° C) that occurred during the period from 1961 to 1990.<sup>213</sup> During this time, minimum temperatures experienced the highest increases.<sup>214</sup> Both the decrease in precipitation and the increase in

---

208. *Id.*

209. *Id.*

210. *Id.*

211. *Id.*

212. Two percent in the northern regions, 17 percent in the southern basins, and 15 percent in the Guadalquivir basin.

213. These results are from specific studies based on historical climatic records in Andalusia performed at the Department of Geography of the University of Seville. *See generally* Camarillo Naranjo et al., Homogenisation process and temporal patterns of historical temperature records in Andalusia (unpublished paper presented at the International Conference on Climate Change, May 31–June 3, 2000) (on file with authors).

214. *Id.* at 11.

temperature that global warming is expected to bring will reduce natural water resources.

Using the INM's 1995 projections as a baseline, the overall potential reduction has been estimated at 17 percent for the whole country and 34 percent for the Guadalquivir basin by the year 2060.<sup>215</sup> The 1998 white paper on water<sup>216</sup> estimated an eight percent reduction in natural water flows in the Guadalquivir basin for the 2030 horizon assuming a temperature increase of 1° C, which was modelled in scenario one.<sup>217</sup> The estimated reduction rapidly rose to 20 percent in scenario two, which assumed a temperature increase of 1° C plus a precipitation decrease of five percent. As for the potential reduction in available water resources, some estimates project as much as a 39 percent reduction in available water for regulated resources whose water demands are stable over the year, such as urban water supply.<sup>218</sup> At the same time, resources that supply variable or seasonal demands such as irrigation could drop by 22 percent.<sup>219</sup>

#### A CENTRAL LOCUS FOR ADAPTATION: WATER (RE-)ALLOCATION

An institutional analysis can identify specific institutional aspects that are crucial to understanding the process of how institutions learn and adapt to drought. In the lower Guadalquivir basin, the central locus for exploring the responses to drought is the set of norms, rules, and practices regulating water allocation between users. In Spain, regulating water allocation between users is achieved by defining unitary (per capita or per hectare) water allowance during the general water planning process.<sup>220</sup> River basin water plans include recommended theoretical irrigation water allowances by crop type and irrigation district as well as a population-based water allowance for domestic supply.<sup>221</sup> Theoretical water allowances aside, the temporal irregularity of the Spanish climate means that in some years the unitary water allowances cannot be supplied. The acceptable level of

---

215. Francisco Ayala, *De la política hidráulica a la política de aguas sostenible*, 90 *TECNOAMBIENTE* 5 (1999).

216. Ministerio de Medio Ambiente, *supra* note 23, at 259-61.

217. Ayala, *supra* note 215.

218. *Id.*

219. *Id.* Note that this evaluation does not take into account the evaporation losses from reservoirs and wetlands that would also increase with temperature increases.

220. del Moral Ituarte et al., *supra* note 104, at 288-90.

221. CONFEDERACIÓN HIDROGRÁFICA DEL GUADALQUIVIR, *supra* note 171, at 52, 55.

guarantee, which dictates how often water shortages can occur, is established by law<sup>222</sup> and is used by water planners as a guide.<sup>223</sup>

Within a specific river basin consultation committee there is usually some room for negotiation in the resource allocation area: for example, at the beginning and end of each irrigation season, the dam water release commission, *Comisión de Desembalse (CD)*<sup>224</sup> discusses proposals for filling and emptying the reservoirs.<sup>225</sup> In the case of an official drought,<sup>226</sup> a permanent commission of the river basin's managing board, the *Junta de Gobierno*, can be set up. The permanent commission has the power to reduce or stop any water use in the basin. It also has the power to obligate users to install water meters as well as the power to build small water schemes in emergencies.<sup>227</sup>

Although it possesses paltry decision-making powers, the irrigation-dominated water release commission is an important means of institutionalising the hegemony of irrigation sector values and objectives within broader water policy and within society. The allocation decisions, pressure mechanisms, arguments, and strategies used in the course of the 1990s drought brought the internal cohesion and external legitimisation of the irrigation community to light.<sup>228</sup> These features of the irrigation community are extremely important because they are closely tied to the survival of the traditional water community.<sup>229</sup>

The traditional water community is in crisis. The erosion of irrigation agriculture's role in society brought on this crisis. Its decline was exacerbated by socio-economic and cultural factors<sup>230</sup> and by internal

222. Ministerial Order of the Ministry of Public Works and Transport (Sept. 12, 1992).

223. This is used mainly to calculate the dimensions of water storage reservoirs needed to regulate a certain volume of water with the level of guarantee established by law.

224. The members of this commission are representatives of the river basin authority, central government, and water users of the basin. The representatives of the water use sectors are appointed by the Management Board on proposal of the Assembly of Users and are appointed according to the water volumes used; therefore, the irrigation sector makes up the vast majority of this commission.

225. Giansante, *supra* note 87, at 15-16.

226. A Drought Decree defines the geographical areas affected by drought, defines compensation to the farmers sector in the form of exemption from the payment of certain taxes, and enables the river basin decision-making bodies to impose restrictions and reduce irrigation water allowances.

227. Giansante, *supra* note 87, at 10-12; Real decreto 531/1992, de 22 de mayo.

228. del Moral Ituarte et al., *supra* note 104, at 296.

229. This is due to the historical links existing between the irrigation community and the traditional water community. See PÉREZ-DÍAZ ET AL., *supra* note 23.

230. Rapid dissociation of the population from the rural realm and gradual de-legitimisation of the agricultural sector as a whole, partially due to the increase in subsidies based on agricultural surfaces rather than real production, resulting from European agricultural policies.

fragmentation.<sup>231</sup> The main divisions in the traditional water community run across the following lines: (1) differences between legal and illegal irrigation farmers,<sup>232</sup> (2) differences related to the size of agricultural plots; (3) differences between upstream and downstream irrigation farmer interests; (4) differences related to specific water requirements, especially to irrigation technology; (5) differences related to the crop types; and (6) differences between the interests of surface water and groundwater users.<sup>233</sup> While the differences in agricultural plot-size were an important fragmentary force during the drought of the 1990s,<sup>234</sup> at present the most salient fragmentary force comes from differences in water demand. Demand is directly related to an irrigator's levels of technology and efficiency and may be a key impetus for future change.<sup>235</sup>

The technological divide within the irrigation community has major implications for the management of water stocks. New districts that have high efficiency conveyance and distribution systems can function better with limited resources, while older irrigation districts need larger water volumes to function well.<sup>236</sup> As a result, districts with newer technology tend to favour smaller water allowances and endorse more conservative strategies for managing water stocks while districts with older equipment oppose water allowance reductions because they lack the technology to adequately adapt to that change.<sup>237</sup>

The irrigation sector's dynamism was demonstrated during the 1999 irrigation season, which was a breaking point for traditional water allocation practices.<sup>238</sup> As a result of a very dry autumn and winter, the water regulation system of the Guadalquivir basin had only 12,000 m<sup>3</sup>/ha of water left at the beginning of the 1999 irrigation season.<sup>239</sup> Initially, the Guadalquivir river basin authority proposed releasing one-third of this volume, 4000 m<sup>3</sup>/ha, during the current season, in exchange for a

231. del Moral Ituarte et al., *supra* note 104, at 292-94.

232. This is an extremely relevant issue due to the importance of illegal irrigation (both in terms of total surface and water use) and lack of control in the basin.

233. Generally, when this was possible, farmers opted for the drilling of (mostly illegal) wells in order to cushion the consequences of the restrictions or the general irrigation ban. Given the almost complete lack of control of groundwater abstractions, the Guadalquivir river basin authority (CHG) and its participatory bodies almost renounced consideration of the groundwater cycle, except in the last and most dramatic phases of the last drought.

234. del Moral Ituarte et al., *supra* note 104, at 294. The plot-size split was exemplified best by the debate on the allocation of water according to social criteria.

235. del Moral Ituarte et al., *supra* note 104, at 293.

236. *Id.*

237. *Id.* at 295

238. *Id.* at 298-99.

239. Minutes of the Water Release Commission (Mar. 1999) (confidential document, on file with authors); del Moral Ituarte et al., *supra* note 104, at 298-99.



guaranteed irrigation supply of 4000 m<sup>3</sup>/ha for the following two years.<sup>240</sup> This strategy would have reduced the future risk to the irrigation community in the event of a new multi-annual dry spell. The irrigation sector rejected this proposal outright and pressured the river basin authority into granting a 6000 m<sup>3</sup>/ha water allowance in March of 1999.<sup>241</sup> In July of 1999, this volume was increased to 8000 m<sup>3</sup>/ha.<sup>242</sup> For the first time in the Guadalquivir basin's recent history, the decision to increase the irrigation water allowance garnered harsh social and political criticism.<sup>243</sup> Although this started to open a fissure in the hegemonic discourse, the situation is still very fluid.

All of these characteristics paint a portrait of an extremely dynamic irrigation sector that exhibits divergent approaches to water allocation, to its collective bargaining strategies, and to its discourses. It is important to note that although water allocation is a basic function of water management, the discourses favouring water re-allocation as an instrument to cope with water scarcity have only recently emerged.<sup>244</sup> The water re-allocation discourse often diametrically opposes the dominant discourse, which favours resource augmentation as the definitive solution to Spain's structural water deficit.<sup>245</sup>

### Game Theory Analysis of Farming Sector Incentives and Strategies

Using the water allocation proposals and practices from the 1999 irrigation season, we used game theory to analyse the incentives and strategies of the farming sector regarding water allowances.<sup>246</sup> A static two-agent game where two farmers compete for water resources yielded

240. Minutes of the Water Release Commission, *supra* note 239; del Moral Ituarte et al., *supra* note 104, at 298-99.

241. Minutes of the Water Release Commission, *supra* note 239; del Moral Ituarte et al., *supra* note 104, at 298-99.

242. Minutes of the Water Release Commission, (July 1999) (confidential document, on file with authors); del Moral Ituarte et al., *supra* note 104, at 298-99.

243. A local newspaper published on its front page the following headline: "The same volume as a six year water supply for the city of Seville was diverted for irrigation purposes." *See Desviada para regadío tanta agua como Sevilla consume en seis años*, DIARIO DE SEVILLA, Sept. 1, 1999. The new element is the shift in focus from a claim for more reservoirs—as a solution to the drought—to the critique of how the remaining water had been managed and allocated, with a special concern for the possibility of a failure in the urban supply system.

244. del Moral Ituarte et al., *supra* note 104, at 299-300.

245. The concept of *structural water deficit* and the treatment of uncertainty within Spanish water planning is analysed in Leandro del Moral Ituarte & Consuelo Giansante, *Constraints to Drought Contingency Planning in Spain: the Hydraulic Paradigm and the Case of Seville*, 8 J. CONTINGENCIES & CRISIS MGMT. 93 (2000).

246. *See generally* Weitze Lise et al., *A game model of farmers' demands for irrigation water from reservoirs in Southern Spain* (Mar. 23, 2000) (unpublished paper, on file with authors).

different equilibria across the three irrigation districts to which the game was applied, Bajo Guadalquivir, El Viar, and Genil-Cabra. Farmers in a self-managed irrigation district such as El Viar tend to be conservative and save water in the reservoirs for the next seasons. But, in centrally managed irrigation districts, such as Bajo Guadalquivir and Genil-Cabra, farmers tend to demand water instead of saving it.<sup>247</sup>

Modeling farmers' strategies as a repeated game enabled us to analyze how the preferences for a high-demand strategy depend on the inherent risk level of the hydrological variables. Under the current conditions, a repeated game demonstrates that a more demanding strategy is optimal for farmers in both types of irrigation districts.<sup>248</sup> However, an extreme climate change scenario that substantially increases the risk of drought creates an incentive for farmers to become more conservative—assuming there are enforceable rules to protect farmers' water rights.<sup>249</sup> This indicates that farmers actually do react to present hydrological risks, but just not enough to achieve equilibrium with climatic patterns. These findings support the hypothesis that more transparent water rights that spell out the rights and duties of the water system beneficiaries may create a greater incentive for farmers to accept proposals that manage water stocks over time, such as the one made by the Guadalquivir river basin authority in 1999.<sup>250</sup> Specifically, if farmers' water rights were guaranteed across seasons they would be much more willing to cooperate with more conservative strategies than in the current system that pools unused water rights allocations from previous years and new inflows before beginning the allocation process for a new year.<sup>251</sup>

### EVALUATING THE WATER ALLOCATION DECISIONS IN THE LOWER GUADALQUIVIR BASIN

To evaluate the efficiency of the water allocation decisions made by water managers in the lower Guadalquivir basin in the 1991–1998 period, we created an Economic Drought Management Index (EDMI) and applied

---

247. *Self-managed irrigation districts* (for example El Viar) are here defined as those districts whose supplies depend exclusively on one reservoir and are only aimed at irrigation purposes. On the other hand, *centrally managed irrigation districts* (for example Bajo Guadalquivir) depend on a large number of reservoirs throughout the basin, which are shared with other irrigation districts and water use sectors (for example, urban supply). In both cases, the management of water stocks is supervised by the river basin authority.

248. Self-managed districts and centrally-managed districts.

249. The farmers are facing a so-called prisoner's dilemma.

250. Lise, et al., *supra* note 246, at 244.

251. *Id.*

it to data from the area.<sup>252</sup> The index adds an economic dimension to climatic and hydrologic information and can assist water managers by providing information about the economic risk of their strategies along with the cost of reducing that risk. The main appeal of the EDM I is that it combines four key pieces of information in an easily interpretable index: (1) the structural constraints of a supply system based on reservoirs, (2) the stochastic nature of natural run-offs flowing into the storage facilities, (3) the institutional rules that have been followed by water managers during the periods of historical record, and (4) the benefits accruing to the consumptive users.

An EDM I result uses the ratio of the present use-value of water and the expected use-value of the water left in stock to provide a measure of the opportunity cost of employing a more conservative, water-saving management strategy. An EDM I ratio of one indicates that the water management strategy is perfectly efficient because the opportunity-cost of saving the water equals its expected use-value for the following irrigation season. If the EDM I ratio is less than one, the cost of saving one water unit is less than the expected use-value for the following year and reveals that the water managers are having an exceedingly risky management behaviour. If the EDM I ratio is greater than one, the opportunity-cost of saving one water unit is greater than the benefits it would generate the following year and water should be used in the current season. Table 4 reports the EDM I ratios calculated for the El Viar (EV) and the Bajo Guadalquivir (BG) irrigation districts, using data available for each of the nine years from 1990 through 1998.

Table 4. Actual EDM I s for the EV and BG Supply Systems (1990-1998)

Year	EV			BG		
	Stock on Feb. 1 (% of capacity) <sup>1</sup>	Water allowance (acre-feet/ha)	EDM I	Stock on Feb. 1 (% of capacity) <sup>1</sup>	Water allowance (acre-feet/ha)	EDM I
1990	91	7.54	0.170	37	5.01	0.030
1991	60	5.88	0.650	26	4.42	0.080
1992	42	4.60	0.640	21	2.54	1.040
1993	13	0.62	3.820	15	0.06	36.180
1994	35	3.86	0.806	18	0.73	6.350
1995	9	0	9.540	11	0	11.890
1996	95	5.80	0.760	36	4.76	0.660
1997	92	5.90	0.182	89	6.39	0.007
1998	93	5.90	0.750	87	7.05	0.940

<sup>1</sup>Source: Unpublished reports of the Guadalquivir river basins.

252. See generally Eva Iglesias et al., *An Economic Management Index to Evaluate Irrigators' Vulnerability to Water Shortages* (Oct. 19, 2000) (unpublished paper, on file with authors).

The EDM I values reported on Table 4 show several cases of inefficient management. To be fair, please note that the EDM I ratios were computed based on average inflow values that did not anticipate the early 1990s drought. Even so, EDM I ratios in 1991 are less than one in both districts, indicating a need for lower water allowances in the 1991 irrigation season. The reservoir inflows for the 12 months following February 1, 1991, were below average, resulting in lower stock values on February 1, 1992, than in the previous year. However, the EDM I ratio for the Bajo Guadalquivir district hit its optimal value in 1992 with a water allowance of 2170 m<sup>3</sup>/ha, which was historically low but efficient. El Viar's 1992 and 1994 decisions contrast sharply with that efficiency. The 1992 EDM I ratio was 0.64; the 1994 (a year between two extremely dry ones) EDM I ratio was 0.80. Although Bajo Guadalquivir EDM I ratios have been very high since the hydrological drought started in 1992 and until its end in 1995, when rainfall levels recovered, throughout the drought period no action could be taken to move them closer to one simply because there was no water left in the reservoirs. That said, the Bajo Guadalquivir district in 1990 and 1991 was managed with EDM I ratios close to zero, when stocks were at 37 and 26 percent of reservoir capacity respectively. If water managers had reacted at the time, the effects of the severe 1992 to 1995 droughts might have been partially mitigated or put off until the last two years of the drought period.

All EDM I ratios after 1996 are less than one in both irrigation districts. This indicates that both systems are running inefficiently and at very high risk levels. These results also indicate that, so far, water managers have taken entirely too much risk. The high risk level suggests that lower maximum water allowances are acceptable and that a conservative, water saving strategy should be implemented as soon as reservoir network water levels start to drop.

The EDM I ratios confirm our initial hypothesis that the current rules for irrigation water allowances and for managing reservoir water stocks are highly inefficient. It also suggests that the recent amendment to the Water Act, which timidly introduces water markets, may fall short of expectations because water right holders are not given sufficient guarantees of ownership over the resources left in the reservoir. This uncertainty makes it unclear whether the water left will be available either for sale in the market or for future consumption. This effectively limits the role of the market to the allocation of the resources available in a single irrigation season. The single season focus distorts scarcity signals, which may give incentives to defer consumption at the onset of droughts and soften the supply variability inherent to the Mediterranean climate.

## CATALYSTS AND INHIBITORS OF INSTITUTIONAL CHANGE

There are identifiable catalysts for change within the lower Guadalquivir basin that are likely to influence the water system's ability to cope with present and future risks. In this regard, even though climate change is not yet a major catalyst for change in Spain, it may significantly affect future water management scenarios.<sup>253</sup> Climate change has either been ignored or written off as an environmentalist concern. Although it has recently aroused greater interest,<sup>254</sup> its possible effects continue to be excluded from discussions of present water management options.<sup>255</sup> This attitude is fuelled by the perception that the existing uncertainties the water planning process faces, such as estimating present water resources, projecting socio-economic trends, projecting water demands, predicting short term horizons, lack of control, and lack of credibility are greater than climate change uncertainties.<sup>256</sup> In point of fact, water managers tend to view the current imbalance as a good proxy for an intermediate climate change scenario.<sup>257</sup> However, in the short term, climate change is not likely to be a catalyst for change, as what is perceived as a chronic water deficit seems to be a more urgent issue to tackle.

One of the factors likely to enhance adaptation in the drought management practices is growing public, expert, political, and media awareness of the continuing crisis the present water system faces.<sup>258</sup> This crisis is often blamed on the uncontrolled expansion of irrigated land over the past two decades.<sup>259</sup> The most recent drought has played a key role in

---

253. Ayala, *supra* note 215.

254. The issue of climate change is considered in the White Paper on Water and in the last draft of the National Hydrological Plan (Sept. 2000) and is receiving increasing attention in the media and expert circles.

255. The climate change scenarios have not been considered in the estimate of future available water resources in any planning document. See CONFEDERACIÓN HIDROGRÁFICA DEL GUADALQUIVIR, *supra* note 171.

256. These ideas are derived from a seminar on climate change organised by the Seville SIRCH team, to which several experts and water managers from the basin were invited. See SIRCH, WORKSHOP ON CLIMATE CHANGE AND WATER MANAGEMENT SCENARIOS IN THE GUADALQUIVIR BASIN (June 6, 2000) (unpublished report, on file with authors).

257. From this perspective, the problems related to climate change are perceived as present and urgent. This paradoxical relationship with the subject shows the very imprecise information generally available and the lack of reflection regarding climate change. At present, the idea that the variability of rainfall and temperature and the persistence of dry spells have increased over the last three decades in the Guadalquivir river basin has been accepted in climate research and water management circles.

258. See generally, Juan López Martos, *Los problemas del agua y su gestión en el territorio andaluz*, in III CONGRESO IBÉRICO SOBRE GESTIÓN Y PLANIFICACIÓN DEL AGUA (2000), available at [www.us.es/ciberico](http://www.us.es/ciberico).

259. *Id.* at 256.

increasing awareness of the weakness of the present management system.<sup>260</sup> Although extreme events and crises can trigger change, they exist within a specific social-institutional setting. In Spain, the backdrop is a "structural deficit" one in which droughts are viewed as circumstantial expressions of a chronic water shortage.<sup>261</sup>

This social understanding of droughts as a symptom or expression of chronic shortage makes it easy to neglect important planning areas like contingency planning and crisis management. This view has also made it easier to rationalize and to justify both a dangerous demand-hungry mindset<sup>262</sup> and a vigorous infrastructure building strategy by the state.<sup>263</sup> However, the pervasive confidence in the system's robustness that existed before the 1990's drought contrasts sharply with the present awareness of vulnerability.<sup>264</sup> As a result of that drought, two innovative approaches have gained support and may enhance future adaptation to uncertainty and risk. The two approaches are drought contingency planning and the reallocation of water between sectors and user groups.<sup>265</sup> The latter mechanism falls under the more general marketisation trend,<sup>266</sup> but they also reflect a stronger commitment to guaranteeing a basic urban water supply in drought situations even in the face of pressure from the irrigation sector.<sup>267</sup>

Possibly the greatest potential for the water system in the lower Guadalquivir basin to adapt to scarcity comes from reduced irrigation that could result from agricultural policy changes or water rate increases.<sup>268</sup> Although full cost recovery, FCR,<sup>269</sup> is unlikely in either the short or medium term, some price increases and changes in the Common Agricultural Policy (CAP), which would liberate significant water volumes,

260. del Moral Ituarte et al., *supra* note 104, at 298-99.

261. del Moral Ituarte & Giansante, *supra* note 245, at 94-95.

262. *Id.* at 95-96. A similar analysis is performed on discursive mediation of droughts in California in L. Nevarez, *Just wait until there is a drought: mediating environmental crisis for urban growth*, 28 *ANTIPODE* 246-72 (1996).

263. del Moral Ituarte & Giansante, *supra* note 245, at 99-100.

264. *Id.* at 98.

265. BAKKER ET AL., *supra* note 82, at 27, 63.

266. Discourses favouring the reallocation of water according to social criteria have given way to the introduction of market instruments as the main methods for enhancing flexibility and efficient resource allocation.

267. The experience of the 1981-1983 and 1991-1995 droughts—when millions of households suffered from water cut-offs and poor water quality—and of the 1999 irrigation season—when water managers' decisions on the allocation of water to farmers have been harshly criticised—played a key role.

268. Sumpsi, *supra* note 117.

269. About 80 percent of the value of production in half of the 600,000 ha of irrigation surfaces in the Guadalquivir basin comes directly from subsidies of the Common Agricultural Policy (CAP) and only about 25 percent of these irrigation surfaces would be able to subsist under a scenario of full cost recovery (FCR).

are very likely.<sup>270</sup> These changes, however, are highly dependent on institutional arrangements and are causing and will continue to cause great social resistance.<sup>271</sup>

The greater awareness of vulnerability, the prospect of changes in water use patterns, and the promotion of inter-sectoral water allocation and contingency planning notwithstanding, significant portions of the traditional water paradigm persist unchanged and are poised to resist change, even when it appears necessary to cope with water scarcity. The main sources of resistance in the Guadalquivir basin are aligned with various features of the traditional water policy community. The traditional engineering mindset and long-standing support of structural solutions to water scarcity continue to hinder serious consideration of other alternatives, such as temporary re-allocation, contingency planning, or managing demand.<sup>272</sup> In particular, structural solution supporters view demand management as possible and even necessary but ultimately insufficient to address the "structural deficit."<sup>273</sup> Additionally, the still very low water prices and lack of awareness of environmental impacts provide little incentive to users to choose good scarcity responses or technology and discourage demand reductions.<sup>274</sup>

The implementation of new policy preferences like water markets, metering, and price incentives are also seriously hampered by weak management and a general lack of monitoring and control over water uses.<sup>275</sup> In particular, the present licensing system provides neither incentive nor legal guarantee of a minimum supply of water for the following year (inter-temporal allocation) for irrigation farmers who are willing to reduce water consumption during droughts. Also, lack of institutional transparency and conflict between distinct parts of the administration with

---

270. Sumpsi, *supra* note 117.

271. *Los agentes sociales rechazan la tasa destinada a los gestores de agua*, EL PAIS, July 16, 1998.

272. In particular, the attitude of the Seville water company toward this option is still hesitant, despite the recent legal changes opening up new possibilities for inter-user transfers and the inclusion of this option in the 1998 Drought Manual. At the same time, water conservation measures are not developed within integrated programs of demand management but as isolated measures without defined objectives and calendars. On the other hand, the stable reduction of demand would have clear repercussions on a water company's financial balance. So far, the sustained low level of consumption that has persisted in Seville even after the drought emergencies has been absorbed by water price increases. However, this solution has high political costs for the municipal government that must approve them and results in the municipal water company's ambivalent attitude. See EMASESA, *MANUAL DE SEQUÍA* (1998).

273. See *Plataforma del Guadalquivir*, at <http://www.sevsigloxxi.org/plataforma> (Mar. 15, 2002).

274. *Id.*

275. Professor Ramon Llamas asserts that the state of underground waters in Spain is in chaos, Aragón Press, at <http://www.circe.cps.unizar.es/spanish/waterweb/dossier.html> (June 14, 2001).

different political affiliations and between the administration and users or citizens also contribute to the maintenance of the status quo.<sup>276</sup>

But, of all the features of the traditional water community, the social hegemony of the irrigation sector is the most important. It explains the emphasis placed on the negative effects of full cost recovery water tariffs for agriculture as well as the sustained increase in irrigation lands<sup>277</sup> that fly in the face of more general trends and the preferences set out in the National Irrigation Plan. After emerging from the last drought streamlined and strong, the agrarian sector can now rely on a well-consolidated structure, as well as new ad hoc pressure groups and alliances to push its agenda.<sup>278</sup>

### SOCIAL AND INSTITUTIONAL ADAPTIVE RESPONSES

The most promising responses to water scarcity are likely to result from demand management, contingency planning, and inter-sector and inter-temporal allocation of water stocks. As a result of these catalysts for institutional change, in the lower Guadalquivir basin innovative water management practices (whose degrees of development vary) have emerged.<sup>279</sup>

For example, demand management measures have been promoted with greater energy in the Seville water supply system since the mid-1990s.<sup>280</sup> Similarly, a general downward trend in urban water use could be related to increased public awareness and could become the basis for a long-term water conservation strategy.<sup>281</sup> As regards contingency planning, the main development in this field is the elaboration of a drought manual by the Seville water company.<sup>282</sup> The manual proposes criteria for defining

276. PÉREZ DÍAZ ET AL., 1996, *supra* note 23, at 61-64.

277. To a large extent, this increase has been uncontrolled—without the corresponding water licences. In some cases the Andalusian regional government has officially supported it, though. One of the main factors behind this growth is the current European agricultural subsidisation policy.

278. Although their infrastructure agenda has dominated the discourses of the main political parties and media, none of the water schemes that they were demanding have been carried out since 1995. Thus, a paradoxical situation exists in which an apparent social and political quasi-unanimity about the need for hydraulic infrastructure exists, but there is also a real stagnation in its implementation.

279. del Moral Ituarte et al., *supra* note 104, at 297-98.

280. del Moral Ituarte & Giansante, *supra* note 245, at 99.

281. However, the urban development model (suburbanisation) currently in force in Seville, as in other Spanish and European cities, also represents a clear obstacle to the reduction of urban water demand.

282. See EMASESA, *supra* note 272.



different phases of a drought according to increasing severity and also proposes correspondingly severe conservation measures.<sup>283</sup>

But the response to water scarcity that lies at the centre of the recent water debate concerns inter-sector and inter-temporal water re-allocation.<sup>284</sup> This response came to the forefront because of the unequal distribution of water resources among sectors with different levels of economic and social status and because of the 1999 amendment to the Water Act, which prepares the ground for water transfers between users.<sup>285</sup> The idea that these transfers may increase the overall efficiency of water allocation is beginning to be accepted, albeit with some reticence.<sup>286</sup> But more turmoil lies ahead as the introduction of water markets is likely to elicit divergent reactions from differently situated irrigation farmers. Socio-demographic features, farm size, crop type, technology, source of supply, and geographical position in the water system will all impact different irrigation farmers in different ways and the group could experience more tension, especially if water were to become even more scarce.<sup>287</sup>

## CONCLUSIONS

In the Lower Guadalquivir basin, as in the rest of Spain, a resource-oriented water management model with deep historical roots, the "hydraulic paradigm," has dominated so far.<sup>288</sup> This model has had a distinct impact on how the risk of water scarcity is perceived and on the vulnerability of the water system, which is increasing as a result of users' demand-hungry attitude. In this paradigm, droughts have traditionally been viewed as expressions of a "structural deficit," a permanent imbalance between water demand and water supply. This view has led water managers and water planners to neglect the crisis management and contingency planning areas. Nonetheless, the idea that the water management system faces a serious crisis is becoming more widespread among water managers and stakeholders alike. The last drought increased awareness of the water system's vulnerability and became a catalyst for social participation in the water debate.

The uncontrolled expansion of irrigated lands over the past two decades also had important ramifications for current water allocation

---

283. Ministry of the Environment, *supra* note, 38, at 839.

284. 1999 Water Act, B.O.E., 1999, 298, art. 61 bis.

285. *Id.*

286. del Moral Ituarte et al., *supra* note 104, at 299-300.

287. *Id.* at 292-94.

288. This term describes a type of water development policy that advocates building new water infrastructure (dams that make more water available) instead of managing demand (by increasing water efficiency or campaigning in favour of water savings).

methods. The 1999 irrigation season was a breaking point for urban water users; for the first time, water allocation decisions that put the basin's urban water supply at risk were harshly criticized. This criticism also has important implications for current water management, which needs to change in order to be able to guarantee a basic urban water supply. As it now stands, the water system struggles to handle today's risks with traditional water management approaches.

Climate change would further challenge the current water management model. Despite the increase in rainfall, temperature variability, and persistence of dry spells in the Guadalquivir river basin over the last three decades of the twentieth century, climate change has not yet become a standard consideration in Spanish water planning. If climate change were integrated into the planning, this would probably result in a greater push to address the current system's deficiencies. In particular, if the process put more emphasis on inter-annual reservoir operation and if groundwater issues were included in the global management model, it might be possible to mitigate the effects of the lower rainfall and the lower water flows that global warming might bring.

Water allocation could become a useful tool for increasing the water system's overall efficiency and ability to cope with scarcity. The importance of efficiency and the ability to deal with scarcity will become more important since competition for water among metropolitan and coastal users; among urban, environmental, and agricultural users; among inland users; as well as among different irrigation zones, according to location, crop type, size, technology, and efficiency is likely to continue increasing. There is a new provision requiring some economic analysis of water uses that will be used to fashion some form of cost recovery, probably partial cost recovery. When this provision becomes effective, when the EU Framework Directive has been fully implemented, it would positively affect both the current concept of water deficit and the current priorities for allocating water. According to economic modelling of the situation in the lower Guadalquivir basin, the efficiency gains from re-allocation over time, gains associated with increasing the certainty of water rights to saving water left in reservoirs for use in a subsequent year, could overshadow gains in efficiency achieved by water trades that occur in a single season. But at present, the licensing system provides neither the incentive nor the legal security necessary for irrigation communities to be willing to defer/reduce their water consumption.

The irrigation community emerged from the last drought streamlined and more powerful. The irrigation sector opposes the prospect of reduced demand and claims that it unduly burdens traditional agricultural interests and jeopardizes its well-advertised, deep-seated, traditional values. As a result of the irrigation community's skilful media management, a considerable amount of publicity is focused on the negative

effects cost recovery water tariffs would have on agricultural interests. Similarly, structural solutions continue to dominate mainstream political party and media agendas. But while these traditional attitudes persist, they face more opposition than in the past; for example, none of the water schemes (mainly reservoirs) demanded by the irrigation community has been built since 1995.

In summary, Spain's water system is facing a crisis. The innovative measures of demand management and contingency planning are viewed by the incumbent institutions and actors as viable and even necessary but still insufficient to completely overcome the inherent "structural deficit." The incumbents continue to clamour for resource augmentation as the better long-term solution to water scarcity. In the midst of this ongoing tension, the stress on Spain's water system grows larger as does the threat of global warming. Hopefully, Spanish stakeholders will realize that what is needed to face the future is a water management system that is willing and politically able to use all the tools available to adapt to water scarcity.