

10. CONCLUSIONS AND RECOMMENDATIONS

10.1. Conclusions

At the end of each of the six chapters, we have pointed out conclusions related to each of the aspects of water management included in this thesis. From all the previously mentioned, we highlight the following findings:

1. California and Spain are very similar in terms of climate and water resources distribution. Both regions have a Mediterranean climate and their surface water resources are concentrated in the north, while the center and the south areas remain dry almost all year round.
2. In neither California or Spain does water demand match water resources availability, although imbalance is much stronger in California. California's water supply systems is based on large transfers thought the entire State, whereas in Spain demand is usually fulfilled with resources available within the local basin.
3. Residential water demand is almost four times higher in California than in Spain mostly due to private residential landscaping. In addition, the State's productivity within the commercial and residential sector (generated income per water use) is half of what it is in Spain. Moreover, volume of applied water per irrigated crop area in California is two times higher compared to Spain. One of the main reasons for such a high difference is the use of high-water consuming crops in California.
4. Agriculture accounts for 80% of applied water demand, yet it only generates a hundredth of the countries' wealth. Agricultural water use has the highest savings potential among all water uses. Agriculture water conservation is usually called on during dry periods because of its higher elasticity in demand. However, most of the effort in long term water conservation and enhanced management is focused on urban uses.
5. Since the drought of 1987-1991, California carries out aggressive urban water conservation programs at all levels, from local agencies to the Department of Water Resources, to large retailers such as Metropolitan Water District and voluntary associations like the California Urban Water Conservation Council. In contrast, Spain's actions are limited to educational campaigns and establishment of general conservation guideless.
6. In terms of investment over water savings, water conservation for large landscaping is 2.6 to 3.6 times more cost-effective than it is for residential and commercial uses respectively
7. As regards agricultural water use efficiency measures, DWR and the Agricultural Water Management Council provide funding and assistance to local projects. No similar water efficiency programs have been found in Spain, yet economic productivity (generated income per applied water) of Spanish farms is over three times higher.

8. Despite being the lowest water efficient methods, gravity irrigation is the most common system in Spain and California. In many cases, crop subsidies, low water prices and billing by volume stimulate water squandering.
9. Low-value and high-water consuming crops including cotton, alfalfa and rice, account for 37% California's irrigation water, whereas the same variety of crops only use 17% of total applied irrigation water in Spain.
10. California and Spain make similar use of water recycling. However, California has a boarder range of applications. Moreover, two of the world's top water recycling facilities in terms of research and innovation are located in Southern California.
11. Recycled water for irrigation appears to be cheaper than fresh water supplied by water agencies. Nevertheless, use of recycled water is limited due to risk that it entails for human health.
12. Conjunctive use of surface and groundwater has become a key management tool in California. Actually, two of the world's largest water banking projects are located in Kern County in central California. In contrast, application of conjunctive use in Spain is still symbolic, yet both regions share similar hydrogeologic conditions.
13. Spain's installed desalination capacity is over three times larger than that of California. Moreover, two-thirds of desalted water in Spain comes from the sea, whereas in California brackish water is virtually the only source of raw water for desalting plants.
14. Both regions are planning to largely increase their desalination capacity, although the growth will be much faster in Spain. By contrast, the State of California and certain water agencies are carrying out outstanding efforts in research and development of desalination technologies.

10.2. Recommendations

Bearing in mind the results obtained from the comparison between California and Spain, we will make a series of recommendations that both regions should follow to improve water management.

Recommendations for both regions

1. In accordance with the "full cost recovery principle" water prices should reflect its true cost. Moreover, water for agricultural use should be billed by volume instead of by irrigated area. Based on the water use efficiency achieved by urban block rates, a similar billing system could be applied for agricultural water uses.
2. Public funds should be invested in agricultural water use efficiency measure, instead of subsidizing agricultural water and unprofitable crops. In addition, high-value and low-water consuming crops should be prioritized versus low productive crops such as alfalfa, cotton and rice.
3. Data on water use should be made public and easily available for everybody. Urban water customers should become aware of how much water is used for irrigation and what its efficiency level is. The media should drive attention towards agricultural

water uses and thus, increase social pressure on farmers to improve their irrigation systems.

4. Water recycling should be implemented wherever it would be cost effective and entail no risk for human health or the environment. Educational campaigns should be carried out to increase understanding and acceptance of reclaimed water use. Public concerns about potential risk for human health should not stop wastewater recycling from being used in the cases where lack of side effects has been proved
5. A comprehensive guide on groundwater basins, groundwater levels. Water quality and additional storage capacity should be created in order to identify opportunities for conjunctive use projects.
6. Further research should be carried out in order to improve desalination technology. Recent studies have shown that there are several innovative methods that could cut down energy use in desalting process. Furthermore, projected desalination plants should be integrated as part of regional long-term water supply plans instead of becoming a resource “to be used only in case of emergency”. Planning mistakes such as that of Santa Barbara and Carboneras should be avoided at all costs.

From California’s perspective

7. California should learn from Spain’s efficient use of water and try to achieve similar levels of industrial, commercial and agricultural productivity.
8. California Water and Sanitation Agencies should carry out Integrated Management of Water Supply and Sanitation services.

With regards to Spain

9. From the institutional viewpoint, Spain should create specific committees for different tasks like DWR does with the Office of Water Use Efficiency and Transfers, Recycled Water Task Force and California Water Desalination Task Force.
10. The Spanish Ministry of Environment should give financial incentives to develop more efficient water management, like the State of California does through numerous programs including Proposition 50, Proposition 13, CALFED Bay-Delta program, etc.
11. The Spanish Ministry of Environment should create a specific organization for sustainable water supply and water savings, like the Institute for Energy diversification and Savings (IDAE) that belongs to the Ministry of Industry, Tourism and Trade.
12. Urban and Agricultural water planners and other stakeholders should carry out integrated management plans regarding water supply and demand. A large institutional effort is required at the Government Level between The Ministry of Agriculture, on behalf of agricultural water users, and the Ministry of Environment, responsible for water resources management.
13. Spain should diversify its water supply portfolio increasing the use of recycled water and conjunctive use, instead of focusing so strongly on desalination. In fact, numerous opportunities for artificial recharge have been identified, although they have not been developed. Thus, it is high time Spain water policymakers take a step forward and invest in alternative sources in order to expand the country’s sustainable water supply to its maximum potential.

To summarize, both California and Spain should carry out an important institutional effort in order to improve management of their water resources. From California's perspective, Integrated Management of Water Supply and Sanitation services should be adopted, while Spain should enhance conjunctive management of surface and groundwater resources and improve coordination between urban and agricultural water stakeholders.

All in all, Spain is more efficient than California in terms of water use, yet California is making a larger effort to improve water management. However, in both cases there is still much that must be done and hopefully California and Spain will learn from each other along their way towards sustainable water management