Water Crisis in Sao Paulo and California – Groundwater legislation comparison in both states

MELINA SCARASSATI GALVANI

Melina Scarassati Galvani
melinagalvani@gmail.com
Mestranda em Direito pela Universidade Metodista de Piracicaba
LL.M. em Direito Comparado com foco em Direito Ambiental e Direito da Energia pela Universidade de San Diego/CA
Especialista em Direito Ambiental e Gestão Estratégica de Sustentabilidade pela Pontifícia Universidade Católica/SP
Bacharel em Direito pela Universidade Presbiteriana Mackenzie/SP

ABSTRACT

The essay purposes to address a link between climate change and water availability as well as associate the effects of climate change with the water crisis that has affected two regions in a similar way: California and Sao Paulo. In this scenario, as one important water source supply, this paper will focus on groundwater. It will indicate the legislation related to groundwater usage and management in both states, California and Sao Paulo. It analyzes if the legislation in both places establishes a link with climate change, that is, if groundwater regulation is based on climate change in order to mitigate its effects.

Keywords: Climate Change. Drought. Water crisis. Groundwater. California. Sao Paulo. Legislation.

TABLE OF CONTENTS

I. INTRODUCTION

The scope of this study, firstly, is to indicate how climate change affects water and how the severe drought worsened the water availability that became into a water crisis in California/United States of America and in Sao Paulo/ Brazil.

Considering that a substantial portion of water is underground and that groundwater is one of the most valuable resource of freshwater available in the world, this paper will focus on groundwater usage and management, especially taking into consideration the importance of groundwater as a water supply in periods of drought. Adequate groundwater usage and management is extremely important, in order to maintain water quality and quantity for consumption. In order to safeguard against drought and climate change effects, an effective groundwater management system is required.

In this regard, this paper will indicate the groundwater legislation in Sao Paulo and California, mentioning if this legislation was a step toward during the water crisis or if these rules existed before it. This paper aim is to analyze if the legislation is being effective in order to change the perspective of water crisis, especially observing if climate change has affected groundwater regulation or not.

II. WATER CRISIS – How Climate Change Interfered in Water Availability

Water availability is affected by many reasons[1]. One of these reasons is climate change[2]. One notable effect of climate change was the severe drought[3] that recently affected both, Sao Paulo and California. This severe drought brought to light a water crisis in the most populous state of Brazil and in the most populous state of the United States of America.

2.1 Climate change and Water availability

---

1 "Water availability is also affected by pollution. Most problems related to water quality are caused by intensive agriculture, industrial production, mining and untreated urban runoff and wastewater." The United Nations World Water Development Report 2015. Water for a sustainable World, p.13.

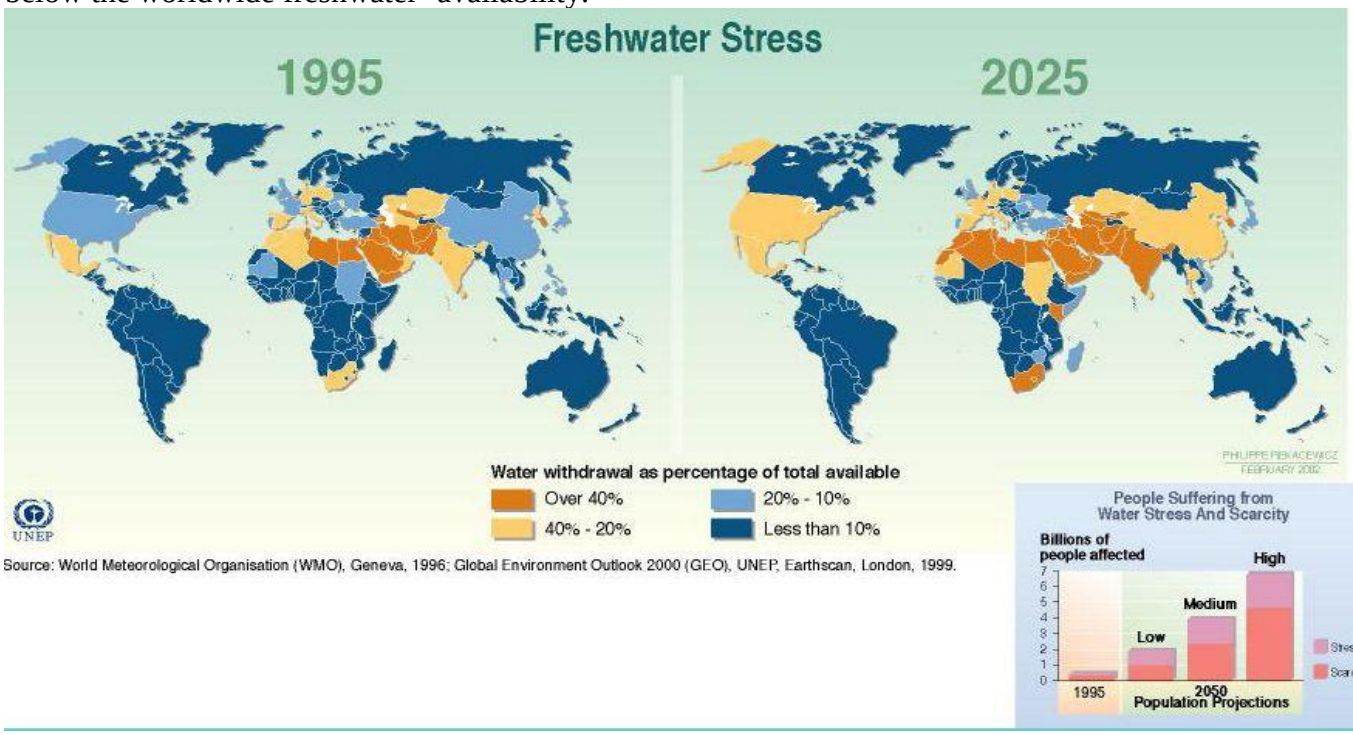
2 "Climate change will exacerbate the risks associated with variations in the distribution and availability of water resources", Id at 12.

3 'Climate change (see Chapter 10) is likely to increase the incidence and severity of extreme events, with some projections including an increase in the frequency of years with above normal monsoon rainfall or extremely low rainfall (IPCC, 2014). Melting glaciers will affect water supplies, creating risks of glacial lake outburst floods and downstream flooding for some regions, and in the long term leading to an overall reduction in water supplies from snow cover and glacial runoff (World Bank, 2013). Over the long term, drought will become an even more serious concern, particularly given the already strained water access issues (IPCC, 2013)." Id at 74/75.

The outcome document of the 2012 United Nations (UN) Conference on Sustainable Development (Rio+20), The Future We Want[4], recognized that "water is at the core of sustainable development." Progress towards sustainable development goals involves substantial improvements of water management worldwide. Water resources are vulnerable to climate change's effects. Increases in global temperatures are associated with changes in the water cycle, including changes in water vapor, precipitation, as well as changes in groundwater. In fact, the water cycle is accelerating due to climate change and is affecting water supplies[5].

Water availability is also affected by many other reasons that are related to climate change, such as population growth, urbanization, industrial production, intensive agriculture, pollution and wastewater[6]. All of these influence ecosystems, undermining their health. Consequently, the services provided by ecosystems are affected, and among these services is water not only water quantity but also water quality. As implied in "*The United Nations World Water Development Report 2015. Water for a sustainable World"*, "degraded ecosystems can no longer regulate and restore themselves; they lose their resilience, further accelerating the decline in water quality and availability."[7]

In a comparison view through the years, it is possible to observe in the figure below the worldwide freshwater[8] availability:



Source: World Meteorological Organisation (WMO), Geneva, 1996; Global Environment Outlook 2000 (GEO), UNEP, Earthscan, London, 1999.

---

4 The Future We Want: Outcome document adopted at Rio+20 (2012), available at http://www.un.org/en/sustainablefuture/.

5 "Since flood damages have grown more rapidly than population or economic growth, other factors must be considered, including climate change (Mills, 2005). The weight of observational evidence indicates an ongoing acceleration of the water cycle (Huntington, 2006)." Linking climate change and water resources: impacts and responses, https://www.ipcc.ch/pdf/technical-papers/ccw/chapter3.pdf, p. 37.

6 See at The United Nations World Water Development Report 2015. Water for a sustainable World, p.13.

7 Id.

8 According to information from the document, Where is Earth's Water?: "Out of all the water on Earth, saline water in oceans, seas and saline groundwater make up

Currently, 1.6 billion people live in regions with absolute water scarcity and the number is expected to rise to 2.8 billion people by 2025.[9]

Water resources are also affected by changes in policies, legislation and management. These non-climatic factors are likely to aggravate or attenuate the adverse effects of climate change, once they have significant influence on water demand. Water availability is a critical factor that has to be taken into consideration as a top priority global issue. Conscious actions are needed to prevent further depletion of this vital resource, since the rate of its usage is creating a crisis worldwide. It is necessary to maintain water availability in a reasonable range for population, managing this resource in a sustainable manner and conserving it for future generations.

2.2 Sao Paulo and California Drought

This section compares water scarcity in two specifics regions: Sao Paulo, Brazil and California, United States of America. These states, which are the most populous states of their countries, have faced a water crisis followed by a severe drought, in 2014.

Concerning São Paulo's water crisis, in July 2014, the net volume of *Cantareira* reservoir was exhausted. The *Cantareira* system is the most important surface water supply of Greater Sao Paulo[10] (it is important to consider that in the Greater Sao Paulo, surface water accounts for about 80% of water usage). The *Cantareira* system is a set of dams created in the 1970s, in response to a rapid population growth in Sao Paulo. The *Cantareira* System was designed to produce excellent quality water to supply, according to a flow rate of 33 m3/s, a population of 8.8 million people located in the Greater Sao Paulo. However, to keep the reservoir filled, the system depends on the summer rains, but in the first three months of 2014, it rained less than half that expected for the period and the reservoir reached only 15.8% of its usable capacity, the lowest level since 1974 – the year when it was created. Therefore, with the emptying of the reservoir, Sao Paulo faced the worst water crisis in 80 years. Due to that, the National Water Agency (*Agência Nacional de Águas – ANA*) and the Department of Water and Electricity of Sao Paulo (*Departamento de Águas e Energia Elétrica de São Paulo – DAEE*) determined in the beginning of 2014, a reduction in the maximum water flow.[11] In addition, the Governor announced some measures to contain the crisis, such as fines for consumers who increase their water use and discounts for those who reduce their use. But since the second half of 2014, many residents in the Greater Sao Paulo are feeling the water crisis effects with periods of no water in taps and showers.

---

about 97% of it. Only 2.5–2.75% is fresh water, including 1.75–2% frozen in glaciers, ice and snow, 0.7–0.8% as fresh groundwater and soil moisture, and less than 0.01% of it as surface water in lakes, swamps and rivers.", available at http://water.usgs.gov/edu/earthwherewater.html.

[9] Available at http://water.worldbank.org/topics/water-resources-management/water-and-climate-change, ©2015 The World Bank Group.

[10] Greater Sao Paulo is an informal name for the Metropolitan Region of Sao Paulo (*Região Metropolitana de São Paulo* – RMSP) (7.946,82 km²) that consists of 39 municipalities, including the state capital, Sao Paulo and has approximately 20 million people (almost half of people that live in the state of Sao Paulo).

[11] José Eduardo Cavalcanti, O aproveitamento do volume morto do Cantareira, (11 de março de 2014), available at http://www.institutodeengenharia.org.br/site/noticias/print/id_sessao/70/id_colunista/4/id_noticia/8432.

California is experiencing a water crisis similar to that of Sao Paulo. Three main sources of water sustain California – mountain snowpack, water stored in reservoirs and water pumped from underground aquifers. The Sierra Nevada snowpack stood a low average for the date[12]; the state's biggest reservoirs held a lesser amount of their capacity and aquifer levels from Siskiyou County to San Diego County were in decline. The current Governor announced his first mandatory water restrictions, declaring a drought emergency on January 17, 2014.[13] Some measures were taken in order to conserve resources and avoid waste of water, such as asking all Californians to reduce water consumption by 20 percent; directing local water suppliers to immediately implement local water shortage contingency plans, among others.[14] Moreover, a relevant regulation regarding groundwater was enacted.[15]

2.3 Groundwater

There is much more freshwater stored globally in the ground (more than 2,000,000 mi3 – 8,400,000 km3) than there is in liquid form on the surface.[16] Groundwater results from infiltration that allows water precipitated on the continents, or resulting from snow melting that is transferred to the subsurface, reaching the deeper strata. The discharge of groundwater in surface water bodies is responsible for maintaining the level of water from rivers and lakes in rainless periods. The depth of the water level can vary throughout the year, since it is affected by climate change. Therefore, in rainy periods, there is greater infiltration of water and the water level rises. During dry seasons, with little infiltration and increase in evaporation process, the level of water may be deeper. An underground water reservoir, characterized by layers or sufficiently permeable geological formations is called an aquifer. Aquifers are capable of storing and conveying water in amounts that may be seized as a source of supply for different uses (wells can be drilled into the aquifers and water can be pumped out). In order to do that, uncontrolled or abusive groundwater extraction shall be avoided, to maintain the natural recharge capacity of the aquifers and prevent reducing in water reserve.

The figure below shows the percentage of groundwater, compared with the total of freshwater in the world.

---

12 "The statewide electronic reading of the snowpack's water content stood at 5 percent of the April 1st average. Today's content was only 1.4 inches, or 5 percent of the 28-inch average. The lowest previous reading since 1950 was 25 percent of average, so Water Year 2015 is the driest winter in California's written record.", How Low Can Snow Go? (April 1, 2015), http://water.ca.gov/waterconditions/news-archive.cfm.

13 Governor Brown Declares Drought State of Emergency (January 17, 2014), https://www.gov.ca.gov/news.php?id=18368.

14 Governor's Drought Declaration (October 10, 2015), http://www.water.ca.gov/waterconditions/declaration.cfm.

15 "On September 16, 2014, Governor Jerry Brown signed into law a three-bill legislative package, composed of AB 1739 (Dickinson), SB 1168 (Pavley), and SB 1319 (Pavley), collectively known as the Sustainable Groundwater Management Act.", Key Legislation New Groundwater Legislation, Sustainable Groundwater Management Act (January 15, 2015), http://www.water.ca.gov/groundwater/groundwater_management/legislation.cfm.

16 How much water is there on, in, and above the Earth? (August 07, 2015), http://water.usgs.gov/edu/earthwherewater.html.

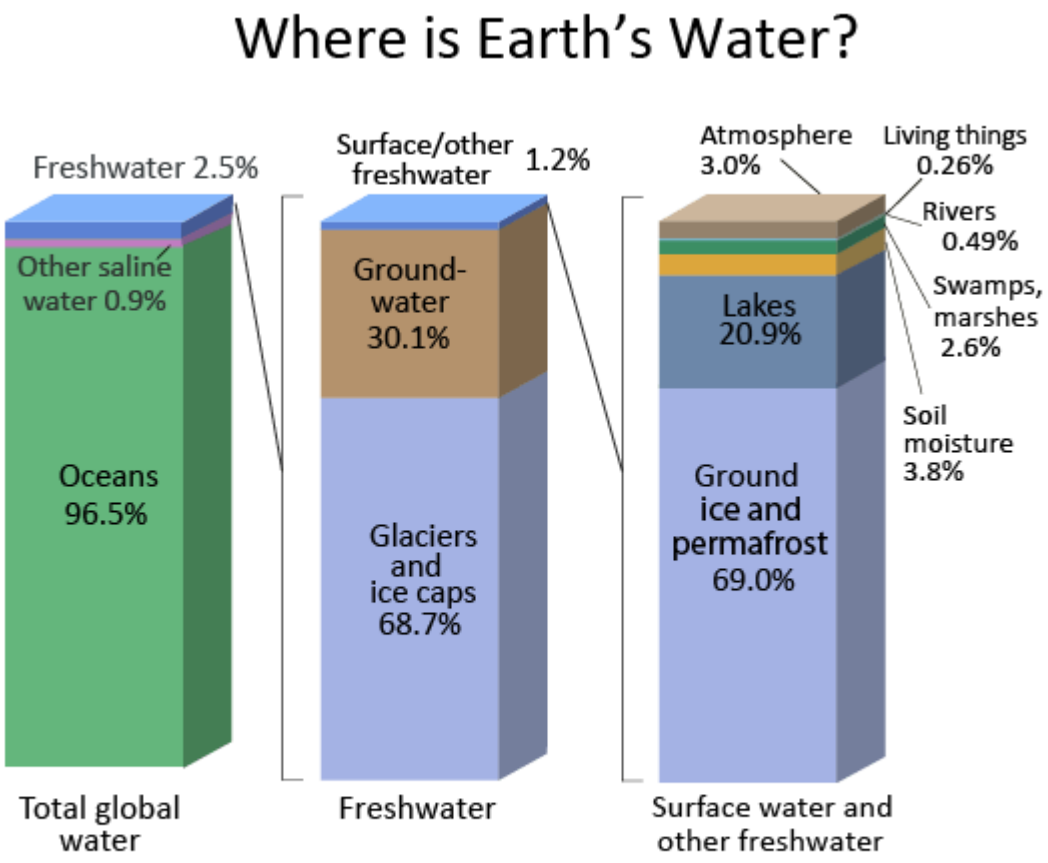


Figure 1See at http://water.usgs.gov/edu/earthwherewater.html

Groundwater is one of the most valuable resources, constituting around of 30% of freshwater available in the world, and its importance is much higher in periods of drought. Groundwater should be considered a strategic water supply resource because of its relative abundance, especially considering the poor condition of surface water associated with the high cost of treating it. The over-exploitation and contamination of groundwater should be avoided. Therefore, an effective groundwater management with an efficient monitoring process is required, in order to provide a buffer against drought and climate change.

III. CALIFORNIA–Which Measures Were Taken and Under Which Legislation?

California's government took some steps in order to address the water crisis that has affected the area. Groundwater regulation, penalties to parties who waste water and recycling water are some of the measures taken by California's government to improve water quality and quantity and to prevent water scarcity. This paper, however, will focus on measures specifically, concerning groundwater, adopted by the government after this recent water crisis.

3.1 Groundwater Regulation

Groundwater is a vital component of California's water supply, which accounts for around 30% to 50% of California's total annual water supply[17]. In periods of drought, groundwater becomes even more important as pumping increases to compensate for the lack of rain. The groundwater reservoir is greater than available surface water; in California, supplies of usable groundwater are estimated at about six times the volume of all of the state's surface water reservoirs combined.[18] However, many groundwater basins have experienced significant overdraft. Therefore, to manage California's groundwater it is important to have a comprehensive groundwater regulation.

A. The Public Trust Doctrine and the Reasonable Use Doctrine

The Commerce Clause listed in the United States Constitution (Article I, Section 8, Clause 3) gives Congress the power to regulate navigable waters. States also retain authority under their own constitutions to regulate waterways for the public good. A number of states, over the past 30 years, have applied to waters rights a doctrine called the Public Trust Doctrine[19]. The Public Trust Doctrine (PTD) is an ancient doctrine (developed in the law of the Roman Empire[20]) but that has served as a foundational principle of modern environmental and natural resources law. The most significant expansion of public trust principles, however, has been in the context of water rights. The PTD[21] has been applied to protect public rights to use waterways for navigation, commerce, and fishing. Nevertheless, the uses protected by the PTD in California have expanded to protect not only navigable waters but also non-navigable tributaries of those waters.

In California, the seminal case on the PTD's application is *National Audubon Society v. Superior Court.*[22] In this case, known as the "Mono Lake" case, the California Supreme Court held one of the most important public trust decisions of the nation. The Court recognized the state's duty to protect not only navigable waters traditionally covered by the PTD, but also diversions from non-navigable tributaries of those waterways, when the diversions harm or destroy public trust resources. The case is related to permission that the city of Los Angeles, in 1974, received from the State Water Resources Control Board, to appropriate an amount of water. The Audubon

---

17 Juliet Christian-Smith & Kristyn Abhold: Measuring What Matters Setting Measurable Objectives to Achieve Sustainable Groundwater Management in California (2015), p. xi.

18 "In California alone, current supplies of usable groundwater are estimated at about 250 million acre-feet [2] -- six times the volume of all of the state's surface water reservoirs combined.", available at http://www.nrdc.org/water/pollution/ccg/execsum.asp.

19 "The Public Trust Doctrine is an ancient legal doctrine under which some waters, tidelands and wildlife resources of the State are held in trust for all of the people, and the State acts as the Trustee to protect these resources for present and future generations.", see at http://www.envirolaw.org/documents/ScottFAQ.pdf, p.01.

20 "It was founded upon the very sensible idea that certain common properties, such as rivers, the seashore, and the air, were held by government in trusteeship for the free and unimpeded use of the general public.", see at Plater, et al, Environmental Law and Policy: Nature, Law and Society, (Aspen; 4th Ed.), p. 861.

21 "The Public Trust Doctrine allows any person to bring a lawsuit against the State if it fails to fulfill its duty as Trustee to manage these protected resources in accordance with the Doctrine.", see at Plater, et al, Environmental Law and Policy: Nature, Law and Society, (Aspen; 4th Ed.), p. 861.

22 National Audubon Society v. Superior Court (1983) 33 Cal. 3d 419, 446.

Society then filed a lawsuit three decades late, alleging that with this permission, the inflow of Mono Lake was reduced, its salinity would increase, and consequently, the activities in the lake were negatively affected. The California Supreme Court held that the State Board has a continuing duty to supervise the appropriated water use from Mono Lake and from its tributaries. The Supreme Court mentioned that if the PTD applies to constrain water supplies usage in navigable waters, likewise it should apply to constrain the extraction of water that destroys navigation and other public interests.[23] The California Supreme Court concluded that, under the PTD, it is possible to protect "navigable waters from harm caused by diversion of nonnavigable tributaries"[24]. This decision extended the uses protected by the PTD in California, including not only navigable waterways but also water rights associated with non-navigable tributaries associated with navigable waters.

In addition to that, on July 14, 2014, a Superior Court's decision in California took a step further. In the *Environmental Law Foundation v. State Water Resources Control Board*[25] case, the court has expanded the uses protected by the PTD to include groundwater that is hydrologically connected to navigable waterways. At the central part of this case is the Scott River, a navigable waterway used for boating and fishing, which has groundwater supplies connected to it. The Environmental Law Foundation argued that groundwater is hydrologically connected to the Scott River and that the river for the past two decades has experienced decreased flows in part because of groundwater pumping.[26] Due to that, the navigable water is being reduced and its fish population has been injured.[27] Whether the PTD relates to the Scott River is not the issue, the issue is whether the doctrine specifically applies to the groundwater hydrologically connected to surface water that can harm trust uses of the river. The Superior Court of Sacramento sustained that the PTD applies not only to navigable waters but it should apply also to groundwater connected to navigable water. The court held the continuing duty of the state to manage groundwater resources, under the PTD, protecting navigable waterways from harm caused by groundwater extraction.

This decision has been an important interpretation of the PTD. If the Supreme Court upholds the lower's court decision, then the PTD interpretation in California extends to groundwater that is connected and have potential to harm navigable waters. In 2011, however, when the Environmental Law Foundation filed this suit, there was no appropriate regulation in California related to managing groundwater resources. Nevertheless, in 2014, California passed the Sustainable Groundwater Management Act. This decision thus should have practical influence considering the provisions of this new legislation.

Water rights and use are subject not only to the PTD but also to the Reasonable Use Doctrine[28], under Article X, Article 2 of the California Constitution, in order to

---

23 Id at 436-37.

24 Id at 437.

25 Environmental Law Foundation, et al. v. State Water Resources Control Bd., et al. Case No. 34-2010-80000583 (Cal. Super. Ct. July 14, 2014).

26 Id at 3.

27 Id.

28 In *Light v. State Water Board* [Light v. State Water Res. Control Bd., 226 Cal. App. 4th 1463 (2014) (No. A138440)], is said, "The Supreme Court has recognized as much, describing the Board's regulatory authority in the broadest terms. "The Legislature, consistent with its authority under [Article X, Section 2], has established a thorough statutory system insuring reasonable water allocation and safeguarding water purity, commensurate in scope with the constitutional provision. The statutes vest the [Board] with full authority to 'exercise the adjudicatory and regulatory functions of the

promote more efficient water use. According to this piece of legislation, the water resources of the State is required to prevent the waste or unreasonable use of water. The California Constitution states that "The right to water or to the use or flow of water in or from any natural stream or water course in this state is and shall be limited to such water as shall be reasonably required for the beneficial use to be served, and such right does not and shall not extend to the waste or unreasonable use or unreasonable method of use or unreasonable method of diversion of water."[29]

The State of California observed the Reasonable Use Doctrine when enacting the Sustainable Groundwater Management Act. The Act explicitly mentions this principle: "To enhance local management of groundwater consistent with rights to use or store groundwater and Section 2 of Article X of the California Constitution. It is the intent of the Legislature to preserve the security of water rights in the state to the greatest extent possible consistent with the sustainable management of groundwater."[30]

B. Sustainable Groundwater Management Act – A Regulation after Crisis

For the first time in California's history[31], the state enacted a statute that instituted comprehensive provisions on groundwater. Although the laws grant the duty to regulate water use in its broad meaning, which encompasses surface waters and groundwater, the State Water Board has never regulated groundwater as much as surface waters are regulated, which allowed inappropriate extraction of groundwater and consequently negative impacts on surface waters that are hydrologically connected to groundwater.

Periods of drought, as mentioned in this study, interfere with the quantity of water, especially related to surface water, so whilst surface water diminishes in drought period, groundwater usage increases[32]. Therefore, the recent drought that California has experienced helped boost the state to enact a legislation to manage groundwater resources. Consequently, on September 16, 2014, the Governor Jerry Brown signed the Sustainable Groundwater Management Act (SGMA), which went into effect on January 1, 2015. The SGMA, which is constituted by three pieces of groundwater legislation, SB 1168, AB 1739, SB 1319, establishes a process and a timeline for local agencies to achieve sustainable groundwater management.

This regulation aims that groundwater should be properly managed, in order to reach the goal of sustainable management. This management should be done at local or regional level by local agencies with minimal state intervention. This new statute gives some powers to local agencies, such as, to fine those who violate the rules, to implement fees to fund the implementation of the management plans[33] and fine those

---

state in the field of water resources.' The [Board's] powers extend to regulation of water quality and prevention of waste.", at 1485.

[29] CA Const. art. X, sec. 2.

[30] See at SGMA 10720.1. Legislative Intent (b), p.12. This principle is also mentioned in the 10720.5. (a)/ 10735.8. (d).

[31] In 1992, the state of California passed a regulation, AB 3030, but the system failed to solve groundwater issues, since California continued to face troubles regarding groundwater management.

[32] See at SGMA, Uncodified Findings (a) (2) "Groundwater provides a significant portion of California's water supply. Groundwater accounts for more than one-third of the water used by Californians in an average year and more than one-half of the water used by Californians in a drought year when other sources are unavailable.", p. 1

[33] Planning Deadlines "(1) By January 31, 2020, all basins designated as high- or medium-priority basins by the department that have been designated in Bulletin 118, as

who fail to pay such fees, and to monitor wells. However, if a local agency fails to manage groundwater in a sustainable manner, then the state can intervene until they are able to properly manage it. This legislation also recognizes the authority of cities and counties in managing groundwater in accordance with their police powers.[34]

According to this new regulation, "sustainable groundwater management means the management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results."[35] Undesirable results can be caused by improper groundwater extraction, such as overdraft, failed wells, deteriorated water quality, environmental damage, and irreversible land subsidence.[36] These undesirable results diminish the capacity of aquifers, interfering in the water quality and quantity. However, these undesirable results caused by improper usage and management can also be affected by climate change effects.[37] "Climate change will intensify the need to recalibrate and reconcile surface water and groundwater management strategies."[38]

This legislation represents a significant step forward for groundwater management in California, in which agencies have authority to use a variety of tools in order to reach a sustainable groundwater usage. This new legislation brought the concept of sustainable groundwater management, considering climate change effects as negative impacts on groundwater availability.

IV. SAO PAULO – Which Measures Were Taken and Under Which Legislation?

The water crisis that affects the state worsened with the drought last year. The recent drought has been the worst and longest drought in recorded history since 1930. Even in the absence of a drought, the supply of water in the Greater São Paulo has faced stresses with demand from the rapid pace of population growth in the past decades. In April 2014, the Governor announced fines for consumers who increase their water use and discounts for those who reduce their use, but due to 2014 being an election year, the government denied the crisis until 2015 (the Governor seeking re-election in the October 2014 elections was accused of minimizing the crisis for political reasons).

Legislation is not an issue though, Sao Paulo's legal framework for water resource management is vast, but it has been built based on the aspects related to surface waters. Despite the existence of groundwater regulation, groundwater seems not to be seen as a measure until the water crisis. The state of Sao Paulo did not enact new legislation after water crisis.

4.1 Groundwater Regulation

---

it may be updated or revised on or before January 1, 2017, as basins that are subject to critical conditions of overdraft shall be managed under a groundwater sustainability plan or coordinated groundwater sustainability plans pursuant to this part. (2) By January 31, 2022, all basins designated as high- or medium-priority basins by the department that are not subject to paragraph (1) shall be managed under a groundwater sustainability plan or coordinated groundwater sustainability plans pursuant to this part.", Id at p.13/14.

34 Id at Uncodified Findings (b) (5), p.2.

35 Id at Chapter 2. Definitions (u), p.18.

36 Id at Uncodified Findings (a) (3), p.1.

37 Id at Uncodified Findings (a) (4), p.1.

38 Id at Uncodified Findings (a) (11), p.2.

The State of Sao Paulo is currently the largest user of groundwater in Brazil. The largest and main groundwater reserve in the State of Sao Paulo (155 800 km²) is the Aquifer Guarani[39], which is considered the biggest cross-border underground freshwater source in the world. In the state of Sao Paulo, approximately 80% of the municipalities are fully or partially supplied by groundwater[40], about 65% of urban areas and approximately 90% of Sao Paulo industries are supplied, partially or totally, by artesian wells.[41] However, it is important to consider that in the Greater Sao Paulo, which has approximately 20 million people, surface water accounts for about 80% of water usage while groundwater accounts for only 20% of water usage.

A. Legislation of the State of Sao Paulo

The Federal Constitution of Brazil of 1988 establishes in Art. 21, section XIX that the Federal government has the responsibility to institute National Water Resource Management[42] and to define the criteria of water use concession (the Federal power is responsible to create general rules whilst the states can supplement them). The Art. 23 of Brazilian Constitution establishes that the federal power, the states and the municipalities are responsible to protect the environment and to monitor the concessions of water resources in their territories. Water, as an environmental asset, is a public domain, so the government has the duty, as a manager, to protect, monitor and preserve it for present and future generations. Regarding groundwater, Art. 26, section I defines it as a state good. States are responsible though, for granting rights to use groundwater resources.

The Superior Court of Justice is unanimous in affirming that, according to laws, extraction of groundwater shall only be permitted after granting from public authority. The court held that this restriction is based on the world water crisis and it is in accordance with the Brazilian Federal Constitution that considers water a limited resource, of public domain, and that has an expressive economic value[43].

The Constitution of the State of Sao Paulo of 1989, following the Federal Constitution, establishes (Art. 205 and 206) that the state shall institute by law an integrated system of water management with rational surface and groundwater usage that shall prioritize population supply. Moreover, it states that groundwater is a strategic water reserve for economic and social development. It also states that groundwater as a valuable water supply, shall have a permanent program to protect and preserve it against pollution, contamination and overexploitation, and that all of those statements shall be established by law. The state of Sao Paulo, though, had prior

---

39 The Guarani Aquifer is one of the largest groundwater reservoir in the world, occupying an area of 1.2 million square kilometers among the northeast of Argentina, center-south of Brazil, northwest of Uruguay and southeast of Paraguay. About 70% of its total area is in Brazil. *Aquífero Guarani*, http://www.ambiente.sp.gov.br/aguas-subterraneas/aquifero-guarani/.

40 Environmental Company of the State of Sao Paulo (*Companhia Ambiental do Estado de Sao Paulo* - CETESB), Groundwater, http://aguassubterraneas.cetesb.sp.gov.br.

41 SABESP, artesian wells, http://site.sabesp.com.br/site/interna/Default.aspx?secaoId=104.

42 The National Water Resources Policy and the National System of Water Resources Management was created by the Federal Law (*Lei Federal nº 9.433, de 8 de janeiro de 1997*), which regulates the Art. 21, section XIX of the Federal Constitution.

43 *AgRg no AgRg no REsp 1185670/RS, Rel. Min. Benedito Gonçalves, Primeira Turma, DJe 6.9.2011*.

legislation (*Lei Estadual nº 6.134, de 02 de junho de 1988*), establishing some provisions regarding groundwater. This law considered groundwater to be every natural or artificial water underground that could be extracted or used by man. It said that government will institute when needed areas to protect extraction sites of groundwater in order to preserve and conserve groundwater resources. However, State Water Resource Management was established only in 1991, through a state law (*Lei Estadual nº 7.663, 30 de dezembro de 1991)*. This law institutes as a principle, a decentralized and integrated water management. It establishes as a quantitative and qualitative instrument of groundwater use control, the granting of use rights and it reaffirms that permanent programs shall be developed in order to conserve and protect groundwater against pollution and overexploitation. In addition, this law establishes that pumping groundwater without proper authorization is a violation of water usage and management and can be penalized (Art. 03, 04, 11 and 12).

The state of Sao Paulo has extensive groundwater regulation. This regulation, though, is not recent. In fact, it is fundamental that legislation be effectively implemented. Despite all of the legislation, groundwater has not been seen as an effective alternative to water crisis. There were no regulations enacted after this current water crisis nor were new measures regarding groundwater implemented.

B. Public Administration

The Supreme Court affirms that a specific authorization (granting) for pumping groundwater is mandatory[44]. The granting of rights of water resources use and management is an administrative act, whereby the Government provides the right of water user for a time, purpose and condition expressed in the relevant act. This act is an instrument of the State Water Resources Policy (State Law no 7.663, December 31, 1991). In the State of Sao Paulo, the organ responsible for conceiving this specific authorization is the Department of Water and Power (known as DAEE)[45]. DAEE is the body that grants concession rights to water users in the state of Sao Paulo according to water availability, water quality, and in accordance with its provisions. Anyone who intends to implement a building that demands water resources (surface water or groundwater) shall require prior approval of DAEE[46]. Groundwater extraction is directly related to a specific authorization, which is issued by DAEE in a form of "Granting Application for Use of Water Resources Law". DAEE also has many technical provisions that establish provisions regarding groundwater resources (for example, to grant new uses, regulate the existing ones, expand and renovate as well as deactivate the uses already granted, it is necessary to follow the requirements of the Technical Instruction DPO - No. 006 DAEE).

Controlling groundwater extraction is very difficult, in part because users know that it is difficult for agencies to identify each drilling and control the amount of water withdrawn (when an aquifer is overexploited, its capture overrides its recharge capacity, reducing water quantity). Moreover, there is a serious issue related to illegal drilling of wells, many of which are clandestine and take place without public control and appropriate technologies, interfering in the quality of water. In addition to that, it is relevant to consider the effectiveness of this supervisory body's provisions, since some state procedures are very slow.

---

44 *AgRg no AREsp 263253 / RS 2012/0251336-0, Relator(a) Ministra Regina Helena Costa, data do julgamento 21/05/2015, data da publicação DJe 15/06/2015.*

45 See at http://www.daee.sp.gov.br/index.php?option=com_content&view=article&id=68%3Aoutorgas&catid=41%3Aoutorga&Itemid=30.

46 *Lei Estadual nº 7663, de 31 de dezembro de 1991 - Artigo 9.*

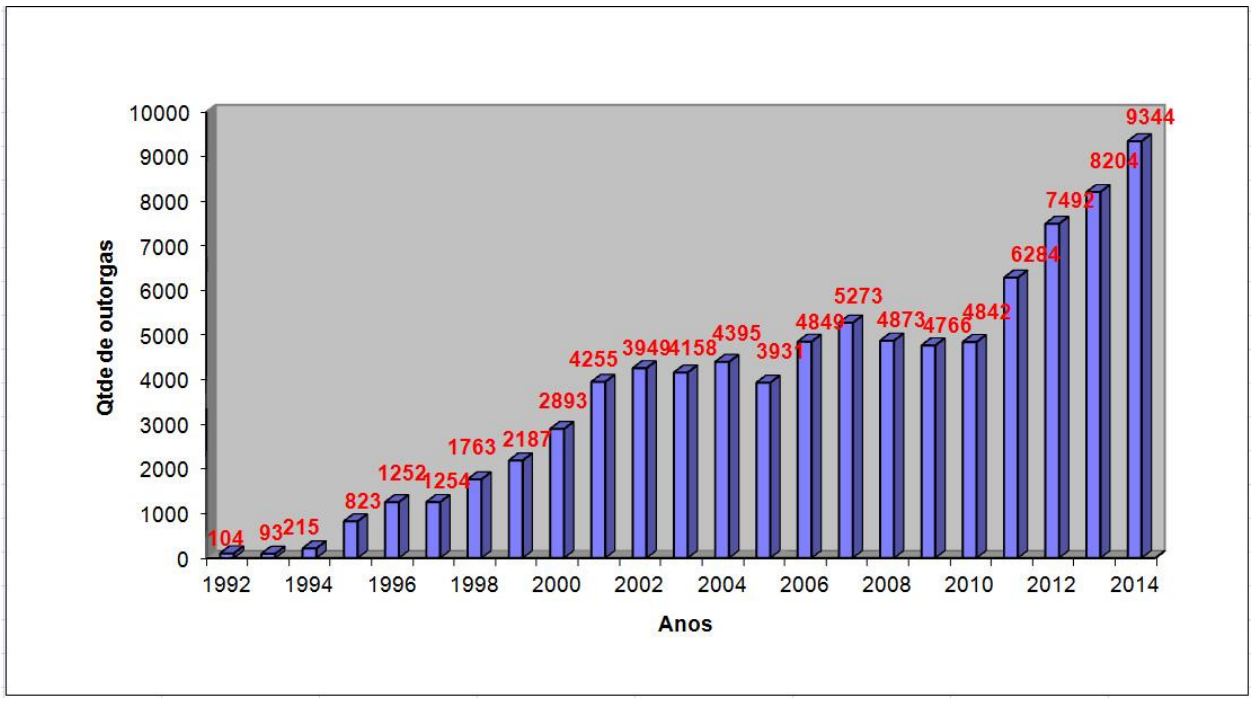
V. COMPARISON BETWEEN GROUNDWATER LEGISLATION: CA/ SP

The foregoing analysis has shown that both states, California and Sao Paulo, have regulations regarding groundwater management. Sao Paulo's legislation is not recent whilst California enacted a groundwater act right after the severe drought that took place last year, as a measure to mitigate the water crisis.

In both legislations, states delegated power to agencies or public bodies. In California's legislation, however, groundwater management is delegated to local agencies with guidelines and funding provided for agencies to create groundwater management plans. Agencies have a timeline to achieve sustainable groundwater management and if they fail to manage groundwater in a sustainable manner, then the state can intervene until they are able to manage it properly. The SMGA was an important step towards groundwater management regulation in California, since the focus is sustainable management. Nevertheless, there are some points in this regulation that could be developed. For instance, there seem to be no provisions allowing the public to sue a local agency or the state if there is a failure to successfully implement a groundwater sustainability plan. Moreover, regarding "undesirable results" mentioned in the act, the regulation does not require agencies to address undesirable results occurred before January 2015, limiting the possibility to reverse the causes of these negative effects[47]. Besides, California regulation only requires to agencies to establish a plan to manage groundwater but does not requires mandatory grants for groundwater extraction.

In Sao Paulo, the public organ responsible for granting groundwater extraction is also the one that provides regulation, technical provisions as well as the one that supervises the whole procedure. There is no state intervention if the body fails in complying with its responsibilities. Moreover, likewise in all environmental field, the legislation is vast. The issue is not the lack of regulation but the lack of its effectiveness. There were no improvements in the current legislation after water crisis took place. In addition to that, it is important to consider that Sao Paulo has a significant amount of water in aquifers but since the water crisis has been announced, no action was taken in order to improve the Greater Sao Paulo's groundwater supply. On the other hand, the main intervention to mitigate the water crisis implemented by the government was the building to interconnect two of the main surface water systems of Sao Paulo. Despite the fact that Sao Paulo's government has not seen groundwater as solution to water crisis, the number of grants considerably increased in these past years (as demonstrated in the figure below), which seems to be a reflection of water crisis, demonstrating the lack of vision in the public policies regarding groundwater.

[47] See at SGMA 10727.2. Required Plan Elements (b) (4).



The central issue, however, is not the lack of laws and regulation but the lack of strong public policies. Nevertheless, in order to reach concrete results, all of those regulations should be effectively implemented and their procedures should be strongly supervised.

5.1 How Does Climate Change Affect Groundwater Regulation?

Climate change affects all aspects of the hydrologic cycle[48], which can lead to more or less rain, higher evaporation rates, or more melting snowpack. Reservoirs will be not able to accommodate these changes and maintain their levels for water supplies. Groundwater supplies may also decrease. And all of that can impair water quality for consumption. The effects of climate change are difficult to predict, due to its uncertainty. However, climate change has substantially increased the overall likelihood of drought, interfering, consequently, in the demand for water.[49] Climate change, therefore, is an ultimate challenge in order to establish adequate water supplies management.

---

48 Alavian, Vahid & others. Water and climate change: understanding the risks and making climate-smart investment decisions. Washington, DC: World Bank (2009), p. 9/10.

49 "For example, as the lower atmosphere becomes warmer, evaporation rates will increase, resulting in an increase in the amount of moisture circulating throughout the troposphere (lower atmosphere). An observed consequence of higher water vapor concentrations is the increased frequency of intense precipitation events, mainly over land areas. Furthermore, because of warmer temperatures, more precipitation is falling as rain rather than snow. In parts of the Northern Hemisphere, an earlier arrival of spring-like conditions is leading to earlier peaks in snowmelt and resulting river flows. As a consequence, seasons with the highest water demand, typically summer and fall, are being impacted by a reduced availability of fresh water. Warmer temperatures have led to increased drying of the land surface in some areas, with the effect of an increased incidence and severity of drought." The Water Cycle and Climate Change, http://earthobservatory.nasa.gov/Features/Water/page3.php.

Thus, it is necessary to accommodate climate change effects in water supplies management. Both subjects have to be integrated not only in legislation but also in public policies. Water management regulation should consider climate change effects and the uncertainty of these effects to provide effective regulation. Otherwise, water management provisions will not reach their goal. They will not be able to reach sustainable water management nor will they avert the water crisis.

However, the current legislation, neither in California nor in Sao Paulo, is dealing with these two issues – climate change and water management – together. California took a first step forward with this new groundwater regulation, since it considers "undesirable results" in order to establish plans of management and reach the goal of groundwater sustainability management. The legislation also mentions climate change as a negative factor that needs to be considered in order to "recalibrate and reconcile surface water and groundwater management strategies."[50] These provisions need to be concretely considered. Sao Paulo, in its turn, has a State Policy of Climate Change[51] since 2009 and this specific legislation states the importance of the multiple uses of water that need to be protected, in order to have a shared and rational water management. Nonetheless, this legislation and groundwater legislation do not seem to be integrated in practice, especially because the public organs that work with these two subjects are different, which demonstrates that public policies are not working with these issues in an integrated manner.

Both states have to develop water policies that could be adapted to climate change. Water policies and climate change policies cannot be apart; they have to be integrated. Moreover, in order to deal with climate change effects, it is necessary to improve coordination of water storage in surface reservoirs and groundwater basins (for example, favoring the movement of water from reservoirs into groundwater basins during wet years for use during drought). An integrated system of surface water and groundwater that considers the effects of climate change is the ideal scenario.

VI. CONCLUSION

Groundwater is an important freshwater resource and caring for its availability, access and quality should take the priority. Considering that the water crisis has many elements (natural, social, political), an integrated water management system (surface and groundwater) that considers climate change effects is needed.

Governments of both places, California and Sao Paulo, do not seem to have had a strategic or long-term vision yet, since these subjects (water crisis and climate change) are treated in a segregated manner. The intersection between climate change and water, in practice does not exist in legislation and public policies. However, to deal with the water crisis is necessary to have an effective water management policy that considers climate change effects. Until now, California and Sao Paulo have demonstrated only a few steps towards this ideal scenario. Public policies and regulation need to continue being improved; current regulations need to be effectively implemented. They also need to integrate both policies – water management (considering surface water and groundwater) and climate change to have feasible results and to really reach the goal of sustainability.

---

50 "Sustainable groundwater management in California depends upon creating more opportunities for robust conjunctive management of surface water and groundwater resources. Climate change will intensify the need to recalibrate and reconcile surface water and groundwater management strategies.", SGMA, Uncodified Findings (a) (11), p. 2.

51 *Lei Estadual nº 13.798, de 9 de novembro de 2009.*

BIBLIOGRAPHY:

1. Alavian, Vahid & others. Water and climate change: understanding the risks and making climate-smart investment decisions. Washington, DC: World Bank (2009), http://documents.worldbank.org/curated/en/2009/11/11717870/water-climate-change-understanding-risks-making-climate-smart-investment-decisions.

2. Aquífero Guarani, http://www.ambiente.sp.gov.br/aguas-subterraneas/aquifero-guarani/.

3. Brazilian State Laws of Groundwater, http://www.ambiente.sp.gov.br/aquiferos/legislacao/

4. California Constitution, Article 10 Water， Sec. 2.

5. California's Public Trust Doctrine, http://www.envirolaw.org/documents/ScottFAQ.pdf.

6. Chess: Crise Hídrica, Estratégia e Soluções da SABESP para a Região Metropolitana de São Paulo, http://site.sabesp.com.br/site/uploads/file/crisehidrica/chess_crise_hidrica.pdf.

7. Climate Change and Water PPIC Water Policy Center, Climate Change Will Affect California Water management in many Ways, April 2015.

8. David G. Victor, Paulo Almeida, Linda Wong, Water Management Policy in Brazil, Laboratory on International Law and Regulation (ILAR), University of California, San Diego, ILAR Working Paper, March 2015.

9. Environmental Company of the State of Sao Paulo (*Companhia Ambiental do Estado de Sao Paulo* - CETESB), Groundwater, http://aguassubterraneas.cetesb.sp.gov.br

10. Environmental Law Foundation, et al. v. State Water Resources Control Bd., et al., No. 34-2010-80000583 (Cal. Super. Ct. July 14, 2014).

11. Francis Priscilla Vargas Hager & Marcelo Lopes D'almeida: Legislação Aplicada Às Águas Subterrâneas (2008), http://aguassubterraneas.abas.org/asubterraneas/article/view/23747

12. How much water is there on, in, and above the Earth?, http://water.usgs.gov/edu/earthwherewater.html

13. José Eduardo Cavalcanti Publicado, O aproveitamento do volume morto do Cantareira, (11 de março de 2014), http://www.institutodeengenharia.org.br/site/noticias/print/id_sessao/70/id_colunista/4/id_noticia/8432

14. Juliet Christian-Smith & Kristyn Abhold: Measuring What Matters Setting Measurable Objectives to Achieve Sustainable Groundwater Management in California (2015).

15. Light v. State Water Res. Control Bd., 226 Cal. App. 4th 1463, 1476 (2014).

16. Linking climate change and water resources: impacts and responses, https://www.ipcc.ch/pdf/technical-papers/ccw/chapter3.pdf.

17. Mara Aikie Iritani & Sibele Izaki: As Águas Subterrâneas no Estado de São Paulo (*Groundwaters in the State of Sao Paulo*). Governo do Estado de São Paulo, Secretaria do Meio Ambiente e Instituto Geológico. São Paulo (2009).

18. National Audubon Society v. Superior Court ("Mono Lake") (33 Cal.3d 419 1983).

19. Philip Womble and Richard Griffin, Two Interactions Between California's Sustainable Groundwater Management Act and the Public Trust Doctrine, https://journals.law.stanford.edu/stanford-environmental-law-journal-elj/blog/two-interactions-between-californias-sustainable-groundwater-management-act-and-public-trust.

20. Richard M. Frank: The Public Trust Doctrine: Assessing Its Recent Past & Charting Its Future, http://lawreview.law.ucdavis.edu/issues/45/3/Topic/45-3_Frank.pdf.

21. Plater, et al, Environmental Law and Policy: Nature, Law and Society, (Aspen; 4th Ed.)

22. SABESP, artesian wells, http://site.sabesp.com.br/site/interna/Default.aspx?secaoId=104.

23. Sabrina Mac Fadden, Captação de Águas Subterrâneas no Estado de São Paulo, http://www.unimep.br/phpg/mostraacademica/anais/6mostra/5/371.pdf.

24. State conferment, http://www.daee.sp.gov.br/index.php?option=com_content&view=article&id=68%3Aoutorgas&catid=41%3Aoutorga&Itemid=30.

25. State agency supplier, http://site.sabesp.com.br/site/interna/Default.aspx?secaoId=321.

26. Sustainable Groundwater Management Act (2014)

27. The United Nations World Water Development Report 2014. Water and Energy. Volume I, http://unesdoc.unesco.org/images/0022/002257/225741E.pdf

28. The United Nations World Water Development Report 2015. Water for a sustainable World, http://unesdoc.unesco.org/images/0023/002318/231823E.pdf.

29. Water Conditions, http://water.ca.gov/waterconditions/news-archive.cfm.

30. Water, Water and Climate Change, http://water.worldbank.org/topics/water-resources-management/water-and-climate-change, ©2015 The World Bank Group.

31. "Where is Earth's Water?", U.S. Department of the Interior | U.S. Geological Survey, http://water.usgs.gov/edu/earthwherewater.html (07 August, 2015)

32. William R. Attwater & James Markle: Overview of California Water Rights and Water Quality Law, 19 PAC. L.J. 957, 979 (1988).

33. 2012 United Nations (UN) Conference on Sustainable Development (Rio+20), The Future We Want, http://www.un.org/en/sustainablefuture.