VALMIR DE ALBUQUERQUE PEDROSA

RESOLVING WATER CONFLICTS

2017

SUMÁRIO

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In March 2016 I carried out a training program on water conflicts for the São Francisco River Basin Committee (CBHSF) organized by PEIXEVIVO Basin (AGBPEIXEVIVO). I would like to thank CBHSF and AGBPEIXEVIVO for the authorization to use in the book part of the material produced for the training.

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Vitória, January 2017.

For my wife Mayumi and our sons Leonardo and Tiago.

SUMÁRIO

FOREWORD

In this valuable work professor Valmir Pedrosa entrusts us with his experience and methodology to mediate water conflicts aiming at the construction of peaceful cohabitation agreements.

The shared use of water in fair quantity and quality is something that must be in the agenda of all managers – being them public, private or from the third sector. Most world class companies have already understood that this utility, which used to be plentiful and disregarded in strategy rounds, has shown for some time now signs of scarcity, be it for availability reduction, demographic and populational growth, or the unfortunate contamination of water springs which used to be or could have been a supply source for sustainable development.

Analysing the current water crisis that Brazil is facing, we were able to assess the importance this resource has to the society and its impact on the value chain of a company. It is no use to look for an independent solution for the businesses if the whole chain – from suppliers to the end client, and including the workers – do not have access to water.

The River Basin Committees have a significant role in this process, ensuring the management of water resources through a decentralized and participative representation between the government, users and the civil society. Their work ensures the construction and approval of River Basin Resources Plans, reasonable use, conservation, conflict mediation of water conflicts and the establishment of values and mechanisms to charge for the use, among other things.

The steel producer - ArcelorMittal Tubarão – located in Serra, Espírito Santo, is a company that has the search for the reasonable use of freshwater ingrained in its business premises. The initial design of the company considered the large-scale use of sea water – currently above 95% - as a premise which was established and implemented in the high temperature steel production processes. The high freshwater reuse level currently reaches impressive 97.4%. The company tries to reuse basically all industrial waste including all the sewage treated in the plant and rainwater. In 2014, the unit launched a robust Water Master Plan, aiming to guide all its actions and strategies in the search for reducing consumption in processes, maximizing reuse

and identifying new alternative sources. Studies focused on seawater desalinization, treated household sewage waste water reuse, and groundwater use are some of the actions unfolded from this Master Plan. During the water crisis, the answer of the company was fast and included solid solutions which made it possible for the company to reduce water consumption from the local water/sewage treatment supplier (Cesan) in 49%. By adopting sustainable solutions to ensure processes stability, the company kept its water consumption practically unaltered even after the end of the water rationing imposed by the state government.

ArcelorMittal Tubarão guides its work by the principle of institutional co-responsibility placing itself as part of the social fabric, engaged in strengthening and boosting the sustainable development aiming at creating an ideal scenario of justice, peace and equality.

Water Management at ArcelorMittal Tubarão will remain an integral part of the central strategy based on the 10 assumptions for sustainable development of the ArcelorMittal Group aiming at making it possible to build a more sustainable future.

Well, this is one of several successful examples of reasonable management of water. I hope you all enjoy the reading and that this publication becomes a source for many researches that contribute to the preservation of such important natural resource and, mainly, to the environmental education of the readers.

Another legacy of Professor Valmir Pedrosa to the future generations and of which we are proud to be part.

Jorge Luiz Ribeiro de Oliveira

ArcelorMittal South America Flat Carbon Segment Operations Vice-president

1.

THE NEED TO HAVE AGREEMENTS FOR WATER USE

The studies on the nature of water conflicts come from my work in the university, government agencies and private companies, and in the river basin committees I have been involved with in the last 20 years. The water resources sector is the repository of endless conflict situations. Fortunately, great efforts have been made to create agreements among those sharing the same water.

This text was written to be an introductory book on the subject, aiming to raise readers willingness to learn more about the nature of water conflicts as well as the mechanisms to overcome them.

Instead of relying on the legal system to search for a solution to impasses regarding water use, more frequent each day, the Brazilian society has increased the search for alternative mechanisms for conflict solution.

This search is in line with the recent text of the Civil Processing Code (CPC).

The new Civil Processing Code (CPC) authorized by Federal Law n.13.105 of March 16th, 2015 makes provisions that the state shall promote as much as possible a consensual solution for conflicts. Article 3 establishes that conciliation, mediations and other methods of consensual solution for conflicts shall be encourage by judges, lawyers, public defenders and member of the Public Ministry including during judicial processes.

In the same lines, Federal Law n.13.140 of June 26th, 2015 makes provisions on mediation between private entities as a way to solve controversies and on the self-composing of conflicts regarding the public administration. In article 2, it is established that mediation will be guided by the following principles:

I – impartiality of the mediator;
II – isonomy between the parties;
III - orality;
IV - informality;
V – party autonomy of will;
VI – search for consensus;
VII – confidentiality;
VIII – good faith.

The National Council for Justice (access on July 20th, 2016) defined the difference between conciliation and mediation. "**Mediation** is a way to solve conflicts in which a neutral and impartial third person facilitates the dialogue between the parties so that they can build the best solution for the problem with autonomy and solidarity. As a rule, it is used in multidimensional or complex conflicts. Mediation is a structured process, has no defined deadline, and can end in agreement, or not, because the parties have the autonomy to search solutions compatible with their interests and needs".

Whereas **conciliation** "is a method used in simpler, or restrict, conflicts in which the third person or facilitator can adopt a more active, but neutral and impartial, position

regarding the conflict. It is a short consensual process which searches for an effective social harmonization and restoration within possible limits of the social parties' relationship" (NATIONAL COUNCIL FOR JUSTICE, access on July 20th, 2016).

And to conclude the discussion, the National Council for Justice (access on July 20th, 2016) affirms that "both techniques are guided by principles such as informality, simplicity, processing economy, speed, orality, and processing flexibility".

There is a very recent example of the search for an agreement in a water and environmental conflict. In November 2015, a gigantic environmental tragedy mobilized the attention of the Brazilian population: the breaking of a dam from the company Samarco in the town of Mariana, MG caused a huge disaster in the Doce River. The images were broadcast all over Brazil and the world. From the location of the dam in Minas Gerais to the mouth of the river in the Atlantic Ocean on the coast of Espírito Santo, the damage was visible and shocking. Two months after the tragedy there was a meeting in Palacio do Planalto, Brazilian federal government headquarters, in Brasília, with the President of Brazil, the governors of Minas Gerais and Espírito Santo, the Federal Prosecutor, the Environment Minister and the President of **Vale** – **Samarco**'s shareholder together with **BHP Billiton**. The Environment Minister – Izabella Teixeira, and the Federal Prosecutor summarized the meeting to the press on January 18th, 2016 (apud MATOSO, 2016) as follows:

> *"Our meeting focused on the necessary steps to start the recovery of the Doce River basin. […] The idea is the possibility of an agreement with the companies mentioned in the civil suit aiming at the basin recovery program. The meeting had a positive outcome, the dialogue between the authorities, and after that we had a committee meeting with Dr Murilo Ferreira, president of Vale. There is an interest on the part of the companies to make a transparent legal agreement including requirements to recover the basin. After that, Izabella Teixeira added that the agreement was not closed yet and, therefore, the government and Samarco want to find a way to recover the river instead of having a legal battle. We do not want a legal battle that will go on endlessly. The Federal Prosecutor highlighted that the conditions for this possible agreement are not settled yet. '… he said that he was not announcing the agreement, but stating Samarco's interest in reaching one".*

A few weeks later, on March 2nd, 2016 in a ceremony in the Palacio do Planalto, the Federal Government through the Federal Prosecutors' Office and the Environment Ministry, the Governors of Minas Gerais and Espírito Santo and Samarco signed the Conduct Adjustment Agreement (TAC) aiming to fully recover the Doce River basin.

Investments of R$20 billion over a period of 10 years were announced regarding the actions to fully recover the social, economic and environmental damages in the basin area. From this total, R$4.4 billion will be deposited by Samarco by 2018 to the bank account of a foundation created to coordinate recovery actions. At the time of the public session to announce the agreement the president of Brazil said:

> *"...the parties were able to establish a convergence of interest in defence of the common good, not making use of legal actions which speeds up the facing of the challenges posed by the environmental disaster. More importantly, we conciliated speed with the certainty that no right will be disrespected, no repairing will be forgotten, and all responsibilities will be taken" (BRASIL, 2016).*

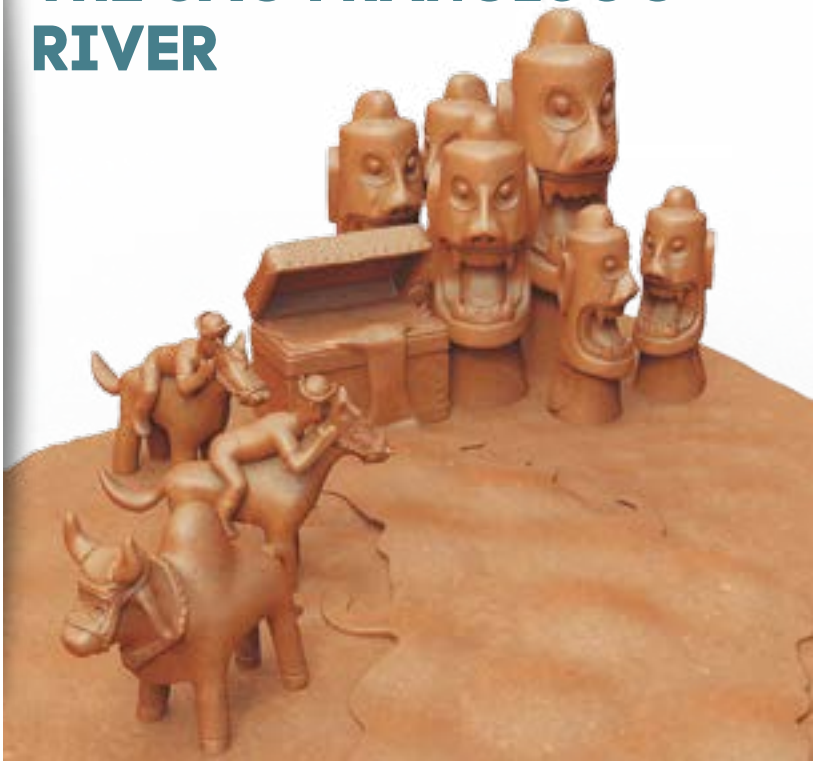
In the site of the Doce River Basin Committee (CBH-Doce) we can read that the president of the committee, Leonardo Deptulski, took part in the event and highlighted the importance of the basin committee supervising this agreement: "The role of the committee increases with the agreement as the committee had a very participative leading role in the construction of programs and actions" (DEPTULSKI, 2016).

Without the willingness of the parties for an agreement, which would be the celerity to resolve the matter during a legal process? In this search for building agreements, the essence of this text is to help the process of resolving controversies related to water resources as provided by Federal Law n.13.105/2015 and under the provisions of Federal Law n. 9.433/1997 which created the National Water Resources Policy and the National Water Resources Management System.

Similarly, this text presents a validated method formed by a set of coordinated actions to work on a resolution for water conflict within the river basin committees, or committees of other nature which face water conflicts. Throughout the text, the variation of the nature of the committees will be further detailed.

2.

THE NATURE OF WATER CONFLICTS: THE SÃO FRANCISCO RIVER



The search for agreements to decrease water conflicts requires to understand the clear nature of the dispute. The best way to explain it would be using a real example of a Brazilian river which crosses several states and whose use of water had nationwide consequences. It would be good that practically all possible uses of the water were included – sanitation services for the cities, irrigation, industry, mining, power generation, tourism, artisanal fishing and fish farming, preservation of river mouth ecosystem, among others, including the transposition of its waters. Regarding the amount of water offered, it would be interesting to analyse a river in which a recent scarcity made it possible to assess the effectiveness of the response to this scenario. It would also be enrichening to choose a river with a relevant amount of water network

infrastructure installed, as well as the presence of all instruments of the National Policy and all the parties forming the National Water Resources Management System. Besides that, it would be educational to detail a case with unquestionable need for an integrated management of surface water, ground water and costal water.

Well, this is precisely the case of the São Francisco River – the river of national unit. Besides what has been detailed above, this river has strong historical components, an old and expressive cultural richness and artistic traditions, and the exuberant presence of several biomes – the cerrado, the caatinga, the Atlantic forest – and ecosystems – estuaries, lagoons, lakes, veredas, and others.

For this reason, the case of the São Francisco River was chosen to perfectly exemplify the nature of the water conflict – the central theme of this book. The notable facts regarding these waters are ancient.

Avé-Lallemant (1980, p. 275), in his book called *Viagens pelas províncias da Bahia, Pernambuco, Alagoas e Sergipe*, describes that he was sailing in the middle of the ocean across from the mouth of the São Francisco river in 1859, when at a "ten-fathom depth, a bucket was filled with turbid water. It was almost fresh water really... Large rivers carry their waters far beyond their margins can be seen from the sea".

This trip took place in the same year the emperor D. Pedro II visited the Paulo Afonso waterfalls in Bahia navigating from the river mouth to the town of Piranhas (AL) and from there on horseback to the final destination. Among other promises made by the emperor, in 1867 the commercial navigation of the lower São Francisco river was launched connecting the town of Piranhas and the river mouth.

Since then, serious water conflicts have arisen in the São Francisco river basin. Considering the demand, there has been increasing consumption of water to serve the urban areas, promote irrigated agricultural activities, ensure power generation, guarantee navigation, boost tourism, develop fishing, preserve the fauna and flora, among others. Considering the offer, there has been a progressive unavailability of water because of pollution, there has been degradation of river springs and margins and increasing deforestation, all that contributing to diminishing average discharge availability for use.

The worldly debated phenomenon of global warming can also be another threat, broadening water conflicts by intensifying and increasing the frequency of water extremes such as prolonged droughts.

In the CBHSF (São Francisco River Basin Committee) webpage it is written that the "São Francisco river basin encompasses a catchment area of 639,219 km2 (7.5% of the country) and an average discharge of 2,850 m³/s (2% of the country total). The São Francisco river is 2,700 km long and its spring is located at the Canastra Mountains in Minas Gerais, the river flows northwards through Bahia and Pernambuco where it alters its course eastwards reaching the Atlantic Ocean through the border of Alagoas and Sergipe. The basin encompasses seven states – Bahia (48.2%), Minas Gerais (36.8%), Pernambuco (10.9%), Alagoas (2.2%), Sergipe (1.2%), Goiás (0.5%), and the Distrito Federal (0.2%) – and 507 municipalities (approximately 9% of all municipalities in the country)" (A BACIA..., access on July 2nd, 2016). Picture 1 illustrates the portions of the states within the basin.

Despite its average discharge, because of the severe drought of the last five years, discharge at the river mouth in January 2017 was at 700 m³/s. This level of discharge paralyzed commercial navigation in some stretches of the river, reduced power generation, diminished effective irrigation area in certain parts of the basin and made it possible for saltwater intrusion to reach the town of Piaçabuçu, in Alagoas. Besides that, tapping river water for sanitation companies was altered to continue the offtake, among other effects.

To exemplify the severity of water conflict and irrigated agriculture expansion, according to AIBA (Bahia Irrigation Association) website in June 2016, the farmers "decided to suspend irrigation in more than fifty per cent of the irrigated area because they were concerned about the low discharge of the rivers supplying the west of Bahia. This means that 72 thousand out of 120 thousand of irrigated hectares had their irrigation equipment turned off" (AGRICULTORES..., 2016).

During the same crisis, the Nilo Coelho Irrigation District located in Petrolina (PE), 23 thousand irrigated hectares, informed all users in September 2015 that "because of the forecast of more severe low levels at the Sobradinho dam, it would adopt an operation regime of rationing starting on October 26th, 2015 when Sobradinho would reach a 5.14% volume" (NOTE..., 2015).

Picture 1. Map of the São Francisco River

Source: Map... (access on July 4, 2016).
Note: Map redrawn and simplified by the author.

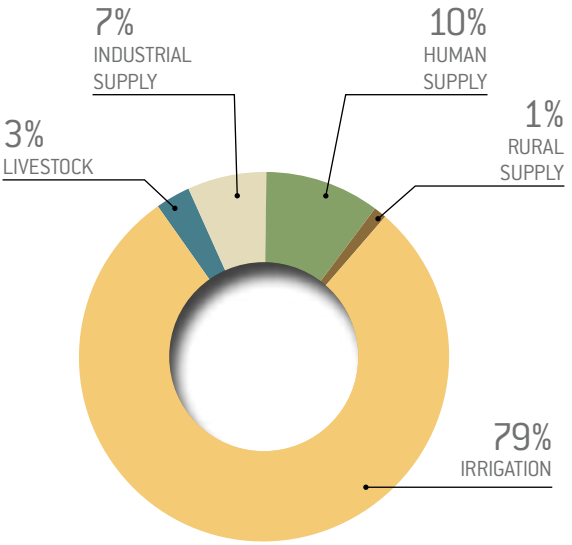
In September 2016, the CBHSF approved the São Francisco River Basin Water Resources ten-year plan for the period 2016-2025 with the support of the AGBPeixeVivo (Peixe Vivo River Basin Management Support Executive Association). Taken from the plan, tables 1 and 2 present the evolution of water demands and its distribution per user sector (SÃO FRANCISCO RIVER BASIN COMMITTEE, 2015). In table 1 it is possible to see that consumption for the irrigation sector jumped from 114 m³/s in 2000 to 244.4 in

2013. In general, withdrawls jumped from 165.8 m³/s in 2000, to 309.4 m³/s in 2010, an 87% increase over a 10-year period.

TABLE 1. Water demands by user sector (m³/s) in the São Francisco river

User Sector	2000	2006	2010
Human supply	26	27.3	31.3
Rural supply	3.8	3.7	3.7
Irrigation	114	123.3	244.4(2013)
Livestock	6.7	9.1	10.2
Industrial supply	15.3	17.4	19.8
Total	**165.8**	**180.8**	**309.4**

This distribution for 2010 is shown in Picture 2 where one can see that 79% of the offtake discharge is used for irrigation. The expressive participation of irrigation over water demands is a repeated fact, with slight variations, in countries that have an agricultural vocation.



Picture 2. Water consump distribution per user sector in the São Francisco river

Table 2 shows offtake discharge divided by user sector and surface or ground water source. It is possible to see that offtake from groundwater represent 10% of the offtake.

TABLE 2. Consumption (m^3/s) by consumptive use in the São Francisco river

User Sector	Total	Surface	Groundwater
Human supply	31.31	27.18	4.12
Rural supply	3.71	0	3.71
Irrigation	244.38	233.83	10.55
Livestock	10.10	1.86	9.02
Industrial supply	19.81	15.59	4.22
Total	**309.44**	**277.80**	**31.64**

Concerned with the advance of water demands and keeping in mind the indissoluble relationship between surface and ground water, professor Tomaz Patrocínio (from the Campina Grande Federal University-UFCG) in his communication to the electronic management list of the ABRH (Brazilian Water Resources Association) dated August 13th, 2015, warned that *"the regularization discharge* of Três Marias and Sobradinho reservoirs are not estimated anymore in the works of Freitas & Gondim Filho (2004) because the exploration of groundwater from the São Francisco Aquifer through deep wells used for irrigation has been excessive rendering the base flow impossible. The baseflow is responsible for almost 50% of the intake discharge of said reservoirs. They are even lower than the estimates using risk aversion curves precisely because they do not consider the origin of the input to the average monthly discharges, based on which the regularization discharges are calculated. They are changing the regime of the rivers in the basin some of them are not perennial any more" (PATROCÍNIO, 2015).

In times of water crisis as the one taking place in the São Francisco River (RSF) it is even more important to emphasize the indissoluble relationship between surface and ground waters. In the case of the São Francisco river this example can be highlighted by the Urucaia aquifer. According to studies of the National Water Agency "the average contribution of Urucaia to form the RSF baseflow in a period of drought is 80% using the Sobradinho Dam as reference. There are studies pointing that it can reach up to 90%. The Urucaia system practically maintain the São Francisco river during a drought period. The Bambuí aquifer is also responsible for the formation of the discharges in periods of no rain, forming the discharges of the Grande River as well as being the source of water for the town of Sete Lagoas" (VIDA..., 2015).

There is a consensus between the states of Bahia and Minas Gerais that there are too many authorized wells and that a more intense inspection is decisive to get to know the amount of water extracted from these aquifers so important to the São Francisco river basin.

The Urucuia aquifer is located on the west of Bahia where there are large irrigation projects in the cities of Barreiras, São Desidério and Luís Eduardo Magalhães. The connection between surface and ground waters is located in the area of the Grande, Corrente and Carinhanha rivers where there are several cases of conflicts. The aquifer potential is high, there are wells that can supply up to 600 m3 per hour, a discharge able to meet the need of a city with 90 thousand with 150 litres per person per day.

During the preparation of the Water Resources Plan in 2013 the CBHSF carried out an event called **Multiple Uses of São Francisco River Water Workshop** (SÃO FRANCISCO RIVER BASIN COMMITTEE, 2013a, b) with activities in the cities of Paulo Afonso (BA), Penedo (AL), Barreiras (BA), Juazeiro (BA) and Três Marias (MG). The goal of the workshops was to provide CBHSF with information that would subsidize the construction of the text to deliberate on the multiple uses of the São Francisco River water. Chart 1 below summarizes the conflicts caused by the multiple uses highlighted in the workshops for each one of the cities above.

Paulo Afonso	Penedo	Juazeiro	Barreiras	Três Marias
Hydroelectric dam operation vs. Supply offtake (reservoir surroundings)	Hydroelectric dam operation vs. Supply offtake	Hydroelectric dam operation vs. Supply offtake	Hydroelectric dam operation vs. Multiple uses of the riverside population	Hydroelectric dam operation vs. Tourism, sports and leisure (lake surroundings)
Hydroelectric dam operation vs. irrigation offtake and pumping	Hydroelectric dam operation vs. irrigation offtake and pumping	Hydroelectric dam operation vs. irrigation offtake and pumping	Small Hydroelectric Power Stations vs Irrigation	Energy (installation of small hydroelectric power stations) vs. supply and multiple uses of affected communities
Hydroelectric dam operation vs. navigation (vessel draught reduction, sand banks)	Hydroelectric dam operation vs. navigation (vessel draught reduction, sand banks)	Hydroelectric dam operation vs. navigation below Sobradinho (vessel draught reduction, sand banks)	Multiple and indiscriminate uses vs. environmental preservation	Hydroelectric dam operation vs. navigation (waterway effectiveness)
Hydroelectric dam operation vs. Tourism (unpredictable level variation)	Hydroelectric dam operation vs. fishing and fish farming (lack of surrounding and nutrients for fish spawning)	Hydroelectric dam operation vs. fishing and fish farming (fishing in safety areas)	Irrigation offtake dam vs fishing (fish reproduction season)	Lack of basic sanitation vs. water quality for multiple uses

Paulo Afonso	Penedo	Juazeiro	Barreiras	Três Marias
Isolated dams vs. Irrigation and multiple uses (Poço da Cruz)	Hydroelectric dam operation vs. tourism (unpredictable level variation)	Hydroelectric dam operation vs. Tourism (unpredictable level variation)	Irrigation vs multiple uses (indiscriminate use of surface water and pesticide)	Forestry vs. Environmental preservation (spring and waterfall protection)
	Lack of basic sanitation vs. water quality for multiple uses	Mining vs. Human supply vs. irrigation (Caraíba mining company Water Supply System)	Lack of basic sanitation vs. water quality for multiple uses	Multiple uses vs. Environmental preservation of veredas
	Lack of rules to discipline the use (for multiple uses)	Irrigation (unreasonable use of water and excessive use of pesticides) vs. availability and quality of the water for multiple uses		
		Lack of rules to discipline the use (for multiple uses)		

CHART 1. Water conflicts in the SF river

Source: São Francisco River Basin Committee (2013a).
Note: Chart redone by the author.

It is easy to see the diversity of conflicts along the basin. Especially regarding to dam operations and other uses – supply to cities, irrigation, tourism, navigations, fishing and fish farming, mining, water quality, forestry, preservation of veredas, lagoons and estuary ecosystems.

In the report from the consultant Rosana Garjulli, which reported the **Multiple Uses of São Francisco River Water Workshop**, the conflicts were contextualized per stretch as follows (SÃO FRANCISCO RIVER BASIN COMMITTEE, 2013a):

1. *On the stream bed stretches located at the sub medium and low São Francisco there are use conflicts regarding the way the dams are operated to generate power, determined by the System National Operator (ONS) and managed by the CHESF with the other user sectors (human supply, navigation for passengers, loads and fish transport, irrigation, fishing, fish farming, dryland farming, tourism).*

2. *In the medium São Francisco there is the indiscriminate use of Waters (including groundwater) and the inadequate use of the soil through irrigation leading to conflicts with other uses.*

3. *In the high São Francisco there is also conflict between the operation of the Três Marias dam for power generation managed by CEMIG but operating according the*

determinations of the ONS, and the other uses (tourism, sports, leisure, supply, irrigation, navigation, fishing and fish farming).

Besides the abovementioned conflicts, the report highlighted some gaps in the implementation of the water resources management system which should make provisions for multiple uses of water. A summary of these gaps can be seen in chart 2.

Paulo Afonso	Penedo	Juazeiro	Barreiras	Três Marias
Poor communication between CHESF and the riverside communities on the changes of dam operations	Poor communication between CHESF and the riverside communities on the changes of dam operations	Poor communication between CHESF and the riverside communities on the changes of dam operation	Cessation of granted authorization	Poor communication with basin communities on the Codevast actions (lack of knowledge regarding result of delimitation of surrounding lagoons)
Poor management of multiple use reservoirs (out of the main stream)	Weak articulation between the agencies in charge of the management of the electrical system (ONS, ANEL, ANA, IBAMA) and CBHSF	Weak articulation between the agencies in charge of the management of the electrical and the water supply system and CBHSF	Cessation of irrigation and relocation of irrigators of PIMirarós (1,500ha), in Ibipeba, due to water crisis at Manoel Novaes Dam.	Lack of dialogue with the community affected by the construction of PCHs
Articulation of CBHSF with CBHs. Insufficient tributaries, especially regarding charges for the use of water in reservoirs belonging to the federal government	Lack of deeper technical studies on water use conflicts on the river basin and its respective social and economic impacts	Lack of inspection and punishment of offenders for non-compliance with the environmental legislation and water resources	Indiscriminate use of surface water, confirming the depletion of respective riverheads.	Improper use of soil (including the lack of proper road maintenance)
Environmental degradation of the banks of São Francisco river and its tributaries, causing erosion and, as a consequence, silting.	Monitoring and inspection regarding multiple use of the basin are practically inexistent.	Low awareness of the population regarding environmental issues and the correct use of water and soil.	Random and indiscriminate drilling of tube wells	Lack of care regarding conservation of veredas that are significant areas for river recharging.
	Environmental impacts caused by the reduction and/or constant variation of non-recovered discharges for energy generation.	Environmental degradation (extinction of riparian forests, deforestation, incorrect garbage disposal, lack of sanitation)	Discharge reduction of rivers in the region	Lack of coordination between sanitation works carried out by Codevasf and the revitalization resources, but with no guarantee of operation of supply and treatment stations.

CHART 2. Gaps for a management that allows multiple uses of the water

Source: São Francisco River Basin Committee (2013a).
Note: Chart redone by the author.

As this is a text about water conflicts, it is important to highlight the actions stemming from the severe moments in the offer-demand relationship. Historically, it is at critical moments of unbalance in the relationship that important decisions meet the political conditions to be taken. The same is true for other countries.

For example, in California, the large reservoirs and the distribution canals have always been approved after a critical period of drought. In 2015, going through a 5-year period of below average rainfall, the government of California got the political support of the population to prohibit the washing of sidewalks, to allow garden watering only once a week, to compulsorily reduce urban consumption up to 25% (with fines for infractions), to seriously inspect the consumption for irrigation prohibiting non-authorized uses or use above allowed limits, among other measures. And an old debate about the building of a tunnel to take water from the Sacramento River and São Joaquim rivers estuaries towards the state central and south regions. The governors were pushed to take these severe measures by the critical scarcity of water. The same is true for Brazil, certain unpopular but necessary measures are only taken and carried out in times of emergency.

Going back to the case of the São Francisco river, although the offer-demand relationship is already fierce, all states in the basin have irrigation and city supply projects to be implemented. As, for example, is the case of the São Francisco River Integration Project (PISF), which will soon start full operation taking water from the São Francisco River to the states of Pernambuco, Paraíba, Rio Grande do Norte and Ceará. The offtake discharge will vary from 27.4 m3/s to 127 m^3/s conditioned to the amount of water reserved in the Sobradinho lake.

In the basin Water Resources Plan for the 2016-2025 period (SÃO FRANCISCO RIVER BASIN COMMITTEE, 2015) conflict situations have been summarized as follows:

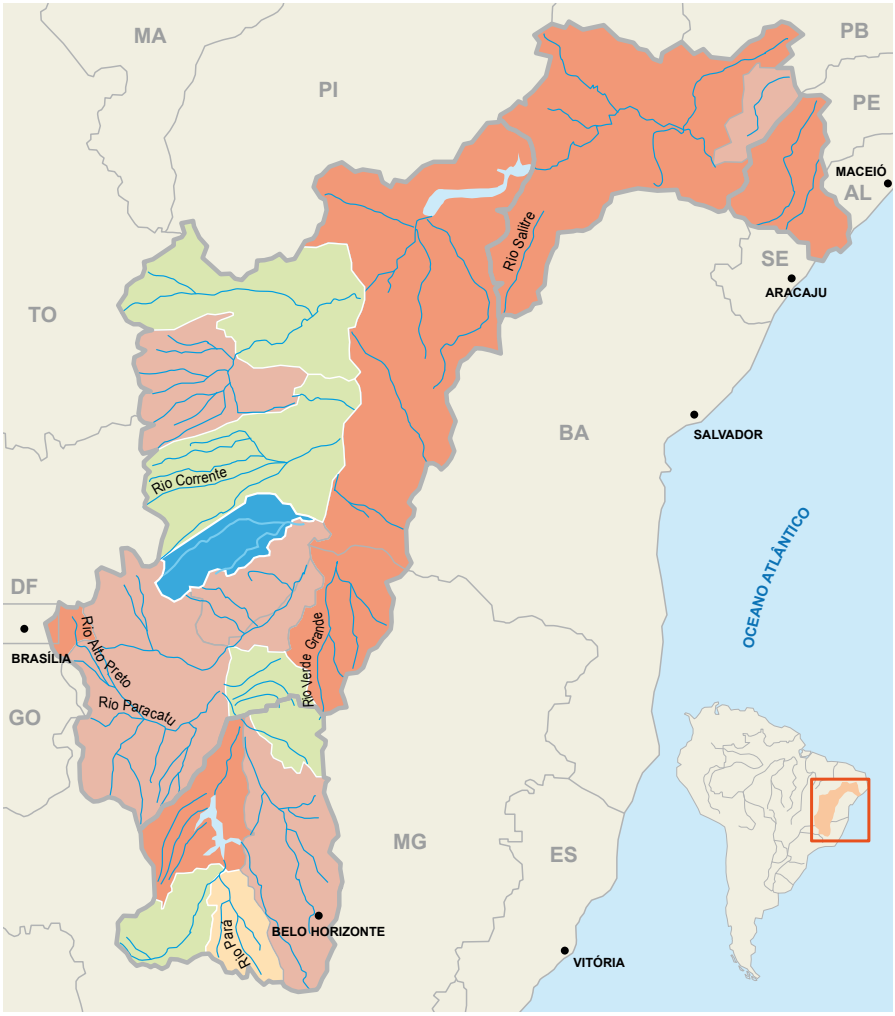
> *"The results of the water balance show that there are cases of over-exploration of available water resources and conflicts over the use of water. The main conflicts result from the difficulty to settle meeting water demands for consumptive uses with the requirements for power generation and the competition for water of the several consumptive uses, irrigation especially because of the water volume required.*

The water uses in the main stream of the São Francisco river basin are conditioned by the hydroelectrical power stations operations. The water volume used in the production of energy is several times higher than the volume required by other consumptive uses.

Picture 3 presents graphically the criticality of the offer-demand relationship, measured as Q95%, 95% of discharge permanence. It is easily seen that the criticality is present along the entire low São Francisco river and in areas of the states of Minas Gerais and Bahia.

Water transport is also affected by water scarcity. Navigation in the São Francisco is as old as its history. However, recent drought years have had a significant impact on this type of transport. As the discharges of the São Francisco river decreased navigation was jeopardized. Commercial transportation was completely halted in July 2014 (CARVALHO, 2014). The ICOFORT company, specialized in the transport of cottonseed explained the situation as: "Our entire production will be transported by road, increasing the damage to the environment, bringing the need to invest in roadways, increasing the risk of accidents and the costs, which will raise final product price between 20% and 30%. Figure 4 illustrates the commercially navigable stretches.

Water conflicts do not take place only in the main stream of the river. There are several conflicts on the tributaries of the São Francisco. In the book ***Velho Chico - A Experiência da Fiscalização Preventiva Integrada na Bahia*** (BAHIA, 2014) there are descriptions of four water conflicts in the rivers of Bahia, all of them tributary of the São Francisco river: i) the case of the Salitre river; ii) the case of the Mirorós dam; iii) the case of the town of Lapão; and iv) conflicts caused by the small hydroelectric power stations (PCH). These cases will be presented next and they are a summary of the information contained in the book mentioned above.



PICTURE 3. Relationship between demand and Q95% at São Francisco river basin

Source: São Francisco River Basin Committee (2015).
Note: Map redrawn and simplified by the author.

PICTURE 4. Commercially navigable stretches along São Francisco river

Source: National Water Agency (2005).
Note: Map redrawn and simplified by the author.

THE CASE OF THE SALITRE RIVER

The Salitre river crosses nine municipalities (Morro do Chapéu, Boca da Madeira, Várzea Nova, Miguel Calmon, Ourolândia, Umburanas, Jacobina, Mirangaba, Campo Formoso and Juazeiro) in Bahia and its mouth is located in the community of Campos dos Cavalos in Juazeiro. Up to the 1970's the river was perennial and its fertile vail supplied vegetables, fruits and greens to several cities. Picture 5 shows the location of the river.

The reason behind the conflict in the Salitre river is the interruption of the water course due to the 35 dams. These reservoirs were built in the 70's, before it was necessary to be granted authorization, and before the need to have a forecast of bottom discharge to maintain a minimum ecological discharge. In order to mitigate the situation, CODEVASF built nine *embankment dams* to make the low Salitre River perennial with the waters from the São Francisco River and thus making the agricultural activities of the Salitre Vail Associations Union possible. This collision of interests between the city and the agricultural sector led to scarcity of water for the cities. In 1970, the government of Bahia and the Juazeiro Town Hall tried to limit the conflict allowing each family to irrigate a maximum of 3 hectares. Not everybody complied with the regulations and as time went by, the conflict increased. In February 1984 it reached its peak with an armed confrontation, which resulted in deaths when the residents turned off the power grid feeding large offtakes. Since then, the situation only got worse.

In March 2010, the Salitre Project was implemented aiming to irrigate 34 thousand hectares. The project reserves 20% of the area for small farmers, each one with 6 hectares. The several requirements to get one of the plots left some of the residents out of the project, *"aggravating even more the water conflict in the area"* (BAHIA, 2014).

In 2011 there were new violent conflicts, some light poles were torn down and wire cut to prevent the large irrigation pumps from working which also affected schools, houses, and medical stations. The remaining quilombola community Lages dos Negros was affected by the conflict, school classes have been suspended and medical stations closed, the commerce collapsed and sometimes even the houses have no electricity. In October 2010, the Salitre River Water Basin Committee required that basin users be registered, which has not happened yet.

So far, despite the actions of the Water Basin Committee and the Public Ministry, "no solution has been found to the problem" (BAHIA, 2014).

PICTURE 5. LOCATION OF SALITRE RIVER

Source: Ighour (access on July 7, 2016).
Note: Map redrawn and simplified by the author.

THE CASE OF THE TOWN OF LAPÃO

Since 2009, large cracks and openings have appeared on the soil of thetown of Lapão. As it is located in a karst area there has been growing concern of new sinkholes. One possible cause of the openings is the elevated amount of water extracted by wells with no compliance with legal requirements. In order to confirm the hypothesis, some studies have been carried out by the São Paulo Technological Institute (IPT) and technicians integrating the Preventive Integrated Inspection (FPI).

In order to side with caution and prevention, the state of Bahia Public Ministry sent recommendations to the Water and Climate Management Instituto (INGÁ), at the time the agency responsible for water management in Bahia, to i) *"stop all processes and refuse to grant new licenses as well as renew existing ones in the municipalities of Irecê and Lapão; ii) update the registration of users in the area so as to detect excessive or uncontrolled uses; and iii) to carry out a detailed inspection of unauthorized users in order to end the use and make these users accountable" (BAHIA, 2014).*

In response, INGÁ suspended the uses of water taken from underground springs from the Juá stream spring to the municipality of Tanquinho, except for human consumption. As informed in the following excerpt, "*this situation does not have a definitive solution, being treated in the Verde and Jacaré rivers Basin Committee"* (BAHIA, 2014).

THE CASE OF THE MANOEL NOVAIS (MIRORÓS) DAM

The Manoel Novais dam, opened in 1984 and known as the Mirorós dam, is located on the Verde River bed in the Irecê area northwest of Bahia between the municipalities of Gentio do Ouro, Barra do Mendes, Ipupiara and Ibipeba. The dam has a 150,000,000 m3 storage capacity and a 780-hectare water mirror ensuring a minimum downstream discharge of 250 litres/second. The reservoir started to be used just a decade after the opening, when the Feijão

Water Supply System in Irecê was built, with a 700 litres/second discharge, designed to meet the supply requirements of the population of 16 municipalities in the area.

To make the Verde river perennial and to supply water to 2,159 hectares of Mirorós irrigated perimeter were the main reasons to build the dam.

The first conflict took place in 1989 when the low levels of water in the Verde river made it impossible to irrigate the farms on the margins and the ones in the Mirorós perimeter, which is under the responsibility of CODEVASF. "*There were also conflicts between EMBASA (State of Bahia Sanitation Company) and Ibipeba Town Hal, between EEMBASA and the residents of the plots in the Mirorós irrigation perimeter, between CODEVASF and the dryland farmers in Mirorós, and between CODEVASF and the cattle ranchers upstream the dam*" (BAHIA, 2014). Recent drought periods, considered the most severe of the last 60 years have progressively worsened the situation.

After intense mobilization and demands from the Community, Environmental, Rural Producers, Religious and Cooperative Associations, the National Water Agency (ANA) established regulation for water use conditions in the dam.

In October 2011, faced with the worsening of the situation the ANA held meetings with "*the Mirorós community to adjust the authorizations to levels that would allow living with the drought*" (BAHIA, 2014), in February 2011 they reached a level which they had to decide for stopping irrigations (ANA Resolution n.273/2010). Later on, in 2013, a new Water Supply System with water from the São Francisco river was built to diminish water scarcity for human consumption in the municipalities.

To conclude the case of the Verde River conflict, the **Velho Chico** book informs that "there is a Civil Inquiry filed the Irecê Region Environmental Justice Prosecutor's Office and the Federal Prosecutor's Office. Besides that, it is important to mention that the CBHSF has already offered support to prepare the before mentioned ecologic discharge study so as to subsidize the actions of the Verde Jacaré committee and the actions of the public ministries" (BAHIA, 2014).

THE CASE OF THE ZABUMBÃO

The CBHSF newspaper, edition 33 of August 2015, there is an interview with the president of the Santo Onofre and Paramirim rivers Water Basin Committee, right margin tributaries of the São Francisco river. The president said that the conflict that has called the attention of CBHSF takes place in the Zabumbão Dam located on Paramirim river basin and built by CODEVASF. The reservoir currently supplies water to four municipalities: Paramirim, Caturama, Botuporã and Tanque Novo (CAIRES, 2015).

Recently the government of Bahia opened a public bid to build a new Water Supply System with water from the Zabumbão to supply six other municipalities in the area: Rio do Pires, Ibipitanga, Macaúbas, Oliveira dos Brejinhos, Boquira and Ibitiara. The new infrastructure will help the government increase offtake from 100 litres/second to 523.9 litres/second. The committee president affirmed that some municipalities do not need the water and that the Water Supply System "*will dry off the Zabumbão*", overly affecting water safety in the area. Recent droughts led to the reservoir volume not being able to go past half of its capacity (CAIRES, 2015).

As an alternative to this project the committee president defends modernization and a more efficient use of the water used in the Paramirim Vail irrigation, where flood irrigation is used in 1,300 hectares, as well as the treatment of the sewage upstream the reservoir and the construction of two new dams in the Caixa and Remédios rivers (CAIRES, 2015).

NEW IRRIGATION PROJECTS IN THE SÃO FRANCISCO RIVER

A short research in the CODEVASF website in 2014 and 2015 to check public bids which carried out feasibility studies, implementation, expansion or recovery of irrigated areas, and, as a consequence, an increase of offtake in the São Francisco river discharge, showed the bids listed below, all of them with a winning bid:

1. **Public Bid n. 01/2014:** Feasibility study for the Serra Negra/Ibimirim II Irrigation project with estimate area of 12,000 hectares and offtake in one of the canals in the construction area of the São Francisco River transfer.

2. **Public Bid n. 52/2014:** Granting of real right for the Baixo Irecê Project in the municipality of Xique-Xique in the state of Bahia aiming at making productive 13,433 hectares of irrigated land.

3. **Public Bid for a Public-Private Partnership in the Pontal Perimeter:** Granting of real right for the Pontal Project in the state of Pernambuco aiming at making 7,717 hectares of irrigated land productive.

4. **Public Bid n. 09/2014:** Recovery of 51 pumping stations to serve the Propriá, Cotinguiba-Pindoba and Betume Irrigated Perimeters located in the rural area of the municipalities of Propriá, Telha, Cedro de São João, Neópolis, Japoatã, Ilha das Flores and Pacatuba in the state of Sergipe.

5. **Public Bid n. 08/2014:** Putting in operation 3 pumping stations to serve the Boacica Irrigated Perimeters in the state of Alagoas with total discharge of 9.0 m^3/s.

6. **Public Bid n. 60/2014:** Putting in operation 2 pumping stations to serve the Itiúba Irrigated Perimeters in the state of Alagoas with total discharge of 1.0 m^3/s.

7. **Public Bid n. 55/2012:** Execution project for the Delmiro Gouveia Irrigated Perimeter in the state of Alagoas with offtake in the Sertão Alagoano canal with discharge of 2.1 m^3/s.

8. **Public Bid n. 54/2012:** Execution project for the Pariconha Irrigated Perimeter in the state of Alagoas with offtake in the Sertão Alagoano canal with discharge of 1.7 m^3/s.

9. **Public Bid n. 82/2013:** Specialized services to consolidate the existing Basic Project and prepare the Execution Project for a 4,990 hectares area of the Inhapi Irrigated Perimeter with offtake in the 64 km + 280 and/or 74 km + 100 stakes of the Sertão Alagoano canal located in the municipality of Inhapi in the state of Alagoas.

10. **Public Bid n. 91/2013**: Preparation of a technical feasibility, economic and environmental study including an EIA ad consolidation of an engineering pre-project for irrigation activities in an estimated area of 12,000 hectares for Steps 1 and 2 of the Mocambo-Cuscuzeiro Irrigation project with offtake from the Meio and Correntina rivers located in the municipality of Santa Maria da Vitória in the state of Bahia.

11. **Public Bid n. 29/2013:** Preparation of a technical feasibility, economic and environmental study of the Bahia Sertão canal starting from the São Francisco

river, in order to ensure water supply to the Tatauí, Salitre, Tourão/Poções, Itapicuru and Jacuípe river basins in the state of Bahia, as well as the preparation of the engineering pre-project of the canal.

12. **Public Bid n. 63/2013:** Preparation of pedological studies and soil classification for irrigation in an area of 30,361 hectares in the Canal Project in the sertão of the state of Pernambuco in areas called "Mancha Pontal de Sobradinho" and "Mancha de Santa Cruz" located in the municipalities of Santa Cruz, Dormentes and Santa Filomena, in the state of Pernambuco, as well as detailed studies in 16,089 hectares in the "Mancha Casa Nova" located in the municipality of Casa Nova in the state of Bahia and in Petrolina in the state of Pernambuco.

13. **Public Bid n. 64/2013:** Preparation of a technical feasibility, economic and environmental study for irrigation activities in an estimated area of 18,494 hectares for the Chapada do Arapuá, Parnamirim and Urimamã Irrigation Perimeters located in the municipalities of Santa Maria de Boa Vista, Parnamirim and Ouricuri in the state of Pernambuco.

14. **Public Bid n. 67/2013:** Preparation of a technical feasibility, economic and environmental study for irrigation activities in an estimated area of 9,400 hectares in the Terra Nova enterprise located in the municipality of Santa Maria de Boa Vista and Lagoa Grande in the state of Pernambuco.

Considering an amount of 0.5 litres/second for each irrigated hectare, the projects above will mean an offtake of 36 m^3/s from the São Francisco river basin. Na offtake amount 150% higher than the minimum offtake in the São Francisco river Integration Project (PISF).

This analysis did not intend to list all the actions in progress that will increase the São Francisco river water consumption, but to observe the projects forecast of just one important basin irrigation agent – the CODEVASF – has to expand the irrigation area of the São Francisco river.

In conclusion, this chapter highlights the content of article 1 of CBHSF Resolution n.10 of 2004, which recommends that the National Water Agency (ANA) and the water management agencies of the states integrating the basin with the arbitration of the CBHSF and the Tributary Basins Committee celebrate an integrated management

partnership as the starting point to build a **Water Pact** in the Basin defining the rules for the sustainable use of its water resources.

The **Multiple Uses of São Francisco River Water Workshop** (SÃO FRANCISCO RIVER BASIN COMMITTEE, 2013 a, b) previously mentioned in this chapter recommended and reinforces the need to build this **Water Pact**. In the São Francisco river basin this pact should at least:

1. *Define and implement mechanisms to articulate and integrate actions of state, federal, CBHSF and CBH tributaries management agencies.*
2. *Promote and implement an effective campaign to regulate water use in the entire basin including the updating of registrations and concession authorizations.*
3. *Establish criteria for a process to review granted authorizations assessing and redefining them according to effective water use capacity and availability.*
4. *Define strategies to strengthen the regional consultation chambers aiming at more dialogue with the basin society.*
5. *Structure an integrated inspection system at federal and state levels articulated with the environmental system.*
6. *Identify dialogue channels and define articulation strategies for CBHSF with regional leaderships and collegiate of other public policies (Identity Territories, EPA Management Councils, Municipal Health and Education Councils, Mayor and Alderman Associations, Public Ministry and others) aiming to ensure more integrated action in the basin.*
7. *Encourage the participation of different CBHSF instances in the Municipal and State Basic Sanitation Plans preparation process aiming to get them closer to the priorities identified in the São Francisco River Basin Plan.*
8. *Articulate with the environmental agencies the demarcation and recovery of the Permanent Protection Area of the Sobradinho lake and downstream the dam.*
9. *Promote and extensive and integrated water quality monitoring program (saltwater intrusion, phosphorus, other...).*

10. *Review the charging criteria and rates for water use according to user size and the 'polluter pays' principle.*

11. *Create a work group to deepen knowledge and propose the proper management of the intermittent rivers in the basin.*

12. *Promote the articulation between the Tocantins and São Francisco river basins to discuss possible integration of the basins.*

13. *Identify articulation mechanisms in the federal, state and municipal instances to make viable the planning and implementation of basic sanitation actions in an integrated and sustainable way.*

Finally, after describing the intensity, variety and recurrence of the conflicts in the São Francisco river basin a question comes to mind: after all, what is the legal and institutional framework the country has in order to face the complexity of water conflicts in this and in other Brazilian states? The answer is in the following chapter.

3.

WATER CONFLICTS LEGAL AND INSTITUTIONAL ASPECTS[1]

In the 1970's it was announced that there is a worldwide water crisis, and since then several international events have been carried out with the goal to discuss and minimize it.

Three important international events specifically approached the crisis:

a) United Nations Water Conference in Mar del Plata, Argentina in 1977 which resulted in the Mar del Plata Action Plan;

1 This chapter was written by the geographer and lawyer Maria Gravina Ogata especially for this book.

b) International Conference on Water and the Environment (ICWE) in Dublin, Ireland in 1992 organized by the United Nations which resulted in the *Dublin Statement*; and

c) International Conference on Water and Sustainable Development in Paris, France in 1998 which resulted in the *Paris Statement*.

The **Mar del Plata Action Plan** was the first major international event on freshwater. The main topics discussed then were:

a) the search for an efficient use of water;
b) the control of pollution and its implications on human health;
c) the planning of the use of water;
d) the education and research on the use and destination of water resources; and
e) the encouragement to international cooperation.

At that time, the most relevant topics were human supply and basic sanitation. In this context, it was decided that the counties would promote specific public policies for access to quality water and basic sanitation to the entire population.

The **Dublin Conference** carried out 15 years after the **Mar del Plata Conference** resulted in an Action Plan based on four important principles:

a) potable water shall be considered a vulnerable and finite resource essential to support life, development and the environment;

b) water management shall be based on a participative approach including consultation to the population involving the users in the planning and implementation of projects;

c) women have a key role in water provision, management and safeguard; and

d) water shall be recognized as an economic asset.

At the time, the event focused on water supply as one of the solution factors to social and environmental issues: water in a sustainable development perspective.

The **International Conference on Water and Sustainable Development** which took place in France in 1998 recommended to face the problem through three lines of action:

a) the improvement of knowledge regarding water resources and their uses from a sustainable development perspective;

b) the development of human and institutional resources for the integrated management of water resources;

c) the definition of water sustainable development strategies and their sources of financing.

It is important to highlight that, one year before the Paris event, the Water Resources National Policy was created in Brazil by Law n. 9.433/97, a demonstration of strong engagement in this global movement.

The carrying out of three events started in Brazil a series of legal, institutional and financial changes considered as necessary to make viable the integrated management of water resources as a proposal to minimize the beforementioned crisis.

Two important aspects were highlighted in the 1988 Constitution: the exclusive competence of the Federal Government to legislate over water and energy as well as water being a public domain attributed to the Federal Government and the states.

The Federal Constitution made it clear that the water located in the soil in its possession, that runs through a state, that is on the border with other countries and that comes from or goes to other countries, belongs to the Federal Government. Besides that, the water from constructions carried out by the federal government in waters belonging to the states are also possessed by the federal government. (BRASIL, 1988, subsection III of article 20; subsection I of article 26).

As a result of this possession the Constitution established that it is the responsibility of the Federal Government:

a) to legislate privately over the waters (BRASIL, 1988, subsection IV of article 22);

b) to create the National Water Resources Management System and define the criteria to grant right of use (BRASIL, 1988, subsection XIX of article 21);

c) to explore power generation and the use of water courses to generate power services and concessions directly or by granting authorization together with the states where the hydro-energy potential is located (BRASIL, 1988, subsection XII of article 21);

d) to ensure participation in the results or financial compensation of water resources exploration for power generation to the states and municipalities they are located, the Federal District and the federal agencies (BRASIL, 1988, single paragraph of article 20).

Besides the competences defined for the federal agencies, the National Congress attributed to its exclusive competence the authorization to explore and use water resources located in indigenous territories (BRASIL, 1988, do subsection XVI of article 49; § 3º of article 231).

APPLICABLE FEDERAL LEGISLATION

The main federal regulations on the topic are:

- **Law n. 9433 of January 8th, 1997**. Institutes the National Water Resources Policy, creates the National Water Resources Management System.
- **Law n. 9984 of July 7th, 2000**. Makes provisions on the creation of the National Water Agency – ANA.
- **Decree n. 24643 of July10th, 1934**. Decrees on the Water Code.
- **Decree n. 4613 of March 11th, 2003**. Regulates the National Water Resources Council.
- **CNRH Resolution n. 32 of October 15th, 2003.** Institutes the National Hydrographic Division.

THE NATIONAL WATER RESOURCES POLICY – PNRH: LAW N. 9433/1997

In order to make the determinations in the Constitution viable, the National Water Resources Policy and the National Water Resources Management System were created by Law n. 9433 of January 8th, 1997 with the following fundaments (BRASIL, 1997, article 1):

I - the water is a public domain asset;

II - the water is a finite natural resource which has economic value;

III - in situations of scarcity the priority use of water resources is human consumption and quenching animal thirst;

IV - water resources management shall always allow the multiple use of the waters;

V - the water basin is the territorial unit for the implementation of the National Water Resources Policy and the actions of the National Water Resources Management System;

VI - the management of water resources shall be decentralized and include the participation of the Government, the users and the communities.

As can be seen, the law incorporated the guidelines of the **Mar del Plata Action Plan** and **the Dublin Statement**.

The law also states as one of its fundaments that the management of water resources shall be decentralized and include the participation of the Government (which has ownership over public waters), the users (which use the water in their production processes) and the communities (which provide balance between the market and the resource regulatory agent).

Because of the specificity of this natural resources, the reasonable and integrated management of water resources shall adopt a specific territorial division: the river basin. This new management and planning space surpasses the federate entities (municipal, state and federal borders) and does not coincide with the Metropolitan

Areas established delimitations for the management of Conservation Units or any other unit adopted for urban planning, biodiversity and others.

In fact, the river basin, as a territorial unit for water resources planning as part of this public policy, shall not be considered just as a territorial division of technical importance. It has to be treated as a territorial division of great relevance from a political viewpoint.

Besides the beforementioned fundaments, three big goals of the National Water Resources Policy were defined (BRASIL, 1997, article 2):

I - to ensure that present and future generations have availability of water at quality standards proper for the respective use;

II - to have a rational and integrated use of water resources including water transport aiming at a sustainable development;

III - to prevent from and defend against critical water events of natural origin or resulting from the inadequate use of natural resources.

Based on the analysis of this set of goals it is possible to see that Brazil has aimed to integrate the management of water resources with the management of the environment favouring the principle of Sustainable Development, as defended by the **Rio de Janeiro Earth Summit in 1992**, through the reasonable and integrated use of water resources by considering them a finite resource notwithstanding being classified as a renewable natural resource.

Besides that, it gave emphasis to prevention and defence against critical water events such as droughts, floods, slope slides which are strongly connected to weather phenomena also called extreme weather events, being them caused by human intervention in the environment or a result of natural catastrophes. This means that these events can be prevented or minimized when there is a national water policy.

Considering that Law n. 9433/97 creates as public policy, it is extremely important to establish general guidelines to make it viable. See them as follows (BRASIL, 1997, art. 3º):

I - the systematic management of water resources without dissociating quantity and quality aspects;

II - the adjustment of the water resources management to the physical, biotic, demographic, economic, social and cultural diversities of the country regions;

III - the integration of water resources management and environmental management;

IV - the articulation of water resources planning with user sectors and the regional, state and national planning;

V - the articulation of water resources management with land use management;

VI - the integration of river basins with estuary systems and coastal zones.

One of the guidelines of the national water resources policy refers to the fact that it should be implemented without separating aspects related to the quality and the quantity of the water, which shall be jointly managed because it is not possible to say that there is water availability when this resource even though abundant has its quality compromised.

This shows the need to articulate the planning of water resources with the user sectors (agriculture, industry, supply, and other user of water resources) with the regional, state and national planning because it is no use to manage the water without knowing the demands of the sectors that use it.

Another relevant guideline is the *articulation of water resources management with land use*. Water quality and availability depend on the uses carried out inside the basin. Thus, "to manage the water" means "to manage the territory". Water resources management is very interested in knowing the uses existing in the territory in both urban and rural areas.

According to the 2010 IBGE Demographic Census, approximately 85% of the Brazilian population lived in urban areas and 15% in the rural areas.[2]

2 According to the 2010 IBGE Demographic Census the Brazilian population was 190,755,799 inhabitants; 160,925,792 lived in urban areas while 29,830,007 lived in the rural areas of the country.

In this context, the urban dimension gains extreme relevance in the integrated management of water resources. Even though the municipalities do no hold possession of the water since 1988, there is little to be done without a strong integration of water resources management and urban and rural land management.

On the other hand, considering that Brazil is a large producer of agricultural and mineral commodities such as soy, cotton, rubber, coffee, tropical fruits, iron ore, aluminium, oil, gold, nickel, silver, and others any pressure to increase the exploration of these resources has na impact on water quality and availability. Thus, it is not possible to dissociate water and land use management.

Taking into consideration the importance of the Brazilian 8,500km of coast, it was established as one of the National Water Resources Policy guidelines the *integration of the river basin management with the estuary and costal zones systems.* How consider the cleanliness of beach water if the fresh water that reaches the sea is full of contaminants carried along from all the uses within the river basin?

Another important guideline in the national water policy refers to the need to *adjust water resources management to the physical, biotic, demographic, economic, social and cultural diversities of the country regions.* As we all know Brazil is a plural country, of continental dimensions, having diverse cultural influences: Indigenous, African, and European, whose costumes and historical aspects should be taken into consideration in the Brazilian freshwater management.

As it can be seen, although the National Water Resources Policy guidelines are legally established, there are strong possibilities of water conflicts as they involve countless actors, several public policies which adopt distinct territorial divisions regarding decision making, strong international pressure to use natural resources, and cultural aspects related to the management of the water resources.

Besides the fundaments, the goals and the guidelines reflecting the philosophical aspects guiding the establishment of the water resources policy, Law n. 9433/97 creates the instruments and the institutional apparatus to put the national water policy into practice.

Regarding instruments the law listed the ones that follow (BRASIL, 1997, article 5):

I - the Water Resources Plan;

II - the classification of the water bodies in classes according to their main uses;

III - the granting of water resources right of use;

IV - the charging for the use of water resources;

V - the compensation to the municipalities;

VI - the Water Resources Information System.

These instruments can be classified according to Chart 3 as per their typology and status of implementation in the national territory.

Instruments		Status	Types of Instrument
1	Water resources plans: national, state and for river basins	On going	Planning
2	Classification of the water bodies in classes according to their main uses of the water	Under developed	Planning
3	Granting of water resources right of use	Well developed	Control
4	Charging for the use of water resources	On going	Economic
5	Compensation to the municipalities	No legal discipline	Offsetting
6	Water Resources Information System	On going	Technical Support

CHART 3. The instruments in Law no 9.433/1997 and their developments

In order to make the National Water Resources Policy viable all these instruments should be implemented. The lack of some of them compromises the completion of the forecast for the integrated management of the water resources.

From an institutional point of view the National Water Resources Management System (SINGREH) was structured as follows:[3]

I - the National Water Resources Council;

I - the National Water Agency;

II - the State and Federal District Water Resources Councils;

III - the River Basin Committees;

IV - the federal, state, Federal District and municipal agencies whose competences are related to water resources management;

V - the Water Agencies.

This institutional matrix is summarized in Chart 4.

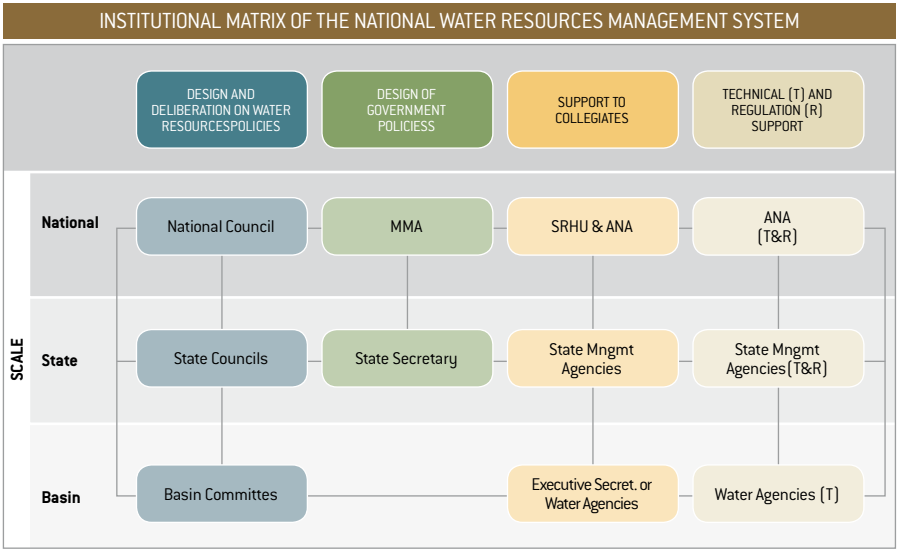


CHART 4. The National Water Resources Management System

Source: Freitas (2014).
Note: Chart redrawn by the author.

3 See content of article 33 of Law n. 9433/97 altered by Law n. 9984/2000.

It is important to highlight in this institutional matrix the importance of the water resources management agencies, either the National Water Agency (ANA) or the state and Federal Districts agencies, regarding the regulatory aspects related to the subject. On the other hand, the National Water Agency outstands in technical support as it makes viable the decisions made by the basin committees.

In summary, when checking who is who in water resources management, one can see that:

a) the national and state water resources councils approve the water resources plans (the national and state water resources plan, respectively) and the classification of the water courses, establish the general criteria for water use authorization and charge defining the amount to be charge within their area of work;

b) the basin committees approve the river basin plan, establish granting priority and guidelines and criteria, approve mechanisms and suggest amounts to be charged for the water in their respective basin;

c) the ANA and the state water resources management agencies grant and inspect the right of use, as well as implement and manage the water resources information system;

d) the state secretariats coordinate the preparation of the state and basin Water Resources Plan (for the basins that do not have their own Water Agencies);

e) the water agencies coordinate, prepare and execute actions related to the plan of the respective basin, propose alternatives for the classification, collect and manage resources from charges (upon delegation of the water resources management agency), and implement and manage the information system of their respective river basin.

These competences are summarized in Chart 5 produced by the National Water Agency.

SINGREH: entities, instruments and competences

INSTRUMENT / SINGREH ENTITY	HR PLAN	FRAMEWORK	GRANT/INSPECTION		CHARGING	INFORMATION SYSTEM
			Federal	States		
CNRH	Approve and follow up execution	Approve	Establish general criteria		Establish criteria and define values	
CERHs	Approve and follow up execution	Approve		Establish general criteria	Establish general criteria and define values	
Committees	Approve and follow up execution	Select alternative	Establish priorities	States variables	Establish guidelines and criteria, approve mechanisms and suggest values	
SRHU/MMA	Coordinate					
State Secretariats	Coordinate				Variable in the States, where some will be in charge of charging	
ANA	Coordinate, prepare and execute (in the absence of AA)	Monitor, control and inspect	Grant and inspect		Prepare studies to subsidize CNRH. Collect, implement (w/ CBHs) and follow up the management of resources	Implement and manage
OGRHs	Coordinate, prepare and execute (in the absence of AA	Monitor, control and inspect		Grant and inspect	Variable in the States, where some will be in charge of charging	Implement and manage
Water Agencies	Coordinate, prepare and execute	Propose and carry out alternatives			Propose values to CBH, collect, apply and manage resources	Implement and manage

CHART 5. Roles of the Water Resources Management System Entities.

Source: Freitas (2015).
Note: Chart redesigned by the author.

Regarding water conflicts it is important to highlight the work of the National Water Resources Council - CNRH, the State Councils and the River Basin Committees which will be shown further ahead.

In face of everything mentioned so far regarding legal and institutional aspects, there is a huge potential for conflict in water management, especially, because of the following possibilities:

a) Difficulty to harmonize the decentralized structure of a federate nation having three political autonomy levels and other territorial divisions of deliberative management as is the case of a river basin;

b) Difficulty to apply a national water policy homogeneously in the whole country because of the great cultural, political, and historical diversion, as well as different regional interests;

c) Difficulty to integrate environment and water resources policies with sectoral policies such as agriculture, industry, sanitation, etc.;

d) Difficulty to understand the role of the municipalities in water resources management: government agent or water user? This question results from the fact that the municipality ended up being a user of the water as they are responsible for basic sanitation services;

e) High cost to the public administration because of the adopted model and the difficulty to implement Water Agencies per river basin;

f) Double possession of the water, an issue not fully clarified;

g) Multiple use of the water implying in the need to have a consensus among the actors involved;

h) Difficulty to share the water because of the lack of an integrated view of the offer/demand relationship in the territorial division of the river basin.

Therefore, resolving water conflicts ends up having na enormous relevance to water management. It is important to highlight that this public policy was drawn to work based on negotiation between the involved parties as the potential for litigations is big, especially in times of strong worldwide water crisis resulting from an increase in the demands on natural resources, water especially.

The institutionality forecast in regards with this water policy facilitates the negotiation processes between the parties as it has already placed the actors face to face on the day-to-day dynamics established in the collegiate favouring conflict resolution among water users.

Water resources management depends on the work of several actors to be made viable. Thus, it can be called a non-state public management.

This management implies in a "new form of contract" between the water users, the civil society and the government which together try to reach a consensus in an environment of dissent by creating clear rules so that the opportunities are the same for all sectors involved in the water resources integrated management. On general, the water resources collegiate take most of the time discussing the coexistence rules to make everybody few feel comfortable in this democratic management. So, this type of democracy can be called the "democracy of conflicts" (WEFFORT, 1994, apud OGATA, 2013).

4.

METHOD TO RESOLVE WATER CONFLICTS

The words “river” and “rival” have the same Latin root. For centuries neighbours that share the waters of the same river have been considered rivals. Notwithstanding, there are a lot more cooperation agreements that declarations of war in the sharing of these waters. Cases of conflict take place in all continents.

In general, conflicts are part of the daily life. There are Family conflicts, conflicts between friends and partners, employer and employees, conflicts between states, conflicts inside government agencies and between government and private agencies, and conflicts between businesspeople and costumers. So, there are innumerable conflict situations taking place every day. A reasonable question is: the water conflicts management methodology differs from the ones used in other cases of conflict? The answer is yes, and no.

Water conflicts can involve political issues of regional development and may depend on intricate relationships between biology, chemistry, oceanography, hydrology and hydraulics. It is usually necessary to integrate several government and private agencies having competence and interest in the use of water. It is also common the need to accommodate the interests of the municipalities, the state and the federal government. It is also necessary to consider the interests of the user sectors such as: supply to the cities, irrigation, power generation, navigation, mining, industry, fishing, scenic tourism, nautical sports, diffuse interests for environment preservation, and others. It is not rare to have cases of conflict which cannot dissociate historical, architectural, cultural and anthropological values from its resolution. It is also important to highlight the interests of the traditional communities, the communities with common land used for pasture, the Indians, the quilombolas, the fishermen, dryland farmers, the social movements, the nongovernmental agencies, and all the other grouping categories which depend directly and indirectly, or have some interest in the fates of the river. Therefore, from what was said in this paragraph it looks like the theme "water conflicts" requires specific methodology.

However, there is a line of "conflict management" study which defends the idea that any type of complexity can be duly classified in a general ordering of methods for conflict resolution. This text bets on this assumption acknowledging and incorporating the entire complexity of the water theme in one conflict management general ordering.

There are hundreds of excellent books presenting conflict resolution concepts which is already a consolidated theme in the technical community. In this text, the method detailed in the book *Getting to Yes: Negotiating Agreement Without Giving In,* written by Harvard professors Roger Fisher and William Ury, who developed a program on the subject in that renowned university. The book gained notoriety as one of the first bestsellers on the subject, which, at the time, was restrict to certain academic, political and corporate environments.

Fischer and Ury (1981) presented a method to achieve conflict resolution based on four steps:

1. **Separate the people from the problem:** in the search to build lasting and profitable work relationships, it is necessary and essential to offer polite and courteous treatment to all process participants. Notwithstanding, it is necessary to be incisive and determined in the search for a resolution. Two English words are constantly used to describe this step: it is necessary to be **soft** on the person **hard** on the problem.

2. **Focus on Interests Not Positions: "**position**"** is the will of the party verbally and publicly expressed. It is what they say they want. Whereas, "interest" is what the party needs to see come true to feel that the conflict was resolved;

3. **Invent options for mutual gain:** this means that in this part of the process everyone bringing a solution to the table needs to make it compatible and, mainly, exercise their creativity to create an agreement that meets the demands of all involved, within the limits of reality;

4. **Insist on using objective criteria:** to reach an agreement it is essential that one or more criteria accepted by the parties be used to show it is an agreement with solid technical basis, which complies with the legal framework, and brings a sense of justice to the parties.

We still have to consider the **BATNA** (Best Alternative to a Negotiated Agreement), i.e., the best alternative if negotiations fail. This concept leads participants to compare the negotiation to the best option available. In the case of water resources, the option of not negotiating does not exist once the law determines the integrated management of water resources and that the management mandatorily takes into consideration the multiple uses.

It is important to observe that such method should be understood as a process to resolve disputes and plan future actions. To resolve a water conflict will never be an end point. The establishment of agreements will always be followed by the inspection of the agreed conditions and the monitoring of the offer/demand relationship evolution and the water demand of the analysed river basin. Therefore, conflict situations will result in future relationships and permanent dialog, monitoring, reassement and planning between the parties of a conflict process.

After all, who are the people involved in water conflicts? The National Water Resources Policy created the river basin committees and established that they are responsible for the first attempt of resolving water conflicts in their area of work. In the committees there are representatives of the government, society and users. By force of law these three segments should be involved in the search for the resolution of water conflicts.

However, in the Brazilian practice of water resources management, the need for speed and effectiveness required the creation of other permanent or temporary groups to help solve conflicts.

In Espírito Santo, in order to address the water crisis that wreaked havoc in the state in 2015-2016, the government created the Government Water Committee including representatives of the State of Espírito Santo Sanitation Company (Cesan), the State Agriculture, Supply, Aquiculture and Fishing (SEAG), Sanitation, Housing and Urban Development (Sedurb) Secretariats, the State Environment and Water Resources Institute (Iema), the Livestock and Forestry Defence Institute (Idaf), the State Research, Technical Assistance and Rural Extension Activities Institute (Incaper), the State Water Resources Agency (AGERH), and the Mayor of the municipalities of Colatina, Santa Maria de Jetibá, Cachoeiro de Itapemirim and Domingos Martins. Although the state has other 13 river basin committees.

In the Paraíba do Sul river basin another group was formed, as a result of water conflicts due to severe scarcity, including the National Water Agency (ANA), the São Paulo Water and Power Department (DAEE), the Minas Gerais Water Management Institute (IGAM), and the Rio de Janeiro State Environment Institute (INEA), which jointly edited Resolution n. 1382/2015. This agreement for the shared management of the Paraíba do Sul River Basin was authorized by the Federal Court (STF) under minister Luiz Fux authority.

These examples do not represent all the types of groups created to resolve water conflicts. The conflict resolution technique explained herein does not depend on the nature of the groups.

TO BE SOFT ON THE PERSON AND HARD ON THE PROBLEM

During the intense discussions regarding conflicts on the São Francisco River transfer I witnessed a debate which perfectly illustrates this step of the method.

At the time, two debaters were invited: Congressman Marcondes Gadelha, representative of the state of Paraíba and a defender of the transfer project, and Senator Teotônio Vilela for the state of Alagoas, against it.

The Congressman spoke for over an hour with a speech full of technical elements and very well placed emotional resources. The Congressman said that the north-eastern would never deny water to a thirsty brother – the core of his emotional speech. Several technical, economic and environmental elements were very well explored by the congressman. At the end of his speech the audience gave him a somewhat cold applause as they were apparently against the construction.

As soon as he finished his speech, the congressman was succeeded by senator Teotônio Vilela. The audience anticipated a conflicting showdown of ideas, a strong speech and argument which time and again raises the temperature of the debate opposing the debaters in a rough and impolite way.

But the experienced senator starts his speech this way:

– My dear colleague, congressman Marcondes Gadelha, I still remember your words at my father's funeral.

At this moment, the senator moved his right index finger upwards his left forearm in an old gesture representing that the words caused a deep emotion. After that the senator went on saying:

– Marcondes Gadelha, you represent the glorious state of Paraíba with pride, strong principles and character, and immeasurable love. Marcondes Gadelha, congressmen like you have helped and still help to build a better Brazil. Marcondes Gadelha, your presence in the National Congress makes that House of the People better.

And, the senator continued highlighting several occasions in which they had both been on the same side, sharing the same ideas. However, to conclude his speech he said:

– Marcondes Gadelha, in multiple occasions we have been together. However, on this specific situation regarding the viability of the São Francisco River transfer I will have to disagree with you.

And for the following 50 minutes the senator talked about figures and criteria to criticize the support to the São Francisco River transfer project.

This passage shows that, although both representatives may have not read the book "Getting to Yes" (FISHER; URY, 1981), they have implemented the recommendations of the first step to manage conflicts to perfection: to separate the people from the problem. The representatives know that the disputes for ideas cannot destroy the relationships between the parties which need to continuously keep cooperating to achieve bigger goals of local, regional and national interests.

In the scene mentioned above, the senator decided to be nice to his counterpart, but hard and assertive when talking about the core of the water conflict. In cases of less experienced debaters, it is very common that, in the heat of the debate, the debaters resort to aggressions toward their opponent, thus violating the recommendations. In this case, two situations are possible: after the attack on the people, the debater can assertively attack the problem or just attack the people and not offer any ideas to resolve the conflict. Both paths are inadequate.

Another common situation is when the debater is extremely nice and polite with the people, but do not attack the problem in an assertive, timely and resolute way. They are the people that pacify the afflictions but do not solve the problem.

The recommended attitude is a combination of kindness between the parties and hardness on the attack to the problem. The relationships between the parties comprising a river basin committee or any type of committed shall be preserved, expanded and consolidated despite the heated divergence in the analysis of certain issues.

Wouldn't it be extremely undesirable that the state of Bahia government representatives in the São Francisco river basin committee were not on speaking terms with the state of Minas Gerais or the Federal government representatives? Because the committee is a permanent space of debate and several members meet one another in other forums or under other circumstances, there would be an immense loss of cooperation synergy with damaging consequences. The problems that need to be solved cannot push people and institutions towards sheer enmity. This is the core of the advice in the first step of the conflict resolution method explored herein.

However, in the river basin committees it is very common to happen the deterioration of personal and institutional relationships which does not help to build the necessary consensus for the scarce water. Sometimes the institutional relationship is broken jeopardizing the search for a solution. It is necessary to be attentive to the committee mission and to be let it be the guide.

It is also important to highlight that government representatives in river basin committees are always subject to changes of direction and attitude according to the municipal, state and national political stances.

TO UNDERSTAND THE DIFFERENCE BETWEEN "POSITION" AND "INTEREST"

Issues related to water resources usually involve intricated and complexes relationships between biology, hydrology, hydraulics, botanic, physics, chemistry, sociology, history, anthropology and other areas of knowledge. Such complexity requires the coordinated and continuous work of several people of varied educational backgrounds as the ones found in river basin committees.

In a forum of such magnitude and importance it is not easy to listen to declared **positions** and from them extract the **interest**s of the parties. The **positions** are herein understood as the declarations of the committee's parties in the search to express their desires and expectations preceded by their arguments and principles. The **interestes** are herein understood as what the party needs to accomplish so that the conflict is resolved. Let's take a look at a real example.

Since the construction of the Sobradinho and Xingó dams there has been a generalized complaint of the gradual and permanent drop in artisanal fishing production in the São Francisco river.

Thus, in several occasions fishermen's representatives have expressed to the CBHSF their **position** of requesting to the CHESF a programmed flood to flow sediment back to the river. They argued that the sediment would carry aggregated organic matter which would allow the full development of the ichthyofauna.

However, a technical debate involving biologists, engineers, chemists and geologists showed that a programmed flood would not flow the lost sediments into to the river. The sediments would remain deposited at the beginning of the water mass reserved at the Sobradinho reservoir, very distant from the spillways and bottom discharges, and would not come down the river with the volume of water in a programmed flood.

It is possible to notice that the **interest** of the fishermen was to improve artisanal fishing in the São Francisco river, but their **position** was to request an artificial flood as the mechanism to achieve that end. In this case it is clearly possible to differentiate **interest** and **position.** The **interest** of increasing artisanal fishing production in the river depended on a series of integrated actions among which was the artificial flooding, which would not bring the original sediment back, but would certainly flood the meadows of the low São Francisco and favour the increase of fish in the area.

It is worth highlighting the complexity of this fundamental and indispensable topic regarding the low São Francisco, despite its minor economic impact at national level when compared to two examples of users' categories: irrigation and power generation.

Another example took place during the water rationing in the state of Espírito Santo in 2015-2016, when the State of Espírito Santo Sanitation Company (CESAN) decided to implement a rotation of supply to the neighbourhoods in the municipalities of Vitória and Serra, which meant one day without water supply per week. At the time, the population argued that the industrial sector should also face the same rationing schedule. In the case of ArcelorMittal Tubarão – the largest steel producer in Brazil – the company argued that as the process flow is continuous it would not be possible to stop operation for 24 hours and then resume operations again. Thus, ArcelorMittal Tubarão explained that it would enter the water rationing by cutting 1/7 of its water

consumption, which would be equivalent to one day without supply per week. In fact, the company took other measures, described in chapter 5.

The population did not want that ArcelorMittal Tubarão stopped operations for 24 hours. The population request for the industry to take part in the rotation program was their **position.** But their **interest** was to ensure that the industry took part in the effort to reduce water consumption, what in fact happened. ArcelorMittal Tubarão declared its commitment to keep a reduced consumption even after the end of the water shortage. The industry accomplished that using water recirculation, reuse and recycling in their production process. These actions are detailed in chapter 5.

How to find a solution which harmonize these issues? Ahead we are going to show a method that searches for alternatives to conciliate different interests.

TO SEARCH FOR ALTERNATIVES TO CONCILIATE INTERESTS

The third step in the methodology presented here consists in ensuring that all possible scenarios, ideas, situations, location alternatives, construction technologies, institutional and legal arrangements, as well as all alternatives to operate water systems have been analysed before the agreement is decided. It is an exercise of creativity and technical maturity for the team involved. This principle is not new and is in fact established in the Brazilian environmental legislation.

CONAMA Resolution n. 01/1986, article 5 establishes that environmental impact studies have to comply with the legislation, especially the principles and goals established in the National Environmental Policy Law, and also some general guidelines such as: to analyse **all technological and project location alternatives** confronting them with the hypothesis of the project not being carried out. It is worth emphasizing the importance of believing that new ideas, new conceptions will bring new opportunities of solution to the issue under analysis.

The creative process can be helped if a methodological structure is available. In this regard the Stockholm International Water Institute (2008) created a method to help water conflict resolutions. Here, the method was freely adapted to the Brazilian river basins scenario. The method aims to promote the sustainability and equality in the

use of shared waters by means of a table that summarizes a set of actions to solve the conflict. The method has as an auxiliary principle to help the economic development, to search political and social stability within the river basin committee and to promote the regional integration, always aiming at the sustainability of its operations and the environmental preservation. See ahead a summarized description of the method.

The method divides the use of water into four categories: i) power generation, ii) primary production – understood as agricultural and livestock operations, iii) urban human and industrial consumption, and iv) ecosystems maintenance, preservation and recovery.

Whereas water sources are divided in: i) **water to be distributed**, stemming from infrastructural actions to distribute water already available, ii) **water use management**, i.e., to make more efficient the consumption of water in the basin as well as the water use control institutional management actions, and iii) **new sources**, which are the water sources not yet explored. These categories have been adapted by me and organized according to table 3.

TABLE 3. Synthesis of the 'TWO' methodology

Water Sources / Development Vectors	Water to be distributed	Water use management	New sources
Hydroelectric power generation			
Primary production			
Urban and industrial growth			
Ecosystem maintenance			

On its operational side only, the method consists in making the involved parties fill in table 3 to search for **alternatives** that properly contain all the **interests,** or that get as close as possible to this scenario. According to the authors, the method has already been tested and validated in several situations and is effectively useful. The table serves as a big aggregator of ideas, options and possibilities. Its strength is on being filled in collectively.

The way that this methodology applied to the reality of the state of Espírito Santo regarding the actions developed by the Government Water Committee is commented in chapter 5.

Still talking about the alternatives contained in the third step of the method, we can highlight the **alternatives** to expand the offer of water by fighting against the losses in the distribution network. And there is a huge space to "*recover these waters*".

For example, just analysing the São Francisco river, the document called National Sanitation Information System (NATIONAL ENVIRONMENTAL SANITATION SECRETARIAT, 2014) informs that the sanitation companies working in this area have the following (physical and non-physical) rate of loss in the distribution:

- CASAL (Alagoas): 48%
- EMBASA (Bahia): 43%
- DESO (Sergipe): 59%
- COPASA (Minas Gerais): 30%
- COMPESA (Pernambuco): 53%

The diagnosis text mentioned the case of CASAL (NATIONAL ENVIRONMENTAL SANITATION SECRETARIAT, 2014) affirming that:

> *In 2011, the company presented a loss rate in the distribution of 64.5%. In 2012 the rate was 35.6%, representing a 28.9 percentage points decrease. While in the year 2013, the company released information of a loss rate of 48.1%, an increase of 19.2 percentage points.*

It is necessary to say that these numbers represent an average of the losses in the distribution in the whole area of work of the companies in their respective states. They are not numbers referring exclusively to the state areas of the companies within the São Francisco river basin. However, it is possible to verify that there is a huge possibility of "gaining" back these waters, instead of the common idea of always searching for new sources of water more and more distant from the consumer centres.

Tardelli Filho (2016), who used to be SABESP (São Paulo) Supply Control manager, in his article called "Relevant aspects of loss control in public water supply systems" asks and answers how long should loss reduction be pursued. The reply comes in three parts:

> *...it is necessary to consider the lamentable predominance of the single act of* ***constructing****, as opposed to the Permanente act of operating and maintaining, a value so deeply ingrained in the Brazilian culture.*
>
> *...*
>
> *...there is another limit, almost always of greater importance, that is the economic limit, i.e., there is a point where the costs to reduce losses overcome water production and distribution costs. It is not a simple calculation and it is heavily dependent on regional conditions.*
>
> *...*
>
> *The experience observed in the implementation and operation of Loss Reduction Programs shows that in the first years the results are encouraging, but as each year goes by they become slower and the required actions become more expensive. In the case of Tokyo (Japan) the loss indicator dropped from 80% to 20% in ten years and from 20% to 3% in 60 years!*

To sum up the considerations on **alternatives,** some words on general alternatives to power generation. Brazil is going through an important moment of innovation by means of incentives to wind and sun energy generation. The 2014 Summary Report 2013 Base Year from the Power Research Company connected to the Mines and Energy Ministry points out that sun and wind energy generation in Brazil has grown 16.5% from 2012 to 2013. These two energy production options are also present at the São Francisco river basin.

In July 2012, the company RENOVA ENERGIA opened the largest wind energy generation complex in Latin America called Alto Sertão I, installed in the southeast of Bahia in the municipalities of Caetité, Guanambi and Igaporã.

It comprises 14 wind parks with 184 air generators and 293.6 MW of installed capacity.

Obviously to discuss the new Brazilian energy matrix goes beyond the scope of this book. However, the topics water conflicts and power generation are connected, especially in Brazil.

CRITERIA, FUNDAMENTS AND GUIDELINES TO CREATE AGREEMENTS

The fourth step in the method presented herein consists in raising the criteria, fundaments and guidelines to be complied with in the construction of agreements. These criteria can be **mandatory**, in case they are provisions from the Brazilian legal framework, including the principles of legality, finality, motivation, reasonability, proportionality, morality, ample defence, contradictory, judicial safety, public interest and efficiency. Besides those, there are the **eligibility criteria** as comparative study with other situations as well as the compliance with agreements of the same nature in other parts of the world.

The criteria coming from Law n. 9433/1997

The fundaments, guidelines and principles of Law n. 9433/1997 (BRAZIL, 1997) were analysed in chapter 2. The question is how to use these fundaments in the construction of agreements. For example: in case of shortage, it is clear and indisputable that the priority is human consumption. Thus, in cases of scarcity other uses should be reduced or even suspended ensuring the consumption of water for human supply.

In article 3, subsection I, it is determined that the qualitative and quantitative aspects of the water resources be inseparable. This is the case of the debates on accumulation reservoirs: they alter the quantitative capacity of the water downstream and have a possible effect on the quality of the water body. Thus, article three establishes that said debate has to mandatorily include these two sides of the problem.

Article 3, subsection IV, establishes that the articulation of the water resources planning with the user sectors and with the regional, state and national planning is mandatory.

This provision strongly affects the conflict issues regarding power generation as the cases of the São Francisco river. It is largely known that the energy produced at the São Francisco river plants can supply the Brazilian southeast and in other moments help to supply the northeast. Therefore, it is mandatory that in this case the impact and benefit assessment go beyond the border of the river basin and that a nationwide view be taken into consideration.

Article 3, subsection VI, establishes the integration of the river basins with the estuarial systems and the coastal zones. In the São Francisco river this is an indispensable analysis. The São Francisco river estuary has had serious impacts with the decrease of artisanal fishing, the silting of the river bed, the marine erosion on the state of Sergipe side, the decrease of sediment loads that feed the ichthyofauna in the area, among others. Thus, it is determined that it is not possible to discuss the management of the river water without taking into consideration its impact on the river mouth, or better yet, the estuary. Finally, each one of the subsections refers to a mandatory analysis, and certainly all of them have a useful application to the São Francisco river basin.

The implementation of the National Water Resources Policy includes six instruments (BRAZIL, 1997):

> Article 5 – the instruments of the National Water Resources Policy include:
>
> I - the Water Resources plan;
>
> II - the classification of the water bodies according to the main water uses;
>
> III - the granting of rights to use water resources;
>
> IV – the charging for the use of water resources;
>
> V – the compensation for the municipality;
>
> VI – the information system of the water resources.

So, it is necessary to count on the force of all the six instruments in a proper request for the solution of water conflicts. As this is a largely publicized subject, there will be only brief comments on the importance of the instruments. On the other hand, other instruments also useful to face water conflicts will be highlighted.

On February 2, 2016 the CBHSF described on its site the content of a meeting in Salvador (Bahia) with federal prosecutors working in the municipalities of the São Francisco river basin. The lack of control from the states regarding the granting of authorizations to use the waters of the São Francisco river was one of the subjects discussed. According to the prosecutor of the state of Bahia Public Ministry (MP-BA) for the São Francisco basin Defence Nuclei (NUSF) Luciana Khoury (2016), "*the clandestine use of the São Francisco water is much higher than what is authorized*".

Therefore, what is the effectiveness of the instrument if more than half of the offtake is not properly authorized? How can a system be controlled if more than half the users are not registered in the data base? It is necessary that the mandatory authorization reaches everyone and that the authorized discharges are monitored to confirm that the users are taking just what has been authorized and that clandestine offtake discharges are suspended. To make the National Water Resources Policy effective it is necessary that all instruments work in harmony.

In the case of the charging, the lack thereof weakens the National Water Resources System, makes the formation and operation of basin committees nonfeasible, and does not bring the disciplinary effect for reasonable consumption.

A very interesting example between the charging and the agreement on scarce waters was described by Silva, Assis and Aquino (2015) when talking about the allocation of costs and the charging for the use of the water in the state of Ceará:

> *"Besides the historical landmarks of the charging process, it is important to highlight that the charging in the state of Ceará does not use any specific tariff model. In fact, the definition of the charging amounts has always been done through bilateral agreements between the Management Company and the water users' groups. A fact the makes evident the need for a methodological framework able to assess the price of the water in areas which adopt ad hoc charging models."*

Well, obviously the main costs of the water offer are known, the paying capacity studies of several sectors were carried out, the idea that the paying capacity of the irrigation sector is limited is consolidated; however, in the end an agreement between the parties defined the amounts. It will not be the single and original result of a mathematical equation that will be published in the Official Gazette to establish the

amount to be charged for the use of water. In fact, it will be the result of an agreement between the stakeholders, obviously respecting the legislation.

This way, an important aspect of the water resources management is highlighted: the negotiation between the parties. Thus, it is a business management a fact that does not take place, for example, in environmental management.

Criteria from other regulatory provisions

An example of criterion to define conflicts is contained in typical authorization resolutions from the National Water Agency (ANA). For example, Resolution n. 660 of November 29, 2010 granted the Alagoas government the right to a maximum offtake of 84,201,120m³ of water per year through the Sertão Alagoano Canal and **determined** that for irrigation projects it will be required a minimum of 80% efficiency in the use of water, and the efficiency is to be measured by the ratio between the amount used by the plantation and the amount taken from the water source. That is, the authorization should also be an instrument that requires efficiency in the use of water; in other words: it is a preventive measure to face water scarcity scenarios.

Regarding the CBHSF, Deliberation n.11 of July 30, 2004 established in article 1, the following criteria and priorities are to be observed in the analysis processes and granting of authorizations: i) regarding consumptive uses, the requests for human and animal consumption will have maximum priority; ii) the agricultural vocation of the basin shall be met, the incentive to a reasonable use of water for irrigation, agrobusiness and industry so as to optimize the sustainable use of the basin potential; iii) the reasonable use of water for irrigation shall be conditioned to the compliance with efficient use parameters and maximum discharge limit granted, so as to ensure the preservation of the ecosystems and the coexistence of multiple uses; iv) the authorization to use water resources for enterprises of any nature shall require proof of technical, social-economic and environmental feasibility; v) the analysis of requests for authorization shall take into consideration the use of water in the systems used by the enterprise respecting the categories and size giving priority to projects that show more reasonable use of the water resources.

The CBHSF has also defined other limits in Deliberation n.11. Its Article 3 defined that in the granting of authorization for the use of water resources for human and animal consumption, there shall be established loss limits for the offtake, transport and distribution of the water, as well as for the final disposal of the generated effluents. And for projects not yet implemented, there shall be established a maximum limit of 30% for total physical loss. As presented, it is possible to see that sanitation companies operate with losses above this limit. Sometimes with loss rates of more than double this limit. This low efficiency shall be looked at as a huge frontier of possibilities to recover wasted waters.

Water conflict shall be seen as a process full of moments of creativity to search for a solution that best serves the several interests. In this regard, the state of Minas Gerais innovated in 2015.

The state of Minas Gerais has faced several water scarcity situations. The State Council for Water Resources has recently deliberated by means of NORMATIVE DELIBEATION CERH/MG n. 49 of March 25, 2015 on a rule to prevent conflicts foreseeing the risks of water scarcity. Among other actions the normative created the definition of "***discharge states***":

I. **State of Attention:** discharge state preceding a situation of water scarcity and its State of Alert in which there will be no offtake restriction and the user of the water resources shall pay attention to possible changes in their discharge states;

II. **State of Alert:** risk of water scarcity preceding the state of restricted use characterized by a period of time when the discharge or reservoir storage states indicate the adoption of actions of alert to restrict surface water offtake and in which the user of water resources shall take measures of attention to possible changes in their discharge state;

III. **State of Restricted Use:** state of water scarcity characterized by a period when the discharge or reservoir storage states indicate restricted use of water in a hydrographic area;

In order to have just one deliberation provision, it was decided that in situations of **restricted use**, there shall be an offtake reduction as follows:

I. **Reduction of 20%** of authorized offtake daily volume for human or animal consumption or public supply;

II. **Reduction of 25%** of authorized offtake daily volume for irrigation, which can become an exception through a Normative Deliberation of the Council;

III. **Reduction of 30%** of authorized offtake daily volume for industrial and agroindustrial consumption; and,

IV. **Reduction of 50%** of authorized offtake daily volume for other uses except non-consumptive ones.

This is a creative mechanism to anticipate water collapse situations action towards minimizing water conflicts through monitoring and planning of existing water offer and demand.

As briefly shown in chapter 2, the state of Espírito Santo also used this "*discharge states*" instrument to face the water crisis that wrecked the state in 2015-2016. The results of using this instrument were encouraging.

In line with restricting authorized consumption, in January 20, 2016, the president of CBHSF (MIRANDA, access on July 9, 2016) reacting to the content of a teleconference carried out on January 18, 2016, in which ANA representatives raised the possibility of reducing the discharge of the Sobradinho dam from the current 800 cubic metres per second (m³/s) to 500 m³/s, commented:

> *"A possible access to the dead volume of Sobradinho will always bring a degree of impact, but the even bigger negative impact will be caused by the dramatic reduction to 500m³/s. In case the hydrometeorology situation reaches the worst scenario during 2016, which is not the most probable scenario, it will be necessary to find new alternatives such as* ***restricting authorizations*** *to share the weight of these impacts and prevent such degrading discharge volumes for an ecosystem already stressed to the limit."*

Another example of legal requirement which has an important function in the prevention of conflicts is the Certification of Assessment of the sustainability of a water work (CERTOH), whose provisions are included in the Presidential Decree n.4024 of November 21, 2001.

The decree established that are subject to certification: the water infrastructure works for crude water reserve or offtake equal to or higher than R$10,000,000.00 (ten million reais) to be partially or totally implemented or financed by the federal government and whose implementation or financing had been contracted after November 22, 2001.

Aiming to operationalize the provisions the ANA, by means of Resolution ANA n. 194/2002, established that the CERTOH will be issued upon request from the responsible for the water infrastructure work implementation and the **sustainability** will consider: I – the **operational** perspective characterized by the existence of an institutional mechanism that ensures the continuity of the operation of the water infrastructure work; and II – the **water** perspective characterized by the demonstration that the implementation of the water infrastructure work contributes to increasing the level of water use of the respective river basin.

It is important to notice the basic function of the CERTOH: to ensure the sustainability of the infrastructure so that it can **increase the water safety of the respective river basin**.

To make a request for a CERTOH it is necessary to present:

1. A copy of the preventive authorization or the right to use the water resources, or an equivalent document issued by a relevant authority, either state or federal;

2. a) Document proving the operational sustainability of the water infrastructure work showing the technical and operational capacity of the agency or entity responsible for its operation and maintenance; b) presentation of the sources of resources to be used in its operation and maintenance compatible with costs forecast; c) definition of the permanent operation and maintenance system; and d) availability or scheduling of the financial resources of the works that will eventually be necessary to assist the end user, or already exist.

2.1. Document proving water sustainability by means of: a) proper hydrological studies characterizing the reference discharges and their compatibility; b) proof of availability of water volumes and water quality of offtake water, in case of offtake work; c) forecast of implementation, operation and maintenance of measuring structures, and monitoring of water and effluents quantity and quality.

Based on what was said before, the CERTOH is a document that when issued contains all the relevant information to act as a powerful instrument to prevent or minimize conflicts such as the one in the Mirorós reservoir located in Bahia, where a new offtake from a Water Supply System has compromised the established uses. This conflict is mentioned in chapter 2 herein.

A second example of a preventive measure coordinated by the ANA is the Annual Declaration of water resources use (DAURH) established by Resolution n.603 of May 26, 2015. In order to ensure that the grantee monitors the offtake and discharge volumes as well as the quality of the effluents, it is mandatory that the DAURH is sent to the ANA annually.

This declaration contains the necessary measures to help the ANA to check: i) how quantitatively and qualitatively compromised is the water body or river basin; ii) the situation of the river basins regarding regulatory framework, negotiated allocations and/or water use charge; iii) some specific situations or river basins identified in inspection activities; among others.

The minimum monitoring required by the DAURH comprises: i) recording of offtake and/or discharge volumes obtained through the measurement of at least one of the following parameters: flow speed, discharge, water volume per level; ii) recording of offtake and/or discharge volumes obtained through indirect measurement or estimates, as long as the system operation time or energy consumption is calculated; iii) recording of data obtained through analysis of one or more of the following effluent quality parameters: Biochemical oxygen demand (BOD), temperature, nitrogen and/or phosphorus.

Article 21 of the resolution establishes that noncompliance with provisions from specific regulations for a water body or a river stretch is an infraction to the water resources use regulations as provide for in article 49, subsection VII, of Law n. 9433.

Thus, fulfilling the recommendation in **step four** of the method described herein, some regulations were presented that need to be assessed as guidelines and criteria to be complied with in the search for water conflict resolutions.

5.

AGREEMENTS FOR WATER CONFLICTS

This chapter briefly describes agreements reached in rivers outside Brazil and in some Brazilian rivers. This narrative demonstrates the similarities of water conflicts management in various parts of the world. However, the main objective of this narrative is to show the different actions contained in the agreements reached by governments, users and the society in water conflict situations.

THE COLORADO RIVER

Located in North America, the Colorado river is considered the most litigated river in the world, with judicial battles for the division of its Waters, which have lasted for decades. Its Waters are divides among seven North American states and Mexico, as can be seen

in Picture 6. Located at the mouth of the river, Mexico has suffered with the low quality of the water and the insufficient discharge for the water to reach the Gulf of California. Large cities such as Los Angeles, Las Vegas and Phoenix, several irrigation projects in the seven states and some hydroelectrical plants depend on its water. There are also increasing demands for the permanence of an environmental discharge which ensures the life of fauna and flora at the mouth of the river.

PICTURE 6. MAP OF THE COLORADO RIVER

Source: Stretching... (access on July 22, 2016).
Note: Map redrawn and simplified by the author.

In the Colorado river the dispute for an agreement to share the waters started in 1922 (REISNER, 1993). After 11 months of debate and using an estimated average discharge of 21.4 billion m^3 per year, the delegates divided the river into two areas with the limit close to the border between the states of Arizona and Utah. The states of California, Arizona and Nevada are located in the lower basin. In the upper basin are the states of Wyoming, Utah, Colorado and New Mexico. Parts of New Mexico and Arizona are located in both basins. It was decided that the two parts of the river basin would be entitled to use 9.1 billion m^3 per year each. The division of this amount among the states

was to be decided solely and exclusively by the parties involved. It was decided that Mexico would be entitled to 1.8 billion m^3 per year. And, as a bonus, 1.4 billion m^3 per year of the remaining discharge was reserved to the lower basin, a decision that was reluctantly accepted by the members of the upper basin.

This agreement was entered in November 1922 and the delegates returned to their states to ratify the conditions in their respective House of Representatives. California decided that it would only ratify the agreement if, at the same time, it received the authorization to build the current Hoover Dam and the new canal to Imperial Valley to meet their irrigation demands. The state of Arizona conditioned the ratification of the agreement to the previous allotment of 9.1 billion m^3 per year to the lower Colorado River basin states. And as a result, the agreement was not ratified.

In 1928, after six years of waiting, the matter was sent to the American Congress. The Congress authorized the construction of the Hoover Dam and the new canal to Imperial Valley. The former was the first dam on the Colorado river bed and the latter transferred the river water to the south of California located in another river basin. But there was a condition: that at least six states should ratify the agreement and that California limited its consumption to 5.2 billion m^3 per year. This would mean 3.4 billion m^3 per year to Arizona and just 0.5 billion m^3 per year to Nevada. Arizona refused to sing the agreement which started a new debate which would last 35 years. An enormous complicator appeared during the debate: 18 years of measurement indicated an average discharge of 21.4 billion m^3 per year; however, using new and more accurate instruments a study from 1953 indicated an average discharge of only 14.3 billion m^3 per year. A feeling of astonishment permeated the basin.

The area had the largest water works in the world, all of them planned and evaluated for a limit of 21.4 billion m3per year. Dams for power generation, irrigation perimeters, the highest populational growth of the country, a whole planning counting on this volume of water. How to face such situation?

The aim of the narrative above was to briefly present a real case, known all over the world, of water sharing in this famous American river. The fact to be highlighted here is that the condensed division lasted for years and was later threatened for overestimated discharges, which had enormous impact on

the planning of water works idealized for that area of the country. It is clear that there was no lack of creativity to reach an agreement. Even so, it was not possible to get the agreement of all the states involved. It was an agreement not agreed by all. This story was told by Reisner (1993).

Would the sharing of water solve all the conflicts in the basin? Does resolving water conflicts mean to just quantitatively share a certain volume of water among the members of a basin? The answers will be analysed later in this chapter when dealing with the sharing of water in the Piranhas-Açu river.

THE NILE RIVER

In Africa, the Nile River is responsible for the longest survival of a civilization dependent solely and exclusively on one river. The Egyptian civilization which is more than 6 thousand years old has always counted on the Nile as its sole source of water. However, other nine African countries use this water. As shown in Picture 7, Egypt is located in the lower Nile.

In the 1970s, Egypt built an enormous dam for power generation the Aswan Dam. Ethiopia is also finalizing a dam – the Grand Ethiopian Renaissance Dam – for the same purpose, causing repeated protests from the Egyptian government. There are reports indicating grave consequences from this dam on the water discharge in the Egyptian territory. Ethiopia is defending its right to build the dam. Egypt is the biggest economy in the region and has the largest military power, therefore, the tensions to share water scarcity in the region has grown year after year. The mouth of the river has also suffered serious environmental changes with wide repercussion in the international scientific community.

According to Swain (2011), and agreement from 1929 ensured Egypt's right to use 48 billion m^3 per year and 4 billion m^3 per year to Sudan leaving 32 billion m^3 of non-provisioned water per year. The agreement had the power of the British Government, which controlled Egypt at the time. In this agreement there were two notable highlights: it did not include Ethiopia and affirmed that no water work could be carried out without consultation to Egypt and Sudan.

PICTURE 7. MAP OF THE NILE RIVER

Source: River... (access on July 22, 2016).
Note: Map redrawn and simplified by the author.

Between 1956 and 1959, Egypt and Sudan entered a conflict for the division of the Nile waters again. As Sudan was against the construction of the Aswan Dam by Egypt, Egypt opposed to the Sudanese construction of the Roseires Dam at a tributary of the Nile called Blue Nile. Thus, Sudan unilaterally suspended its commitment with the 1929 agreement.

So, in 1959, a new agreement was created allocating 55.5 km^3 of water per year to Egypt and 18.5 km^3 of water per year to Sudan from the 84 km^3 of water available in the Aswan Dam area, and 10 km^3 of water per year were counted as evaporation losses and infiltrations in the Aswan Dam. By this time the other countries located in the White Nile area, the second tributary of the Nile, denounced and complained about being left out of the water division agreements.

However, more recently, in 1999, ten countries (Burundi, the Democratic Republic of Congo, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania and Uganda – Eritrea remained as an observer) united in a transitory organizational basin structure called the Nile Basin Initiative (NBI). The goals of the NBI are:

1. To use the water resources of the Nile river in a sustainable and equalitarian way so as to ensure prosperity, safety and peace to all parties of the basin;
2. To ensure the efficiency of the water resources management and the optimal use of its waters;
3. To ensure the cooperation and joint action of the basin countries aiming at win-win gains;
4. To aim at the eradication of poverty and to promote the economic integration of the region;
5. To ensure that the programs result in a movement from planning to action.

Are these goals universal when searching for a balanced use of water resources?

Comparing to the Brazilian reality, one has to ask if these NBI goals properly summarize what is intended in the management of Brazilian waters. The answer is a trusting yes. That is why the literature on international experiences is valid to help the path of the Brazilian water resources management.

Let's take a look at an international example before returning to the Brazilian scenario.

A FEW WORDS ABOUT THE TIGRIS AND EUPHRATES RIVERS

Turkey is a country that connects Europe and Asia and houses the springs of two historical rivers: the Tigris and the Euphrates. Picture 8 illustrates the location of these rivers, responsible for feeding the Sumer civilization, which lived in the Mesopotamia since 4000 B.C. Turkey, Iran, Iraqi, Jordan, Syria and Saudi Arabia have lands between these two river basins. Until present days the region has been wrecked by historical wars, religious divisions, rival ethnic groups disputes, and serious disputes for the division of waters. There is no permanent meeting forum for the parties in the basin to resolve their conflicts. The civil war affecting Syria, the political instability in Iraqi, recent tensions in Iran regarding their nuclear program have made it difficult to have international cooperation to deal with the division of the waters. As one of the cradles of civilization, there is a long way ahead for an effective agreement on the fate of these waters flowing to reach the Persian Gulf.

PICTURE 8. TIGRIS AND EUPHRATES RIVERS BASIN

Source: Mesopotamia... (2015).
Note: Map redrawn and simplified by the author.

In 1990, Turkey closed the floodgates of the Ataturk reservoir basically cutting the discharge of the Euphrates river for 30 days. At the time, the government of Iraqi insisted that a minimum discharge of 500 m^3/s should cross the Syria – Iraqi border. The Turkish government responded that it was a technical issue, not political, and because of that negotiations froze.

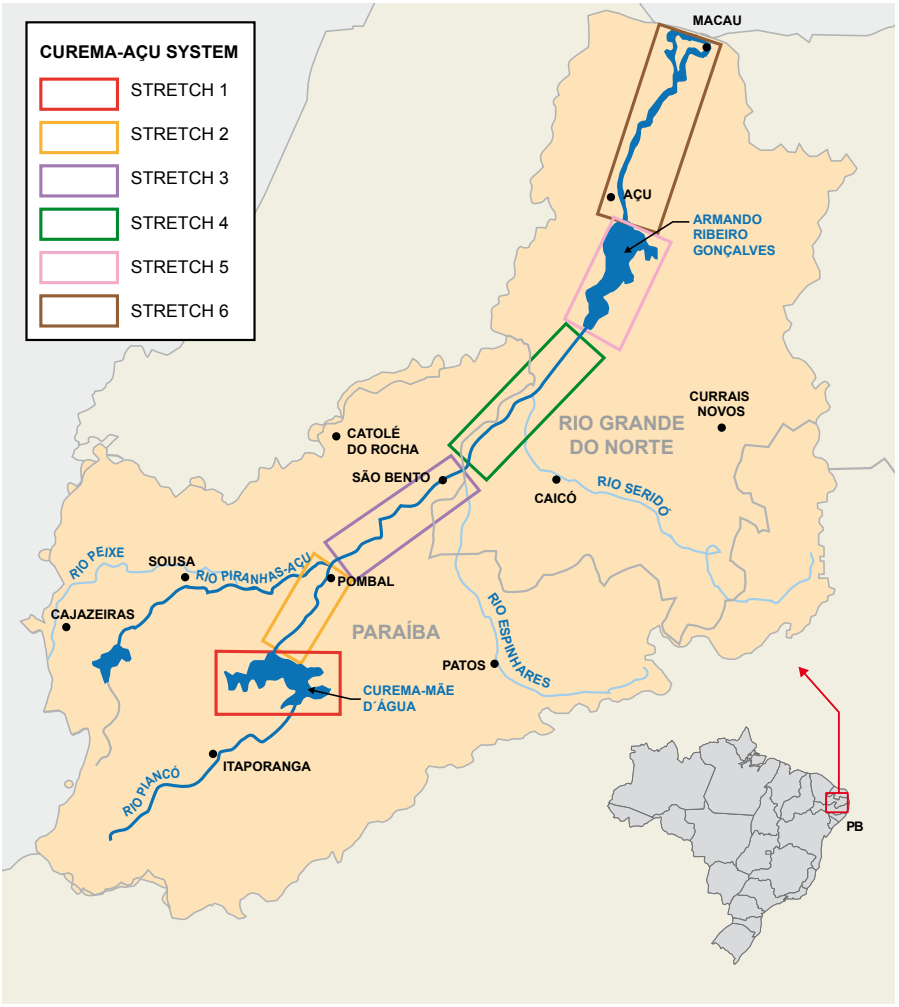
THE PIRANHAS-AÇU RIVER

A well-known conflict in the Brazilian northeast comes from the division of the waters of the Piranhas-Açu river, especially the system known as Curema-Açu located between the states of Paraíba and Rio Grande do Norte as Picture 9 shows. The Piranhas-Açu river starts in the Serra do Piancó in Paraíba and finishes on the coast of Rio Grande do Norte close to the town of Macau. In the stretch located in Paraíba there is the Curema Mãe-D'água reservoir with an adjustable discharge of 9.5 m³/s and a 95% discharge permanence. In the stretch located in Rio Grande do Norte there is the Armando Ribeiro, with an adjustable discharge of 17.8 m³/s and a 90% discharge permanence. Thus, the adjustable discharge at the river mouth is 27.3 m³/s.

The area has serious conflicts on the division of these waters. The most expressive consumptions are: urban agglomerates supply, irrigation, power generation, aquiculture, environmental preservation, leisure and tourism. As a result of an intense work from the states of Paraíba and Rio Grande do Norte, and the National Water Agency, the agency issued Resolution ANA n. 687/2004 making provisions for the division of these waters. The river was divided in six stretches and a minimum ecological discharge of 1.0 m/s was defined. The difference, that it, 26.3 m³/s was divided among the stretches in the following sequence: Stretch 1 – 2.09m³/s; Stretch 2 – 2.16 m³/s; Stretch 3 – 2.14m³/s; Stretch 4 – 1.50m³/s; Stretch 5 – 1.47m³/s; and Stretch 6 – 17.92m³/s.

In this example, first it is necessary to highlight that the minimum ecological discharge at the river mouth was only 1.0 m^3/s representing less than 4% of the maximum adjustable discharge (27.3 m^3/s). Secondly, the negotiation of the conflict was, once again, materialized into a quantitative division of reference discharges under analysis, but it is necessary that this simple arithmetic does not minimize the size, seriousness, and diversity of the conflicts in this basin. Ahead there are some of the problems of this basin (NATIONAL WATER AGENCY, 2010):

1. *Insufficient water to meet existing demands, notedly irrigation, which is increasing and represents the largest use in the basin;*
2. *Incapacity, in several stretches of the basin, of assimilating the amount of domestic, industrial and mining waste due to the low surface water availability of the basin;*
3. *Identification of qualitative and quantitative criticality is several stretches of the basin due to low water availability;*



PICTURE 9. Map of the Piranhas-Açu River

Source: National Water Agency (access on July 11, 2016).
Note: Map redrawn and simplified by the author.

4. *Low rates of urban sewage collection and treatment;*

5. *Occurrence of critical and large magnitude drought and flood events in the basin;*

6. *Silting of rivers and dams caused by the removal of ciliary forests, deforestation in other points of the basin, improper use of the soil, among other activities of environmental degradation;*

7. *Eutrophication of the dams in the basin resulting in the growing of microalgae and cyanobacteria. A probable cause for the occurrence is the dumping of untreated sewage in the basin water bodies. Considering that the water accumulated in the reservoirs is the main, if not the only, available source for human and animal consumption it is necessary that the government prioritize investments to attenuate the problem;*

8. *Dams located in the basin need to have their operations optimized considering their strategic value to the region;*

9. *Water works (dams and weirs) need to be preserved, recovered and maintained;*

10. *Water use processes to assist irrigation projects located in the basin need to be optimized so as to reduce water demand from this sector which is the largest user sector in the basin;*

11. *Indiscriminate use of fertilizers by agricultural activities, irrigated or not;*

12. *Increase of shrimp farming in the lower Açu region having na impact on the mangroves and river-marine systems in this area of the basin;*

13. *Accentuated suppression of native vegetation cover as a result of opening areas for agricultural and livestock activities, especially timber – a source of energy for brick factories, bakeries and households;*

14. *Land occupation pattern in the Seridó Potiguar area, which encompasses the eastern part of the basin and which became one of the desertification areas in the country requiring specific actions to revert the problem;*

15. *Existence of water conflicts in the saline regions;*

16. *Quality of the water compromised by textile and mining activities;*

17. *Salinization of the waters – saltwater intrusion can jeopardize the supply of the cities located in the basin;*

18. *Occupation of EPA and pollution of springs caused by uncontrolled recreational and leisure activities, especially close to urban areas;*

19. *Existence of a large number of irregular water users (no water use authorization) in the basin;*

20. *Existence of irregular water works and dams in the basin;*

21. *Improper disposal of solid residues in most municipalities.*

It is not necessary too many words to call attention to the fact that the above-mentioned problems cannot be solely resolved by the division of the waters as determined in the ANA Resolution.

The ANA Resolution should be understood as part of a larger set of actions to resolve the water conflicts in the Piranhas-Açu river. These actions certainly involve three big areas of work: i) investments in infrastructure such as water distribution and sewage collection networks, effluent treatment stations, just to mention three examples; ii) orderly use of water resources (regularizing registrations and authorization requests of all users, more efficiency and fewer losses in the use of water resources, just to mention two examples; and iii) preservation and environmental management actions, qualification of users, social mobilization towards the subject, and strengthening of the Piranhas-Açu River Basin Committee work, among others.

The list above does not encompass all the appointed needs, it is just a way to show that only a set of actions from different areas involving different agents acting in a coordinated and integrated way will ensure a good start to resolve the listed conflicts in this specific and in any other river basin.

As any complex matter, the water conflicts will never depend on just one and single action. They will Always require the integration of articulated medium and long-term programs with infrastructure, training, organizational and social mobilization actions, partnerships and consortiums between several public and private agencies, control and inspection of water resources uses, basin planning and among others.

A NOTE ON THE PARAÍBA DO SUL RIVER AGREEMENT

In the water conflicts of the Paraíba do Sul river basin resulting from serious scarcity, the ANA (National Water Agency), the DAEE (State of São Paulo Water and Power Department), the IGAM (the state of Minas Gerais Water Management Institute) and the INEA (State of Rio de Janeiro Environment Institute) edited a joint resolution (Resolution n.1382/2015) establishing the conditions for water operations in the Paraíba do Sul river basin, which encompasses reservoirs located in the basin and the structures of the Paraíba do Sul water transfer to the Guandu system (NATIONAL WATER AGENCY et al., access on July 18, 2016). This agreement for shared management of the Paraíba do Sul river basin was authorized by the Brazilian Federal (STF) during the presidency of minister Luiz Fux. The basin is depicted in Picture 10.

This agreement consolidated through Resolution n.1382/2015 (NATIONAL WATER AGENCY et al., access on July 18, 2016) established that whereas the sharing of the Paraíba do Sul river basin water resources shall be inspired by the principles of multiple, reasonable, harmonious and integrated uses always aiming at benefitting all the parties, the agencies managing the water resources shall comply with, among many other restrictions:

I - the discharge downstream the uses shall respect the following limits:

a) Paraibuna: 10 m^3/s (instantaneous);

b) Santa Branca: 30 m^3/s (instantaneous);

c) Jaguari: 4 m^3/s (instantaneous);

d) Funil: 70 m^3/s (instantaneous);

e) Santa Cecília: 71 m^3/s (instantaneous);

f) Pumped to Guandu river in Santa Cecília: 119 m^3/s (daily average); and

g) Pereira Passos: 120 m^3/s (instantaneous).

PICTURE 10. Map of the Paraíba do Sul River

Source: National Water Agency (access on July 13, 2016).
Note: Map redrawn and simplified by the author.

II - it will be considered as normal operation for the Paraíba do Sul Water System those whose instantaneous discharges have 71m^3/s (variation of up to 5% above this amount) downstream the Santa Cecília dam and 120 m^3/s (variation of up to 2% above this amount) downstream Pereira Passos.

III - it will only be allowed to increase discharges above the limit of 71 m^3/s (variation of up to 5% above this amount) downstream the Santa Cecília dam in the case of at least one of the following conditions:

a) increasing noncontrolled discharges in the stretch between Funil and Santa Cecília; or

b) Funil reservoir starts operating to comply with the flood control rules; or

c) Paraíba do Sul Water Systems starts operating above 80% the useful volume of the equivalent reservoir.

IV - it will only be allowed to increase discharges downstream Pereira Passos above the limit of 120 m^3/s (variation of up to 2% above this amount) to the maximum limit of 160 m^3/s when the Santa Cecília dam is discharging 90 m^3/s or more to the Paraíba do Sul river and in the case of at least one of the following conditions:

a) Increasing uncontrolled discharges in the stretch between Funil and Santa Cecília; or

b) Funil reservoir starts operating to comply with the flood control rules; or

c) Paraíba do Sul Water Systems starts operating above 80% the useful volume of the equivalent reservoir.

This is another example of a conflict which resulted in a rule to operate reservoir conditioned to a series of hydrological situations in the rivers and reservoirs. This way of facing water scarcity is deeply consolidated in the National Water Resources Management System scenario.

THE STATE OF CEARÁ

A controversial and innovative case took place in the state of Ceará in the basins of the Jaguaribe and Banabuiú rivers in 2001 (NATIONAL WATER AGENCY, access on July 11, 2016). The waters in these basins supplied the population of Fortaleza and most of the irrigated agriculture (especially rice with 59% of the agricultural consumption) and the vegetable and fruit plantations. Besides using water less efficiently and generating less income per water unit volume, these areas were located upstream.

The resolution to the conflict consisted of:

1. financially compensating rice producers who renounced to half their so far cultivated area;

2. charging for the use of water for irrigation to partially finance the compensations;

3. training farmers to improve their irrigation efficiency (technological expansion);

4. regulating the uses by granting authorizations to use water resources.

Rice producers accepted the agreement and received the following amounts: R$ 600.00/ha for areas of up to 2 hectares; R$ 500.00/ha for areas of between 2 and 100 hectares and R$400,00/ha for areas above 100 hectares. In order to take part in the agreement the farmer had to participate in a training program to improve water use as well as to be qualified to search for alternative crops requiring less water consumption. The ANA document describes this innovation and concludes the experience as follows (NATIONAL WATER AGENCY, access on July 11, 2016):

> *"The idea was to stop plantation of over 5,000 hectares of rice at a total cost of R$ 10 million, 80% of it would be financed by state funds and the collection of charges for the use of water resources which used to be done the following way: users with offtake lower than 1.4 L/s were exempt of payment, users with offtake between 1.4 and 6.9 L/s paid R$ 0.01/m³ with the possibility of paying half the price in case they adopted efficient methods of water use, and users with offtake above 6.9 L/s would pay R$ 0.01/m³ without the possibility of reduction.*

The project resulted in the following highlights:

1. *elimination of the risk of shortage to the city of Fortaleza;*
2. *meeting all the water demands of the vegetable and fruit plantation sector with a 20% increase resulting in a production of US$ 15 million for the sector;*
3. *reduction in approximately 3,600 hectares of irrigated rice plantations for more than 1,600 farmers;*
4. *savings of approximately 60 million m^3 of water (5.7 m^3/s); and*
5. *payment of approximately R$ 1.2 million in compensation."*

This compensation model to induce the suspension of a certain use of water is consolidated in California but it is still innovative in the Brazilian experience.

A consolidated action worth highlighting in the state of Ceará is the negotiated allotment of waters. After the rain season – and already knowing the volumes available in the reservoirs – the users and government representatives of each river basin jointly decide the allotment of waters for each user or group of users. At the occasion a hydrological model simulates the behaviour of the stored volume as a result of the demand scenarios. Thus, the negotiated allotment is a transparent, participative and integrating process for all involved in the water issues of that river basin.

THE STATE OF ESPÍRITO SANTO

The state of Espírito Santo faced its worst water scarcity crisis in 2015-2016. Local papers approached the issue with data, photos and forecasts mobilizing the entire local society. In order to deal with the reality, the Government Water Committee was created, as mentioned in chapter 4, including representatives of the State of Espírito Santo Sanitation Company (Cesan); the State Agriculture, Supply, Aquiculture and Fishing (SEAG) and Sanitation, Housing and Urban Development (Sedurb) Secretariats; the State Environment and Water Resources Institute (Iema); the Livestock and Forestry Defence Institute (Idaf); the State Research, Technical Assistance and Rural Extension Activities Institute (Incaper); the State Water Resources Agency (AGERH); and the

Mayor of the municipalities of Colatina, Santa Maria de Jetibá, Cachoeiro de Itapemirim and Domingos Martins.

During a presentation of AGRH representatives from Espírito Santo in the city of Fortaleza and in a visit to the city of Vitória invited by ArcelorMittal Tubarão, both in December 2016, it was possible to know the actions of the Governmental Water Committee and organize them in the TWO methodology format presented in chapter 4. This set of actions is presented in table 4.

TABELA 4. Methodology TWO applied to the water crisis in Espirito Santo

Sources of waters / Vectors of development	Waters for distribution	Water use management	New Sources
Hydroelectric Power Generation		Negotiation with EDP Escelsa (electric power station) ensuring the use of Bonito Dam for human supply when Santa Maria da Vitória River discharge is not enough to meet the population demand.	
Primary Production	Implementation of the Waters and Landscaping Program, with investments around R$ 1.3 billion in sanitation and water springs recovery.	Restriction and/or suspension of authorization for irrigation. Creation of the Alert, Attention and Extremely Critical States. Sustainability Certificate for the Use of Water in Irrigation.	Well drilling. Creation of the State Program for the Construction of 60 Dams, with an investment of R$ 60 million.
Urban and Industrial Growth	Concession of water trucks. Investment in the expansion and improvement of the water supply systems totalling R$ 95 million. Expansion and implementation of new sewage collection systems totalling R$ 87 million.	Permanent use of the media, partnerships with civil society organizations, meetings with society via basin committees and partnership with the Public Ministry. Rationing of public supply and leakage control Creation of the States of Alert, Attention and Extremely Critical. Community cooperation agreements. Reuse of the water in in Araças and Bandeirantes Sewage Treatment Stations for watering gardens, washing sidewalks and squares and for industrial use.	Well drilling.
Maintenance of the Ecosystem		Adhesion to 20x20 challenge: Espirito Santo government commitment to recover 80 thousand hectares. Implementation of the Waters and Landscaping Program.	

Table 4 reveals a variety of short, medium and long-term actions developed in the state of Espírito Santo ranging from suspending authorization to recovering springs and relating trees, building dams and encouraging water reuse, recycling and recirculation in industrial plants. In order to make all the actions understood, let's explain the less traditional uses in the national scenario.

Regarding these developed actions it is understood as the **Specific Common Cooperation Agreement** the set of actions and behaviour rules technically proved and collectively accepted related to the use of water in the industrial sector and which will ensure the conditions for human supply throughout the State of Alert.

Declaring State of Alert and State of Attention imply in taking several measures, such as:

a) mobilizing the society to create actions and adopt emergency measures of local and regional reach to encourage the reasonable use of waters as a strategy to face the scarcity scenario of 2015;

b) recommending that agricultural foment and/or funding immediately suspend for undetermined period the operations to implement new irrigation systems;

c) adopting measures to reduce supply in water supply contracts for large industrial users;

d) immediately developing and implementing the necessary measures to adapt to this new scenario aiming to encourage the population to reduce average daily water consumption;

e) implementing the necessary measures and interventions to reduce losses in the water distribution sector;

f) suspending for a 90 (ninety) day period, to be extended to as long as the scenario remains the same the granting of new authorizations for the Right to use water resources for: I) Irrigation; II) Aquaculture; III) Fish farming; IV) Industrial purposes; V) reducing dust on streets or other sources;

g) defining time periods for water offtake just for human and animal supply;

h) the possibility of several users of the municipalities springs to make agreements;

i) recommending industrial enterprises to immediately adopt measures to reuse and recycle water in their units aiming at reducing consumption;

j) recommending town halls of the entire state of Espírito Santo to expedite the adaptation of their municipal codes aiming to prohibit and fine activities known as water wasters such as: I) window, sidewalks, flooring, walls and car washing using hoses; II) watering of lawns and gardens; III) cooling of roofs through water spraying or open heat exchange systems; IV) spraying of water to reduce dust on streets and other sources, except in cases of reuse of treated waste water;

k) determining that it is prohibited in the whole state of Espírito Santo in daytime hours – from 5am to 6pm: a) water offtake from surface water courses for any and all uses except human supply; and b) water offtake from excavated well located closer than 300m from a surface water body.

The **Sustainability Certificate** is a document issued by the AGERH as part of the initial procedures for the issuing of a Right of use water resources including a commitment from the receiver to use water reasonably and efficiently in irrigation activities.

Another action to face water scarcity took place in the São Mateus river. In this river, in partnership with the National Water Agency, each hydrological state corresponded to a certain level of permission to use water. Thus, the fluviometric station of Boca da Vala located 40 km upstream the city of São Mateus (ES) was chosen to characterize the situation. The whole methodology is very practical, transparent and easy to understand as shown in chart 6. If water level on the measuring rule of the fluviometric station is between 84 and 103 cm it is an alert situation and in this case the only uses allowed are public supply and authorized uses.

If the level of water is below 46 cm it is a suspension situation and only human and animal consumption are allowed, and so it goes for other levels. In the hydrological state of **Restriction**, water offtake for authorized uses, except human and animal consumption, can only take place from 10pm to 6am.

Bands	Hydrological state	Water uses allowed
Above 104 cm	NORMAL	Public supply + authorized uses without restrictions + Uses without regulation
From 84 - 103 cm	ALERT	Public supply + authorized uses without restrictions
From 47 - 83 cm	RESTRICTION	Human consumption and quenching animal thirst + authorized uses with restrictions
Below 46 cm	SUSPENSION	Human consumption and quenching animal thirst

CHART 6. Discharge states and permission of use of the São Mateus River waters

Source: National Water Agency (access on Dec. 19, 2016).
Note: Picture redrawn by the author.

The strength of this methodology is the transparency of the decision-making process, even though requiring collaboration, acceptance and respect from all users of the basin. It is a social agreement for the division of water in times of scarcity. The results have been encouraging. This operation is defined in the ANA Resolution n. 662/2010.

It is fully proved that the state of Espírito Santo presented several effective and articulated alternatives to face the recent water crisis. In a dialog with the representatives of the committee it was possible to see the amount of synergy and speed in the decision making was achieved in the integration of several public agencies which received a mission of clear and undisputable relevance. The conclusion is that the Governmental Water Committee ended up strong.

And how did the industrial sector react to the water scarcity? That is what we are going to see ahead using ArcelorMittal Tubarão as an example.

THE REACTION OF THE INDUSTRY TO WATER SCARCITY

The World Economic Forum published in 2016 its 11th report on global risks (WORLD ECONOMIC FORUM, 2016). This document highlights events that will affect with higher impact and probability, the institutions and the economy. According to the report it is possible to observe that water crises is among the five biggest impacts in the last 5 years as can be seen in Picture 11, copied from the document. This analysis is in

accordance with the facts taking place in Brazil in the last five years. Let's take a look at an example of how the industry sector reacted to this scenario.

Top 5 Global Risks Terms of Impact

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
1st	Asset price collapse	Asset price collapse	Asset price collapse	Asset price collapse	Fiscal crises	Major systemic financial failure	Major systemic financial failure	Fiscal crises	Water crises	Failure of climate change mitigation and adaptation
2nd	Retrenchment from globalization	Retrenchment from globalization (developed)	Retrenchment from globalization (developed)	Retrenchment from globalization (developed)	Climate change	Water supply crises	Water supply crises	Climate change	Rapid and massive spread of infectious diseases	Weapons of mass destrution
3rd	Interstate and civil wars	Slowing Chinese economy (<6%)	Oil and gas price spike	Oil price spikes	Geopolitical conflict	Food shortage crises	Chronic fiscal imbalances	Water crises	Weapons of mass destruction	Water crises
4th	Pandemics	Oil and gas price spike	Chronic disease	Chronic disease	Asset price collapse	Chronic fiscal imbalances	Diffusion of weapons of mass destruction	Unemployment and underemployment	Interstate conflict with regional consequences	Large scale involuntary migration
5th	Oil price shock	Pandemics	Fiscal crises	Fiscal crises	Extreme energy price volatility	Extreme volatility in energy and agriculture prices	Failure of climate change mitigation and adaptation	Critical information infrastructure breakdown	Failure of climate change mitigation and adaptation	Severe energy price shock

Economic Environmental Geopolitical Societal Technological

PICTURE 11. Main impacts highlighted by the World Economic Forum

Source: World Economic Forum (2016).
Note: Picture redrawn by the author.

In order to comment the actions of the industry sector related to the water crisis, we took as an example ArcelorMittal Tubarão, an integrated producer of flat steel located in the Vitoria Metropolitan Area in the state of Espírito Santo, southeast of Brazil. Having an annual production capacity of 7.5 million tons of steel in slabs and hot coils, it employs more than 4.5 thousand people. Its location close to a logistics complex including port, roads and railway facilities favours the availability of inputs and raw materials as well as the transportation of the products to the domestic and international markets.

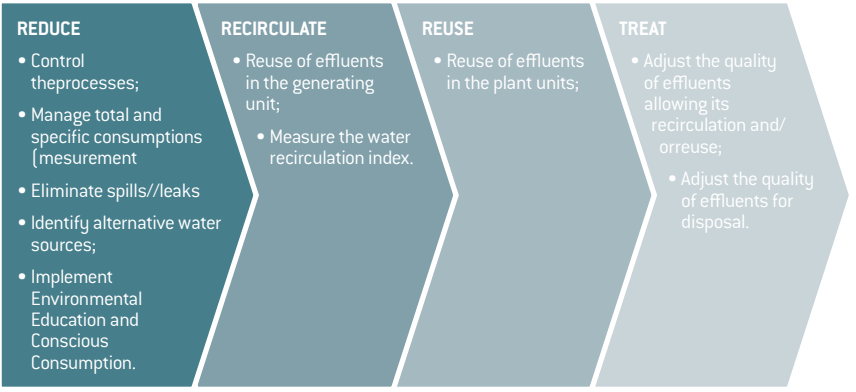
Picture 12 shows the mouth of the Santa Maria da Vitória river forming the Vitória Bay and on the side, it is possible to see the port complex where ArcelorMittal Tubarão is located. The port complex is considered one of the most efficient in the world, especially the Praia Mole Port, which includes a Steel Products Terminal, managed by ArcelorMittal Tubarão.

PICTURE 12. Location of Santa Maria da Vitória River and ArcelorMittal Tubarão
Source: Location... (2017).

Since it started operations in November 1983, ArcelorMittal Tubarão has been guided by the continuous search for process and products innovation and quality having invested nonstop in new technologies and in the expansion of its production capacity.

At Tubarão, 95.5% of the water used in the production process (48,000 m³/h) comes from the sea to be used in equipment cooling, and the other 4.5% (2,100 m³/h) come from underground water wells and the crude Water Supply System from CESAN, whose source is the Santa Maria da Vitória river.

In 2014, ArcelorMittal Tubarão decided to build its **Water Master Plan** for the **FCSA** (Flat Carbon South America) segment (ARCELORMITTAL TUBARÃO, 2016). The aim was to establish guidelines for the management and use of water resources (fresh, surface, underground and sea) and the treatment and reuse of effluents identifying opportunities and aiming at controlling and reducing risks and continuously improving the processes in compliance with applicable legal requirements and taking into consideration future scenarios of availability. The guidelines for water management in the Master Plan are summarized in Picture 13.



PICTURE 13. Guidelines for water management in ArcelorMittal Tubarão Water Master Plan

Source: ArcelorMittal Tubarão (2016).
Note: Picture redrawn by the author.

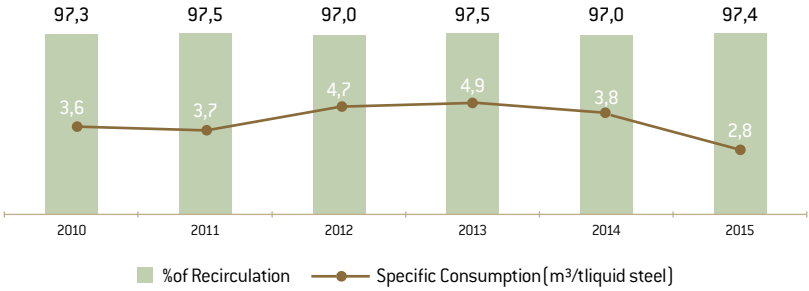
ArcelorMittal Tubarão Water Master Plan was designed to have six lines of work. Picture 14 shows the main lines of action in the company.

PICTURE 14. Water Master Plan Lines of Action

Source: ArcelorMittal Tubarão (2016).

In order to achieve these targets, a water resources management system was created to ensure the legal compliance, the allotment, the aquatic ecological

balance and the monitoring of the use of water resources aiming at the sustainable development of the company. Picture 15 presents the permanent monitoring of the fresh water recirculation targets achieved. It is possible to see that in 2013 the fresh recirculation index at the Tubarão unit was already 97.5%.



PICTURE 15. Fresh water recirculation and specific consumption at ArcelorMittal Tubarão

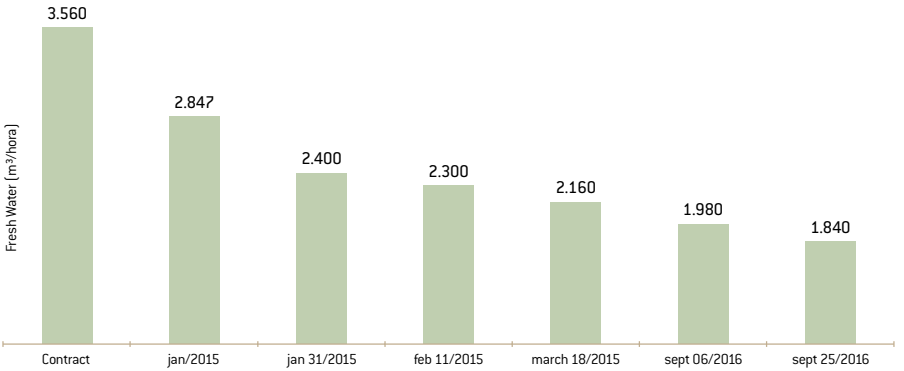
Source: ArcelorMittal Tubarão (2016).
Note: Picture redrawn by the author.

ArcelorMittal Tubarão aware of the importance of the Water Resources National Management System also takes part in the Santa Maria da Vitória River Basin Committee, the spring that supplies the water used in their plant.

In January 2015, when the first water rationing for companies was carried out by CESAN, several actions for the efficient use of fresh water were already in progress inside the company and as a result of the success of these initiatives the year was closed with the 39% fresh water consumption. In 2016, as the rationing continues, and all additional cuts made by CESAN, the company reached a 49% rationing regarding the water volume contracted from CESAN. Picture 16 illustrates this progressive consumption reduction.

The rain that fell in November 2016 brought relief to the water scarcity. However, **ArcelorMittal Tubarão** made a public announcement informing that even with the end of the water rationing, the company would keep consumption reduction equivalent to one day of supply per week, thus providing support to the society and the government to face the water crisis.

Among the actions which allowed to continue operations with less water consumption was the technological modernization of the water treatment station for reuse, representing the biggest private investment in water ruse in the state of Espírito Santo totalling R$ 23 million.



PICTURE 16. Reduction in ArcelorMittal Tubarão fresh water consumption (m³/h) during the two-year period 2015-2016

Source: ArcelorMittal Tubarão (2016).
Note: Picture redrawn by the author.

This station currently has the capacity to produce 400 m³/h industrial water from industrial and internal domestic effluents. The company has also adopted a series of actions to optimize processes such as the elimination of losses and the increase of internal reuses several of these initiatives were suggested by own and contractor's personnel who circulate daily around the plant and are engaged in the search for solutions to the problem.

Besides that, the cleaning and spraying of the streets and pathways has been done with reuse water and the spraying of raw material piles is now using polymers reducing the consumption of water in the process. **ArcelorMittal Tubarão** has also focused on projects to desalinate sea water and studies with **CESAN** to reuse, for example, the effluents from the Sewage Treatment Station in Camburi in the industrial processes.

6.

GOOD PRACTICES FOR MEETINGS

In order to make the described method work properly in the committees dealing with the water crisis some prerequisites are necessary. Some are usual actions now and again violated in the public and private agencies. These actions per se do not ensure the success of an agreement, but when they are disrespected they make it extremely difficult for the parties to reach a successful agreement. The recommendations ahead are based on experiences from the book *Fundamentals of Negotiation: A Guide for Environmental Professionals* (MILLER; COLOSI, 1989) and freely adapted by the author for this chapter:

1. The meeting room needs to accommodate the whole team involved in the discussions. The meeting has a bad start if there are not enough chairs and space on the table for everybody. And the audio-visual shall be working properly. As

obvious as this recommendation may seem, ask yourself how many times have you witnessed basic things fail leading to delays, annoyance and complaints and even compromising the result of a meeting.

2. In meetings for conflict analysis there can be no surprises from information known by just one of the sides. And, above all, it is imperative to assure certain reservations while the conditions of the agreement are being prepared. It is necessary to mention here that the reservation refers to the leaking of information outside the committee while the first lines of the agreement are being dealt with. It is evident that, after this step the whole preliminary text of the agreement is published for analysis, correction, improvement, voting and approval by the committee plenary. The reservation aims to push away the dangerous "ghost participant" as will be commented further ahead.

3. All relevant information shall be known beforehand by everybody. For example: the arrival of a piece of information saying that the discharges offered by some tributary have been updated and, therefore, all the analysis have to be redone will undermine the meeting. It is necessary to be completely certain that all participants have the same information.

4. The team needs to be prepared for the meeting and not just present. It is necessary that the members have exhaustively analysed the proceedings of the process. This shows earnestness, professionalism and mainly respect for the other party.

5. It is important to observe the profile of each professional in the analyses committee. In a brief way it is possible to see that there are three types of behaviour in a conflict meeting. First, there are the ones who are not willing to take any concession, they have their opinions and intend to keep them. Second the ones that a usually willing to concede in certain points and quickly finish the meeting with some agreement reached, they do not tolerate long impasses and reflections. And, finally, it is necessary to find the one with a mediator profile, the one coordinating the meeting needs to have this profile, which means the ability to ponder several points of view, to concede in what is possible, but to preserve the essential. It is indispensable that each one recognizes the profile of the other so that the team can work in harmony.

6. During a negotiation meeting it is very important that each team defending a certain point of view do not show internal differences of opinion. There is nothing

more harmful for the unit of a certain group than having its members discussing in front of the other group representing other interests. If some new surprising information astonished the group it is evident that it is necessary to rethink the strategy, the right thing to do is to ask for a recess, 15 to 30 minutes, so that in a private place the group can reorganize their line of defence.

7. The same recommendation is true when the heat of the debate increases beyond healthy levels. In such cases it is also important to stop and cool down the debate so that some accentuated harshness or nervousness do not undermine institutional or even personal relationships which must be preserved. The success of the agreements reached in the committees comes from the preservation of this unit. This breaktime to reflect helps to share the information privately, to regroup the ideas after a surprise, to cool down the debate when necessary, and to get information on very specific technical issues from specialists who are not part of the negotiation table.

8. The team needs to have a leader. This leader will act as the spokesperson of the group, the person who received the assignment to decide in the name of the group or actors not present at the meeting. The leader after listening to their and other teams has the authority to decide the conditions of the agreement. An important characteristic of the leader is to be a good observer and listener. It is necessary that they show through gestures and words that they are really interested in the arguments and points of view of the other party and always searching to highlight points of convergences and to minimize dissentions.

9. A practice that needs to be well understood is the lateral negotiation. It is a direct negotiation among the managers responsible for the final decision in negotiations working laterally to the group which represent them in the negotiation. In certain occasions it is a desired, even indispensable, situation. However, it is necessary that the team at the negotiation table knows and agrees with this action of the top echelons. In environments such as the river basin committees it is common. Let's imagine a dispute for the construction of a reservoir to generate hydroelectrical energy in a committee meeting. Although the representatives of the power company, the Mines and Energy Ministry, and state government involved are present to defend their interest, it does not seem strange that because of the importance of the debate, the managers in such case the president of the power company, the State Minister and the governors have private negotiations taking

place in parallel with the committee meetings. It would be difficult to believe that managers with this magnitude of responsibility and decision-making power would be out of the entire movement to approve, or not, of large targets of their management area. But it is evident that the team representing the public manager and the manager themselves has to know about their movements. At any moment it means to weaken the power of the committee plenary as a legal and legitimate forum to resolve conflicts at the first instance.

10. Another common situation is the "ghost participants". They are people or entities which are not at the negotiation table but are heard and can influence the decisions, and their opinions are worth a lot to those at the table. The negotiation team has to acknowledge the existence of the "ghost" but remember that it does not act directly in the process nor should or could it be treated as if it did. It is the case of groups that have political interests and do not take part in the committees but have great interest in the debates which draw high public attention. It is also the case of companies having interests in works which depend on, for example, the reassessment of the authorization criteria defined by the committee. But it is necessary that their work is controlled so that the members can act with Independence within the limits defined by the committee work regulations.

11. A dangerous yet common situation in the committee is that support groups' opinion changes according to the issue under analysis. In the operation of reservoirs such dynamics is easy to map. When the decision is to reduce the intake discharge of a reservoir to a value below the minimum ecological discharge there will be defenders and critics to such measure. While in decisions to reduce the reservoir offtake discharge so that the main stream of the river can receive the intake discharges without causing floods downstream all involved would be in favour. Such is the complex and immutable reality of environments with a great variety of participants and interests regarding water resources.

12. The team shall select a member to be the group editor. This person shall have this task only, such is the importance of recording what happens, the main arguments and especially the points of convergence which will later be improved to be part of the reached agreement.

13. In the phase of preparing the meeting it is important to make clear to the whole team the desired goal and the strategy to accomplish it. By the same token, it is essential to know beforehand the acceptable minimum to reach as agreement. The team has to have some manoeuvring room but knowing very clearly where not to accept less. It is vital to determine at the very beginning the negotiable and the non-negotiable items.

14. It is essential to analyse past negotiations and how their agreements were implemented. Which procedures have been used? What were the strengths and weaknesses of past negotiations? What were the items the parties had difficulty complying with?

15. It is important that the meeting starts with a previous distribution of summaries of the analysed issued. Such procedure builds trust between the parties preventing promises and commitments which cannot be delivered.

16. It is important that a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis is carried out to organize each alternative of the debates.

17. It is imperative that all parties fully understand each item of the agreement in progress. It is obvious that a good agreement, written in a clear and accessible language is fundamental to reach, in the end, the desired agreement.

18. Finally, it is necessary to close the agreement emphasizing the collective effort and make the final document containing the conditions of the agreement public.

Evidently, the whole process will be made easier if it counts on the help of a support team used to conflict environments as well as to the methodologies to overcome them.

7.

CONCLUSION

Given the importance of water to humanity the United Nations (UN) proclaimed the years 2005-2015 as the **International Decade for Action 'Water for Life'**.

Among other actions the UN recommended the following actions to make the International Water Decade effective:

1. An integrated view of all agents to cooperate for water
2. A search for innovation and cooperation for the use of water
3. A clarification of the benefits of cooperating for the use of water
4. A need to cooperate to build peace and safety

5. A need to cooperate for sustainable development

6. A need to cooperate to beat poverty and to ensure universal access to water

The chapters and content of this book are um complete harmony with the UN recommendations. As showed herein, the future of water conflicts are agreements for peaceful coexistence in which the sides have their demands fulfilled according to the cooperation conditions negotiated by the parties.

However, as in any complex issue the water conflicts will never depend on a single isolated action. They will always require an integration of articulated medium and long-term programs including infrastructure, training, organization and social mobilization actions, partnerships and consortiums between several public and private agencies, the active and decisive participation of the river basin committees, the control, inspection and monitoring of the use of water resources, the effective application of the six instruments of Law n.9433/1997 having all its fundaments and guidelines fully operational. All that regarding the Brazilian waters.

Therefore, the conflict resolution needs to be understood as a process which develops over time. It will never be a finishing line. It will always need monitoring, inspection, direction correction, and, above all, a respectful and trustful cooperation between the involved parties.

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The Government of Espirito Santo, via the State Agriculture, Supply, Aquiculture and Fishing (SEAG) Secretariat, in view of the priorities and challenges of the agricultural, industrial and public supply resulting from the strong water crisis in the State, gathered a team of professionals to discuss strategies regarding water resources management.

Priority actions to minimize the effects of water shortage have been discussed and implemented. The measures break paradigms and are a revolution in the legal structure related to the matter, among them: an increase in water reservation, shared decisions, empowerment and valuing of basin committees, normatization of water use, sustainability certificates, reduction of bureaucracy in procedures to issue licence for dams, incentives for sustainable production and the use of efficient irrigation systems, reforestation and water and soil preservation.

The book highlights the successful experience in Espirito Santo, showing that we are on the right path, although there is a long way to go. The creation of the Government Water Committee is an innovation and reflects the cross-institution aspect and a synergy in decision-making confirming what water resources policies recommend. Finally, "Agreement" and "Negotiation" are key-words in water resources management, mainly in a scenario of increasingly scarce resources where conflicts are inevitable.

Octaciano Neto

State Agriculture, Supply, Aquiculture and Fishing (SEAG) Secretary

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