Water governance in Brazil
The need to share water in the anthropocene
Costa de Barros, E.

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ANNEX A. SEARCH TERMS

Keywords searched in scientific databases

#1 water governance
TS=(("water" OR "river*" OR "basin*") AND ("governance" OR "conflict*" OR "management*"))

#2 transboundary
TS=("transbound*")

#3 national
TS=(("federal*" OR "domestic*" OR "national*" OR "internal*" OR "state*" OR "Argentina*" OR "Australia*" OR "Austria*" OR "Belgium*" OR "Bosnia and Herzegovina*" OR "Brazil*" OR "Canada*" OR "Comoros*" OR "Emirates" OR "Ethiopia*" OR "Germany*" OR "India*" OR "Iraq*" OR "Kitts and Nevis" OR "Malaysia*" OR "Mexico*" OR "Nepal*" OR "Nigeria*" OR "Pakistan*" OR "Russia*" OR "soviet union" OR "USSR" OR "South of Sudan" OR "south sudan" OR "Switzerland" OR "Swiss" OR "United States" OR "USA" OR "Venezuela*" OR "Somalia*")

#4 sustainable and inclusive development
TS=("sustainable development" OR "inclusive development")

#5 instrument
TS=(("instrument*" OR "policies" OR "policy" OR "adaptive*" OR "indicator*")

#6 river governance
TS=(("river*" OR "basin*") AND ("governance" OR "conflict*" OR "management*"))

Set A = 1 AND 2 AND 3  681 results
Set B = 4 AND 5 AND 6  444 results
## ANNEX B. SUMMARY OF TERMS AND DEFINITIONS

<table>
<thead>
<tr>
<th>Terms</th>
<th>Definitions</th>
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<td>Water governance</td>
<td>The concept of water governance is still being defined and refined, most of the time related to the field of interest. I use the definition “the political, social, economic and administrative systems in place that influence water use and management. Essentially, who gets what water, when and how, and who has the right to water and related services, and their benefits? It determines the equity and efficiency in water resource and services allocation and distribution, and balances water use between socio-economic activities and ecosystems” (UNDP, SIWI, 2016).</td>
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<tr>
<td>Drought</td>
<td>Drought has a complex definition because their definition differs across climatic regions, scientific disciplines, and sectors (UNDRR, 2021). Normally, it is defined taking into account the long-term average climate of a specific region (Heim Jr, 2002; Dai, 2013). The Intergovernmental Panel on Climate Change (IPCC) defines drought as “a period of abnormally dry weather long enough to cause a serious hydrological imbalance” (IPCC, 2012), when apply for this thesis</td>
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<tr>
<td>Ecological flow</td>
<td>Ecological flow “corresponds to the amount of water that must remain in the watercourse in order to maintain the activities of the aquatic and riparian organisms. In order to determine this, besides the studies of the hydrological conditions of the basin, the analysis of the response of the aquatic species to the changes of hydrological factors should be done. The understanding of the interrelation biota-flow is essential for determining the ideal flows to support river ecosystems” (da Silva, Pereira and de Oliveira Vieira, 2020, p. 19)</td>
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### ANNEX C. FEDERAL STATES AND WATER PROBLEMS/ WATER-SHARING

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## ANNEX D. INTERVIEW LIST

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## ANNEX E. MAIN ACTORS IN THE MULTI-LEVEL CASE STUDY

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<tr>
<td></td>
<td>Companhia Hidreletrica do São Francisco - CHESF (Hydropower Company of Sao Francisco)</td>
</tr>
<tr>
<td></td>
<td>Peixe Vivo Agency</td>
</tr>
<tr>
<td></td>
<td>Articulação Semiárido Brasileiro - ASA (Brazilian Semi-Arid Articulation)</td>
</tr>
</tbody>
</table>

Source: (Ioris 2001; CBHSF, 2016, p. 17; OECD, 2015; OECD, 2015c)
## Responsibilities

- **Global World Bank**
  - Grants loans and provides for projects and infrastructure in the water and sanitation sector.

- **Inter-American Development Bank (BIRD)**
  - Provides technical and financial assistance in the water and sanitation sector.

- **National Conselho Nacional de Recursos Hidricos - CNRH**
  - Responsible for approving general criteria for allocating water, including the granting of water permits; elaborate the National Water Resources Plan and deliberated on major issues and disputes.

- **Agência Nacional de Água - ANA** (National Water Agency)
  - Responsible for ensuring everyone’s access to water resources.

- **Ministério do Meio Ambiente - MMA** (National Department of Environment)
  - Implementation of the national water resources management system and regulation of water uses in federal water bodies. Planning, hydrologic monitoring, regulation (definition of rules and enforcement), issuing water permits in federal water bodies. This is also responsible to prevent, minimize the effects of droughts and floods and to mediate conflicts of interest involving water.

- **Ministry of Agriculture**
  - The National Department of Environment coordinates policies related to freshwater, river basins (e.g., river revitalization programs), aquatic biodiversity, water resources, and coastal zones and oceans (OECD, 2015c, 64); formulates policies concerning climate change adaptation and the national policy on climate change (OECD, 2015c); promotes the integration of sustainable development in public policies at all levels of government and society.

- **Ministry of National Integration**
  - The Ministry of Agriculture has an important role regarding irrigation, especially when it comes to financing and products pricing, its role is supplemented by the Ministry of National Integration – meu Irrigation Ministry plays an important role in water management as irrigation is the largest consumer of water in Brazil (OECD, 2015).

- **River Basin Committees for rivers of federal domain (CBHs)**
  - The Ministry of National Integration responsible for inter-basin transfers that cross state boundaries, such as the São Francisco River basin in the Northeast of Brazil.

- **Inspetoria Federal de Obras Contra as Secas - IFOCS** (Federal Department of Drought Control Service)
  - Approve the basin plan, arbitrate conflicts over water use, establish the values of bulk water use fees, and others.

- **Departamento Nacional de Obras Contra as Secas - DNOCS** (Department of Works against Droughts)
  - The major federal agencies involved in the development solutions for the lack of drinking water and physical irrigation in the São Francisco Region, including the states of Alagoas, Bahia, and Pernambuco created in 1945.

- **Comitê de Bacia do São Francisco - CBHSF** (Watershed Committee of the Sao Francisco River)
  - It is formed by 62 full members subdivided into three groups: 38.7% of users; 32.2% of representatives of federal, state, and municipal authorities; 25.8% of civil society; and 3.3% of traditional communities. There are several entities among the committee members from the six states and the Federal District part of the basin (CBHSF, 2016).

- **Companhia Hidreletrica do São Francisco - CHESF** (Hydropower Company of Sao Francisco)
  - CHESF is responsible for the implementation and operationalization of the multi-use hydropowers and dams. The organization was designed based on the North American Tennes-see Valley Authority planning as a model to develop the São Francisco Valley (Ioris 2001).

- **Peixe Vivo Agency**
  - Acts as a water agency and functions as the CBHSF’s executive secretariat, providing technical support since 2010.

- **Articulação Semiárido Brasileiro - ASA** (Brazilian Semi-Arid Articulation)
  - ASA has over 600 non-governmental organizations affiliates under the Semi-arid Articulation. In parallel to the 3rd Conference of the Parties to the Convention to Combat Desertification and Drought (COP3) of the United Nations hosted in Recife city in Pernambuco state in 1999, the organizations launched the Declaration of the Brazilian Semi-Arid. Considered as a ruptured document with the philosophy and actions of the drought combat, the Declaration points out structuring measures for the sustainable development of the region, guides a set of political measures and practices of coexistence with the Semiarid and, in this context, proposes the formulation of a program to build one million cisterns in the Brazilian Semi-Arid.
# ANNEX F. LIST OF POLICY INSTRUMENTS ANALYSE IN TERMS OF GOAL ACHIEVED CONSIDERING THE ID DIMENSIONS

<table>
<thead>
<tr>
<th>Level</th>
<th>Instrument</th>
<th>Policy instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal</td>
<td>Federalism</td>
<td>1988 Federal Constitution</td>
</tr>
<tr>
<td></td>
<td>Priority of use</td>
<td>National Water Law (Law No. 9433/1997)</td>
</tr>
<tr>
<td></td>
<td>Human Right to Water</td>
<td>National Water Law (Law No. 9433/1997)</td>
</tr>
<tr>
<td></td>
<td>Water use permit</td>
<td>National Water Law (Law No. 9433/1997)</td>
</tr>
<tr>
<td></td>
<td>Protected areas</td>
<td>National System of Protected Areas (Law No. 9985/2000)</td>
</tr>
<tr>
<td></td>
<td>Climate proofing</td>
<td>National Policy on Climate Change (Law No. 12.187/2009)</td>
</tr>
<tr>
<td></td>
<td>Disaster Risk Management</td>
<td>National Policy of Civil Protection and Defence (Law No. 12608/2012)</td>
</tr>
<tr>
<td>SFRB</td>
<td>Priority of use</td>
<td>National Water Law (Law No. 9433/1997)</td>
</tr>
<tr>
<td></td>
<td>Irrigation systems</td>
<td>Irrigation Policy (Law No. 12787/2013)</td>
</tr>
<tr>
<td></td>
<td>Bulk water charge</td>
<td>National Water Law (Law No. 9433/1997)</td>
</tr>
<tr>
<td></td>
<td>Crisis Chamber</td>
<td>1988 Federal Constitution</td>
</tr>
<tr>
<td></td>
<td>Minimum flow</td>
<td>Decree 3692/2000</td>
</tr>
<tr>
<td>BA</td>
<td>Priority of Use</td>
<td>Law No. 11612/2009</td>
</tr>
<tr>
<td></td>
<td>Water use permit</td>
<td>Law No. 11612/2009</td>
</tr>
<tr>
<td></td>
<td>Protected areas</td>
<td>Law No. 10431/2006</td>
</tr>
<tr>
<td></td>
<td>Minimum flow</td>
<td>State Decree No. 6296/1997</td>
</tr>
<tr>
<td>PE</td>
<td>Priority of use</td>
<td>Law No. 11.426/1997 art. 2, III</td>
</tr>
<tr>
<td></td>
<td>Water use permit</td>
<td>Law No. 12984/2005</td>
</tr>
<tr>
<td></td>
<td>Protected areas</td>
<td>Law No. 13787/2009</td>
</tr>
<tr>
<td></td>
<td>Minimum flow</td>
<td>Decree No. 6296/1997</td>
</tr>
<tr>
<td></td>
<td>Climate proofing</td>
<td>Law No. 14090/2010</td>
</tr>
<tr>
<td>AL</td>
<td>Priority of use</td>
<td>State Water Law No. 5965/1997</td>
</tr>
<tr>
<td></td>
<td>Water use permit</td>
<td>State Water Law No. 5965/1997</td>
</tr>
<tr>
<td></td>
<td>Protected area</td>
<td>State Law No. 7776/2016</td>
</tr>
<tr>
<td></td>
<td>Minimum flow</td>
<td></td>
</tr>
</tbody>
</table>
### Dimensions of ID

<table>
<thead>
<tr>
<th>Social</th>
<th>Ecological</th>
<th>Relational</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>(ii)</td>
<td>(iii)</td>
</tr>
<tr>
<td>Art. 3, I and III</td>
<td>Art. 4, VII</td>
<td>Art. 11</td>
</tr>
<tr>
<td>Art. 1, III</td>
<td>Art. 4, I to III</td>
<td>Art. 4, XIII</td>
</tr>
<tr>
<td>Art. 11</td>
<td>Art. 5, I to V</td>
<td>Art. 4, V</td>
</tr>
<tr>
<td>Art. 11</td>
<td>Art. 4, III</td>
<td>Art. 4, I</td>
</tr>
<tr>
<td>Art. 19, III</td>
<td>Art. 17</td>
<td>Art. 19, III</td>
</tr>
<tr>
<td>Art. 2, II</td>
<td>Art. 4, VII</td>
<td>Art. 4, XIII</td>
</tr>
<tr>
<td>Art. 17</td>
<td>Art. 4, I to III</td>
<td>Art. 3, XIV</td>
</tr>
<tr>
<td>Art. 2, II</td>
<td>Art. 12</td>
<td>Art. 12</td>
</tr>
<tr>
<td>Art. 13</td>
<td>Art. 4, VII</td>
<td>Art. 4, I to III</td>
</tr>
<tr>
<td>Art. 1, III</td>
<td>Art. 3, XIII</td>
<td>Art. 3, XV</td>
</tr>
<tr>
<td>Art. 16</td>
<td>Art. 4, I to III</td>
<td>Art. 4, XIV</td>
</tr>
</tbody>
</table>
ANNEX G. SEMI-STRUCTURED QUESTIONNAIRE

(1) Professional profile

1.1 Name/e-mail
Gender
Age (approximately)
Profession/Disciplinary background
Name of the organization where the interviewee currently works
Years that he/she works in the organization
Current position in the organization
1.2 Given your professional background as... (engineer/biologist/architect etc), what has been your relationship with water? Do you – in the position you currently fulfil – have any specific responsibility/function related to water?
1.3 What responsibilities/functions does your organization have in relation to water?
   (multiple answers possible?)
a- Decision making/developing public policies
b- developing laws
c- developing quality standards
d- monitoring adherence to quality standards
e- Administration and provision
f- Infrastructure provision
g- Industrial Consumption
h- Consumption for mining
i- Consumption for agriculture/cattle breeding
j- Ecological activism
k- Social activism
l- Research
n - Other: (specify):

(2) Education

2.1 Which ideas/paradigms or approaches to water have been the most influential in your work in the most recent years?
2.2 How did you develop these ideas/this approach?
   a- Formal education
   b- Experience/professional practice
   c- Participation in networks (virtual or non-virtual)
   d- Media
   e- Other (specify): ____________

2.3 Which organization/publications or authors have been most influential in this respect?

2.4 Which concrete influence have these paradigms/approaches as well as these organizations/publications and authors had in your daily work?

(3) Water governance

3.1 Do you think that over time there have been important changes in the water governance system in the São Francisco River Basin/Brazil? (Diagram - Stage of water)
3.2 What are the causes of these changes?
3.3 Which have been historically the most influential actors/organizations on water issues in the Basin/Brazil?
3.4 And which actors/institutions are currently?
3.5 Why are they influential?
3.6 Do you think that in the last decade there have been significant changes in the decision making processes on water related issues in the river basin area?
3.7 If so, what are the causes?
3.8 Which actors have been historically the most influential actors/organizations on water issues in the basin? Which actors/organizations are currently the most influential?
3.9 With which other actors/organizations do you interact on themes related to water?
3.10 With which purpose?
3.11 How would you qualify this interaction?
3.12 Mainly formal/mainly informal – a mix of both?
3.13 Mainly leading to consensus – mainly conflictive – a mix of both?
3.14 Since when does this interaction take place?
3.15 With which frequency?
3.16 Do you share information with these actors/organizations? (e.g. Between sub-committee or national committee)

3.17 What are the potential challenges in the São Francisco River Basin? Challenge a- water quality; b – quantity; c - climate change; d- equitable utilization

3.18 What is the period in the river basin trajectory that the water is more or less stable?

(4) Instruments

4.1 How instruments and actors support effective water governance in the São Francisco River basin?
4.2 Which instruments and actors support shared control and which do not?
4.3 Which instruments and actors of shared control prevent conflict and enhance cooperation?

(5) Climate change

5.1 To what extent do you think that climate change influences or will influence the water related problems in the basin?
5.2 Which are or could be the groups in the basin most vulnerable to the effects of climate change
5.3 Why?
5.4 Where are these groups located? (Use map of the river basin)
## ANNEX H. TYPES OF LAND OWNERSHIP CONSIDERING LAND OCCUPATION TYPES IN RURAL BRAZIL

<table>
<thead>
<tr>
<th>Types</th>
<th>Ownership</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Settlements (Assentamentos)</td>
<td>Public</td>
<td>Rural settlements created with state-assistance usually for land reform purposes</td>
</tr>
<tr>
<td>Indigenous Land</td>
<td>Public</td>
<td>Portion of territory inhabited by indigenous peoples and used for their productive activities and necessary for their welfare and their physical and cultural reproduction</td>
</tr>
<tr>
<td>Vacant Lands</td>
<td>Public</td>
<td>Public land not assigned to any specific use</td>
</tr>
<tr>
<td>Possession (Posse)</td>
<td>Public/Private</td>
<td>In public lands: can be individual or collective. Collective refers to traditional populations (culturally differentiated groups). Private lands include tenancy agreements such as lease and sharecropping but can also include informal occupation of private land.</td>
</tr>
<tr>
<td>Protected Areas</td>
<td>Public/Private</td>
<td>Geographically defined space, in public or private lands, which is designated to achieve specific conservation objectives, such as maintenance of ecosystem services and preservation of existing biological heritage. Different classes of protected areas impose different levels of use restrictions.</td>
</tr>
<tr>
<td>Property</td>
<td>Public/Private</td>
<td>Land owned by legal entities (public or private) or individuals.</td>
</tr>
<tr>
<td>Quilombolas</td>
<td>Private</td>
<td>Territories of ethnic groups with their historical trajectory, with a presumption of black ancestry linked to resistance to slavery.</td>
</tr>
</tbody>
</table>

*Source: (Damasceno et al., 2017, p. 18)*
# ANNEX I. SFRB

## PHYSICAL AND SOCIO-ECONOMIC CHARACTERISTICS OF THE SÃO FRANCISCO RIVER BASIN, BY PHYSIOGRAPHIC REGION

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total or Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area, km²</td>
<td>638,5</td>
</tr>
<tr>
<td>Area, %</td>
<td>100%</td>
</tr>
<tr>
<td>Length of main stem, km</td>
<td>2,863Km</td>
</tr>
<tr>
<td>States encompassed</td>
<td>MG, DF, GO, BA, PE, AL and SE</td>
</tr>
<tr>
<td>Number of municipalities</td>
<td>452</td>
</tr>
<tr>
<td>Population (million) and (%)</td>
<td>14.2 (100)</td>
</tr>
<tr>
<td>Population in urban areas (million)</td>
<td>11.0</td>
</tr>
<tr>
<td>Population density, population per km²</td>
<td>20.1</td>
</tr>
<tr>
<td>Elevation, m</td>
<td>–</td>
</tr>
<tr>
<td>Prevailing climate</td>
<td>–</td>
</tr>
<tr>
<td>Availability of water, m³/per person/year</td>
<td>7,024</td>
</tr>
<tr>
<td>Annual rainfall, mm/year, range and median value</td>
<td>1,036</td>
</tr>
</tbody>
</table>

**Principal hydroelectric dams (power output, MW)**

- Três Marias (396), Rio das Pedras (9.3), Cajuru (7.2), Queimados (10.5), Parauna (4.1)
- Sobradinho (1,050), Panderos (4.2), Correntina (9.0), Rio das Fêmeas (10.0)
- Paulo Afonso I, II, III and IV (3,986), Moxotó (440), Itaparica (1,500), Xingó (3,000)

**Irrigated area (2004), ha and (%)**

- 342,712 (in 2004)
- 626,000 (in 2015)

The abbreviations of the federative units refer to Minas Gerais (MG), Goiás (GO), Bahia (BA), Pernambuco (PE), Alagoas (AL), Sergipe (SE) states and Federal District (DF).

Source: Adapted from (Brazil 2004; ANA 2015)
<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Upper</th>
<th>Middle</th>
<th>Lower-middle</th>
<th>Lower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area, km²</td>
<td>100.1</td>
<td>402.5</td>
<td>110.5</td>
<td>25.4</td>
</tr>
<tr>
<td>Area, %</td>
<td>15.6%</td>
<td>63.1%</td>
<td>18.2%</td>
<td>3.1%</td>
</tr>
<tr>
<td>Length of main stem, km</td>
<td>1,003</td>
<td>1,152</td>
<td>568</td>
<td>140</td>
</tr>
<tr>
<td>States encompassed</td>
<td>MG, DF, GO, and BA</td>
<td>BA, PE, AL, and SE</td>
<td>PE, AL, and SE</td>
<td></td>
</tr>
<tr>
<td>Number of municipalities</td>
<td>151</td>
<td>156</td>
<td>73</td>
<td>72</td>
</tr>
<tr>
<td>Population (million) and (%)</td>
<td>7.1 (50.0)</td>
<td>3.5 (24.6)</td>
<td>2.2 (15.5)</td>
<td>1.4 (9.9)</td>
</tr>
<tr>
<td>Population in urban areas (million)</td>
<td>6.7</td>
<td>2.2</td>
<td>1.3</td>
<td>0.8</td>
</tr>
<tr>
<td>Population density, population per km²</td>
<td>62.9</td>
<td>8</td>
<td>16.8</td>
<td>68.7</td>
</tr>
<tr>
<td>Elevation, m</td>
<td>1,600 to 600</td>
<td>1,400 to 500</td>
<td>800 to 200</td>
<td>480 (sea level)</td>
</tr>
<tr>
<td>Prevailing climate</td>
<td>Tropical humid and temperate</td>
<td>Tropical semi-arid and subhumid dry</td>
<td>Semi-arid and arid</td>
<td>Sub-humid</td>
</tr>
<tr>
<td>Availability of water, m³/per person/year</td>
<td>6,003</td>
<td>15,167</td>
<td>899</td>
<td>1,172</td>
</tr>
<tr>
<td>Annual rainfall, mm/year, range and median value</td>
<td>2,000 to 1,100 (1,372)</td>
<td>1,400 to 600 (1,052)</td>
<td>800 to 350 (693)</td>
<td>350 to 1,500 (957)</td>
</tr>
<tr>
<td>Principal hydroelectric dams (power output, MW)</td>
<td>Três Marias (396), Rio das Pedras (9.3), Cajuru (7.2), Queimados (10.5), Parauna (4.1)</td>
<td>Sobradinho (1,050), Panderos (4.2), Correntina (9.0), Rio das Fêmeas (10.0)</td>
<td>Paulo Afonso I, II, III and IV (3,986), Moxotó (440), Itaparica (1,500), Xingó (3,000)</td>
<td></td>
</tr>
<tr>
<td>Irrigated area (2004), ha and (%)</td>
<td>44,091 (12.9)</td>
<td>170,760 (49.8)</td>
<td>93,180 (27.2)</td>
<td>34,681 (10.1)</td>
</tr>
</tbody>
</table>

The abbreviations of the federative units refer to Minas Gerais (MG), Goiás (GO), Bahia (BA), Pernambuco (PE), Alagoas (AL), Sergipe (SE) states and Federal District (DF).

Source: Adapted from (Brazil 2004; ANA 2015)
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WATER GOVERNANCE IN BRAZIL: THE NEED TO SHARE WATER IN THE ANTHROPOCENE

Eva Costa de Barros