FIELDWORK REPORT

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Water Governance in Times of Uncertainty

Complexity, Fragmentation, Innovation

WP 4 Fieldwork Reports

By Michaela Hordijk, Liliana Miranda Sara, Cathy Sutherland, John Sydenstricker-Neto, Anthony Jo Noles, Adriane Gomes Rodrigues Batata

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Water is life, sanitation is dignity,

"Strategic Framework for Water Services" (2003), DWAF, South Africa

Preamble

This fieldwork report is published to present the preliminary results of the fieldwork carried out in Workpackage 4 of the research programme Chance2sustain, which focuses on urban water governance systems and its capacities to deal with climate change. The aim of this report is to draw out emerging issues in the case-study cities, that merit further analysis. This report draws from the fieldwork reports from Lima and Arequipa (Peru), Durban (South Africa) and Guarulhos (Brazil) and a preliminary report on Delhi/Dwarka, which will become available in March 2013. The synthesis section is meant to draw out similarities and differences becoming apparent across the cities compared, which will guide the comparative analysis in the next phase of the research programme.

1 Introduction

One of the major uncertainties of our era is to what extent and how anthropogenic climate change will affect ecosystems and livelihoods. Given the vast concentration of urban poor in low elevation coastal zones and hillsides susceptible to landslides, many cities in the South are considered particularly at risk. In some cities natural hazards such as droughts will reduce the amount of water available, while in other cities an increase in the number of storms or flood events, where intense flows of water enter the city system very rapidly, and an increase in annual rainfall will intensify the need to capture and manage water in a sustainable and safe manner. Various cities will probably have to face both prolonged periods of droughts in one season and more intense rainfall in another. In some cases different scenarios even predict very different trends. What is evident is that many of the plausible effects of climate change impact water availability, which in turn impacts energy provision in some cities whereas in others it does not. Water is thus one of the primary media through which climate change will impact daily existence and ecosystems (Heath, Parker et al. 2012:619). Yet, as Pelling has recently argued: because of the scalar and temporal nature of climate change and its effects, it is still invisible in and dissociated from everyday life, yet increasingly formative of it. This is a challenge of alienation and separation. There is an existential gap between what can be done to confront the climate change challenges, and what culture and society determine as reasonable and proper to do (Pelling, Manuel-Navarrete et al. 2012:13).

It is the water governance system currently in place that will have to face these uncertainties and deal with the unexpected. Work Package 4 of Chance2sustain therefore analyses the water governance systems currently in place in the case -study cities (Lima and Arequipa in Peru, Guarulhos in Brazil, Durban in South Africa and Dwarka (within Delhi Metropolitan areas in India) and intends to answer the following overarching research question:

To what extent are the metropolitan city's key actors - individuals, institutions, and social networks - capable of reaching socially supported agreements (or ¨*concertar*¨[1]) generating changes in the water governance approach in their city, and to what extent do they take the expected consequences of climate change into account?

Paraphrasing Castro (Castro 2007) we agree that '[i]*n practice, water governance consists in the interaction between governments at multiple levels, large to small businesses, political parties, civil and other organizations representing sector interests (e.g. workers' unions, religious organizations, peasant and indigenous movements, neighbourhood leaders, etc.), international agencies (e.g. international financial institutions other agents of the process of "global governance"), NGOs, and other relevant power holders as well as including the voice of nature. These actors (human and non-human) are involved in continuing dialogues, debates and in socio-ecological and political confrontations around how water, river basins and essential water services should be governed, by whom, with whom and for whom. These confrontations are at the heart of the process of democratic water governance, which is characterized not only by dialogue and negotiation but also, unfortunately, by growing uncertainty and protracted social, ecological and political conflicts that may progressively lead to a ¨concertative¨* process in order to reach some kind of agreement to move on into implementation*'.*

Yet, as argued in the Brazil fieldwork report, 'water governance is a contested issue and it becomes quite complex if examined in its various dimensions. It combines biophysical and social processes to an extent that it is hard, if not impossible, to disentangle what is "natural" from what is human-made nature. The means to apprehend hydrological realities is a social construction involving social, economic, political, and cultural power. These relations define and confine the knowledge forms and contents that are present or absent, valued or dismissed in making sense of water issues and defining the means to use it and rule over its use.'

Work Package 4 aims to capture these dynamics and their complexity. It does so in two different phases. In the first phase the research team has analysed the water governance system in each case study city. In the second phase, to be reported on at a later date, a series of inclusive scenario-building workshops will be carried out in each of the case study cities.

1 "Concertación" is a word which has no proper translation into English. We have discussed the concept elsewhere (Miranda and Hordijk 1998). It refers to the process of reaching agreements for joint action through dialogue and deliberation.

In the first phase and given the level of complexity of the water governance system we have focused on the key actors in this system. This fieldwork report covers the results of this first phase, and will address the following questions:

a. Who are the key actors (individuals, institutions, and socio environmental networks) involved in the water "concertation" process and/or governance of metropolitan cities and what capacities do they have that will allow them to deal with water-related climate change vulnerabilities?

b. What socio-economic and environmental conflicts and power relations between actors (including the state, economic interest groups, marginalized and vulnerable groups, civil society and social networks) in relation to water, and water related energy issues can be identified?

c. Which participatory practices and processes of knowledge construction in water governance are currently in place in the five cases -study cities, and to what extent are the expected effects of climate change already taken into account?

Work Package 4 is based on the premise that social construction of knowledge potentially can bridge the gap between developmental (brown) and environmental (green) concerns, between short-term and long-term needs, and can foster links between different actors in water governance systems. For this to happen a proper understanding of how the different actors value water (as a human right, a social good, a commodity or a socio-environmental good), of their interests and of understanding of the water-related vulnerability in their city is indispensable. The outcomes of this first phase of Work Package 4 will serve as a basis for the inclusive scenario-building workshops in each of the case study cities. As Bennett and Zurek have argued, scenario building is a process that has the potential to integrate different world views and different forms of knowledge (Bennett and Zurek 2006:276). This second phase will answer the question:

> What scenarios and knowledge regarding water and water-related energy do key actors in the case study cities develop? What is the official and socially acknowledged level of decision-making power of those actors in water governance, with regard to the plausible city scenarios, and to what extent are they capable of influencing the main approach to water governance in order to build up a shared, deliberative and/or "concerted" approach?

On this second phase of the research, we will report in at a later stage. Each of the four countries that form part of the Chance2Sustain project have engaged with and constructed WP4 and its main research questions in a way that is informed by their own histories, geographies, and identities. Water is a critical global resource that is under increasing pressure as a result of the threat of climate change on water availability and quality, which poses challenges for its governance and management. Water conflicts and struggles play out at different scales and in different ways in the cities of India, Brazil, South Africa and Peru. This fieldwork report will highlight the particularities of each of the cities and the water basins they form part of.

2 Selection of Case Study Cities and Their Unique Features

To be able to facilitate inclusive scenario building processes with local stakeholders in a an effective manner researcher need pre-existing networks and prolonged engagement with these same stakeholders. We thus had to opt for those cities in which the research teams were based and had their strongest networks established to ensure these conditions were met. Consequently Lima, Arequipa, Durban, Guarulhos (within Sao Paulo Metropolitan Area) and Dwarka (within Delhi metropolitan Area) were selected. Despite this more pragmatic reason, the cities offer some interesting comparisons: three of the case study cities are located in countries where there is an abundance of water (though unequal distribution), two other cities are located in countries with very low water availability. As can be derived from the map below Peru and Brazil have – when assessed at the national level - abundant resources. Brazil even holds 12% of the world's water resources. South Africa and India are water scarce countries. Taking population size into account the UN projected already in the early 2000s that India would

have to face “catastrophically low” water availability per capita (UN 2003)[2].

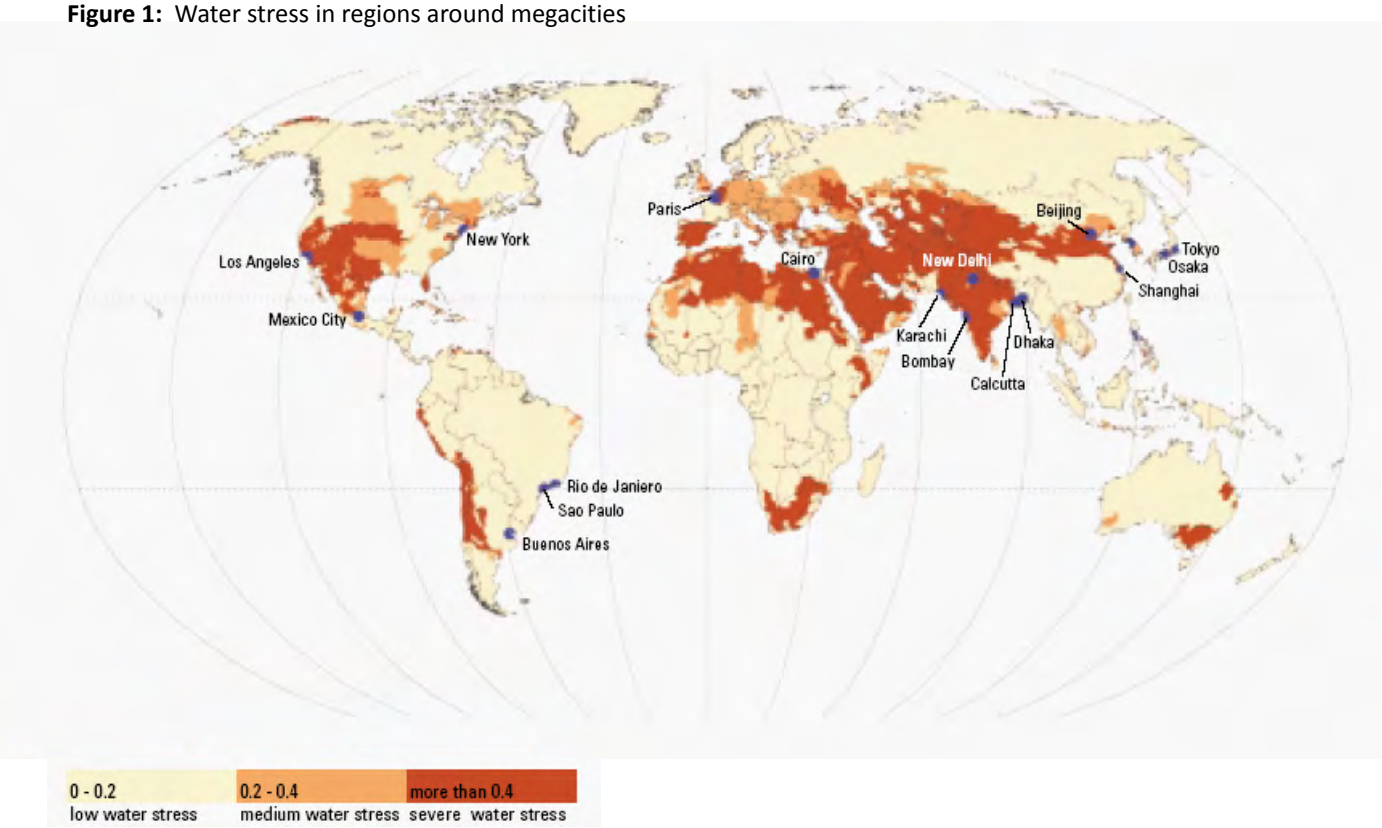
Water abundance at country level however does not necessarily mean that cities can be provided without drawing from waters well beyond the basins in which they are located. In all case study cities water has to be drawn from other basins. Lima offers the most extreme example of geographically uneven distribution of resources: 98% of Peru’s water wealth is in the Atlantic basin, with only 11% of the Peruvian population living in this basin. Lima, home to 30% of the country’s population is located in one of the driest parts of the country, and is considered the second driest city in the world with an annual rainfall of 9 mms. The Pacific basin in which Lima is located, and where 70% of the Peruvian population lives, has only 2% of the country’s water resources. 23% of the water that reaches Lima through the river Rimac is channeled from the Atlantic basin, crossing the Andean mountains.

Delhi depends for the bulk of its water supply on surface water from the Yamuna river. The Yamuna river crosses five states, and Delhi has no right to the river. Delhi Jal Board – responsible for Bulk-supply - depends on inter-state agreements for their user rights, which leads to frequent interstate conflicts. And although the Delhi urban area has the highest per capita supply of water in India, two thirds of the population has to live on less than 37 litres per capita per day. Given the size of Delhi (16,7 million inhabitants) the Indian team has opted to select Dwarka as a case study. Dwarka is a sub-city in South West Delhi, planned and developed by the Delhi Development Authority as an urban expansion project, intended to house 1,1 million inhabitants. It is an interesting case because of the heavy emphasis on private capital for urban development. Given that urban villages, unauthorized colonies (slums) and transit camps (relocated population) can also be found on Dwarka’s territory, Dwarka offers a wide variety of housing situations on a relatively small territory, and can be considered a mega-project on its own.

In four cities the case study sites on water vulnerabilities at community level were linked to the megaprojects under study in WP2 or Chance2Sustain: in Guarulhos/Sao Paulo communities have been chosen that are affected by the Tietê Linear Park; in Lima communities were chosen along the river Rimac that are affected by the

2 Information derived from http://www.un.org/events/water/brochure.htm, accessed November 18th 2012

Figure 1: Water stress in regions around megacities



Source: http://www.unesco.org/water/wwap/wwdr/pdf/chap7.pdf

Parque Via Rimac project; in Durban communities were chosen in the North, affected by the relocation of Ethikwini Airport to the North of the city and all local dynamics and reconfiguration this caused. Dwarka is a special case, given that it can be considered a compilation of housing mega-projects in its own right.

Table 1: Case study cities and their unique features

	Lima Metropolitana	Arequipa (Metropolitan area)	Guarulhos	Durban	Dwarka
Population size	8,5 million	850.000	1,22 million	3,6 million inhabitants	1.1 million
Characteristics	Capital, concentrates 45 % of Peruvian GDP, mainly services	Secondary city, approx, 3,9% of GDP services, trade, agriculture, mining and regional centre, given its strategic position in the South of Peru.	City within Metropolitan São Paulo, hosts São Paulo main airport, second in GDP in the State São Paulo	3rd city in South Africa, largest port in Southern Africa	Sub City of Delhi, mainly residential, but very well connected to city centre, international airport and close to Guargon.
Geography and Climate	Desert city, in an oasis of three valleys, second driest city in the world, annual rainfall 9 mm	Andean city (2330 m.a.s.l.), surrounded by volcanoes, dry climate, 93 mm	Sub-tropical humid climate on plateau/ highland, annual rainfall 1489mm	Coastal city, dry winters, humid summers, annual rainfall 1009 mm	Inland city, characterised by climate extremes with heavy rainfall in the rainy season (June-October) and dry and very hot in summer (April-July).
% of population with safe water supply	93% (connected to official network)	90% (connected to official network)	95% (connected to official network)	91% (within 200 m. of the house)	Very differentiated, from domestic connection in ca 50% of the houses to many forms of private provision, both legal and illegal.
% of population connected to sewerage	84%	95%	88% (but 0 treatment until 2010)	77%	n.d.
Main water related vulnerabilities	Scarcity, water pollution, Mudslides, landslides, flooding (in rainy season), hydro- energy generation uncertainty	Water scarcity, water pollution, flooding, mudslides	Pollution (industrial and lack of waste water treatment), land-slides, flooding.	Poor sanitation, flooding as a result of storm events	Water scaricity, ground water depletion
Main water related climate change threats	High uncertainty, might be more intense rainfall and tropicalization, prolonged droughts or a combination of both. Very rapid glacier melt, threatening low income neighbourhoods but also the main highways, bridges, port and the airport. Heat islands	High uncertainty, might be more intense rainfall and tropicalization, prolonged droughts or a combination of both. Critical pluvial flooding in 2012 and 2013. Affected by very rapid glacier melt.	Increasing intensity and frequency intense weather events, especially rainfall, causing flooding and mudslides. Critical flooding in 2011. Heat islands	Increasing intensity and frequency of intense weather events, both heavy rains and prolonged droughts. Sea level rise.	Water scarcity. Increasing intensity and frequency of intense weather events, especially because rise in temperature might alter and intensify monsoon seasonality, causing flash flooding.
New Water Law adopted	2009	2009	1997	2000	
Annual per capita budget	US$ 95 (2010), Lima generated 49% of its own budget	US$ 285 (2010), generated 4% of its own budget	US$ 1127 (2011)	US$ 1019 (2011) and a high financial autonomy, generating 91% of its budget.	n.d. for the sub-city Dwarka

Key actors and competencies

Current water governance practice in all case study cities exemplifies the global shift from the hierarchical, state-led and sectoral approach to a more integrated and participatory approach based on watershed management. Our cases illustrate Swyngedouw's claim that a growing number of water-related institutions, bodies, and actors are nowadays involved in policy-making and strategic planning at a variety of geographical scales (Swyngedouw 2004: 44). The cases mark the importance of distinguishing water management – still mainly a technical and sectoral affair – from water governance, understood as the interaction between multiple actors at multiple levels, with diverging interests.

It is interesting to note that this shift from hierarchical state-led approach to the more networked approach took place in the decade after major changes in the political systems of the case study countries. In Brazil it happened after the return to democracy (late 1970s – early 1980s) and the participatory development of the new constitution (1988). The State of São Paulo has been a pioneer in Brazil with respect to a new water law and the shift towards more integrated water management initiatives, although not always successful on all fronts. In South Africa, the transition took place following the abolition of Apartheid. The new water law of 1998 had the explicit aim to address the social inequalities and environmental concerns inherited from apartheid. Consequently the law repealed over 100 water acts and related amendments and extinguished all previous public and private rights to water (Nastar and Ramasar 2012). Durban became a pioneer in developing policies and practices for water and sanitation. In Peru the new water governance structure took shape after the return to democracy, in which decentralization and popular participation became two of the most important political projects. The development of the new water law took almost a decade (the law was only adopted in 2009), and though water –resource management became more participatory and decentralized, drinking water provision still very much depends on national government decisions. Yet despite the geographical, historical and socio-political differences between the countries, there are some remarkable similarity in all cases. Although India has not suffered interruptions of democratic rule since its independence, the 74th Amendment to the constitution was an important effort to decentralize competencies to lower levels, including in water provision and sanitation. There are nevertheless clear differences in the extent to which this decentralization actually took place. In both South Africa and India decentralization is mainly related to the provision of water and sanitation. Here municipalities have now substantial room to manoeuvre.

The shift to river-basin management

All case study cities depend on water resources stemming from beyond their jurisdictions and even beyond the water basin in which they are located. Lima is the most extreme case in this respect, with the water providing the city being pumped from the other side of the Andean mountains. In Sao Paulo/Guarulhos water is not only drawn from the Alto Tietê Basin, but also imported from the neighbouring Piracicaba-Capivari-Jundiaí (PCJ) Basin, also a very urbanized and industrialized region with its own increasing water demands and constraints. Arequipa is located in an almost entirely regulated basin, for which water is being transferred from the neighbouring Alto Colca basin. The basin of the river Chillon exemplifies the competing uses found in many basins: hydropower, mining, agriculture, industry and drinking water for Arequipa's 880,000 inhabitants. As indicated, Delhi does not even have rights to the Yamuna river that crosses five states, despite the fact that Yamuna is an important source of drinking water for the city.

In all four countries structures for water governance at basin level have been established. Brazil has the most elaborate structure. Our case study city Guarulhos is located in the Alto Tietê river basin, encompassing 36 municipalities, with a total population of 21 million inhabitants. Because of the size and complexity within this basin, it has been divided into six sub-basins each with their own sub-committee. Guaruhlos is part of the Tietê Cabaceiras sub-basin, with in total 9 municipalities. The basin and sub-basin committees are participatory bodies, with a fixed composition with a wide representation of sectors and stakeholders including state and municipal public officials covering several domains (environment, planning, hydro resources, energy, housing, and civil defence), the water and sanitation company, heavy water users (industry and agriculture), professional associations, local universities and cultural centres, and NGOs and environmentalists. The Peruvian Water Law of 2009 draws heavily on the Brazilian example. The Peruvian national water authority has been established, and water basins each should have their Water authority and their 'water council'. The river Chili from Arequipa for instance, falls under the local water authority Chili, and under the river basin council of the river Chili.

In Brazil, India and Peru we could clearly trace the influence of the Integrated Water Resource Management (IWRM) promoted by the World Bank, and the Dublin principles. There are thus now a variety of actors with responsibilities at basin level, but they are mainly responsible for water resource management. The fieldwork reports from Peru and Brazil also make clear that in Brazil

the decentralization process is more radical than in Peru, where the National water authority still falls under the ministry of Agriculture. In Peru it is this national water authority that in the end decides about water uses. This is different in Brazil, where the river basin councils can develop policies, propose laws and decide about charging water uses. Also, in India, overarching responsibilities are concentrated at the national level, though powerful actors at state level also play a role. Bulk water supply is in general provided by parastatal actors (Umgeni water in Ethewkini, Delhi Jal Board in Delhi/Dwarka). In South Africa water resource management is still mainly a national government responsibility, with the Department of Water Affairs still the main body responsible for water system regulation. Part of its responsibilities have been decentralized to the Kwazulu Natal Coastal Metropolitan Area Water Supply System Strategy Steering Committee, responsible for planning and implementation of water supply in Kwazulu Natal, bringing together national, regional and local actors. Bulk water supply is in general provided by parastatal actors (Umgeni water in Ethewkini, Delhi Jal Board in Delhi/Dwarka). Again Brazil offers a special case, with Sao Paulo SABESP being a private company with the state as majority stakeholder. In Durban and Guarulhos municipal level actors buy water from the bulk suppliers to provide their clients.

From an ecosystem point of view the water basin offers an adequate territorial unit for water governance. Yet, as indicated, all our case study cities have to draw on water resources well beyond the basin in which they are located. This can lead to tensions and conflicts. In Arequipa and Guarulhos there are latent conflicts. In Arequipa there are conflicts with the region of Cuzco and Puno because of inter-basin transfer of water. In Guarulhos/Sao Paulo the bulk-water supplier SABESP had to commit itself to identify other sources of water supply to reduce its dependence on the neighbouring PCJ basin, since the transfer of water from the PCJ basin is detrimental to the development of this basin. It is interesting to note that negotiations on the renewal of the right to import water from the PCJ basin to the Alto Tietê basin started in the technical chambers of the basin committees, and later involved DAEE and federal agencies. It led to the establishment of a fee for water use under state domain. In this case the multi-stakeholder basin committees thus played an important role in establishing a tool for water governance.

As overall pattern, it becomes clear that despite the fact that water quality, monitoring, standard setting and other control functions still all at national level, water resource management is decentralized mainly to basin-level. It is interesting to note that in Brazil, with its federal structure and strong emphasis on participation and decentralization, there are still national standards to be followed but particularly in Sao Paulo this is monitored at the basin level and CETESB the state environmental agency is in charge of setting standards, inspecting, enforcing, and sending out fines.

3 Changing Patterns in Water Governance

Changes in responsibilities for drinking water provision and sanitation

Relatively recently the responsibility for drinking water provision and sanitation has been decentralized to the municipal level. This first happened in India, following the 74th amendment in the 1970s, and last in South Africa (2000). Despite a global trend of privatizing water provision, all case study cities still work with either a municipal department responsible for water and sanitation (Durban) or a para-statal (Arequipa, Lima, Delhi). In Brazil the Water and Sanitation Company SABESP is a private firm with open capital, but with the state as majority stakeholder. SABESP services 350 municipalities in the State of Sao Paulo and has tremendous power in the Alto Tietê basin. Municipalities however can choose their own service provider, and Guarulhos has opted for its own municipal water and sanitation company SAEE, buying water from SABESP as bulk provider.

It is interesting to note what the different sets of conditions under which water provision has been decentralized can imply how the providers can operate. In Lima there is a setup in which different actors strangle each other. The para statal of Lima – SEDAPAL falls under responsibility of the Ministry of Housing. It is the only water company in the country that has no municipal representatives in its board of directors, and the Ministry of Housing has blocked attempts to include municipal actors. Consequently SEDAPAL responds more to demands from real estate developers – ranging from private

companies to invaders – than to municipal planning or ecosystem concerns. Given the dependence on water from the Atlantic basin SEDAPAR can only operate its services when other actors ensure bulk-supply to the city's water treatment plant. It is the electricity company EDEGEL – operating hydropower plants in course of the Rimac and its dam system – that literally holds the key to the dams and decides on water supply to the Rimac. Similarly SEDAPAL depends on national government decisions on infrastructure investments and the public-private partnerships in which they are carried out to ensure principal infrastructure. Once the water has reached Lima it is the national entity SUNASS deciding on tariff setting and metering, therewith determining the level of cost recovery SEDAPAL can realize. The fragmentation in responsibilities seriously hampers adequate provisioning.

The situation in Durban/Ethekwini is almost the opposite. Responsibility for drinking water and sanitation lies within the municipal apparatus, in the Ethekwini Water and Sanitation Unit (EWS). The South African constitution indicates that human dignity and equality should underpin water and sanitation policies, and municipalities have an obligation to ensure that poor households are not denied access to basic services due to their inability to pay. This put a daunting challenge when Ethikwini municipality was formed in 2000 out of 5 municipalities, including a vast rural hinterland of Durban, partly still under control of traditional authorities governing communal lands. The newly formed municipality had to deal with the vast service backlogs in the peri-urban and rural areas, where there was a high concentration of poor households. EWS has developed a clear policy on water and sanitation provision, with a spatial rationale for a differentiated service provision to different parts of Ethekwini's territory, which ranges from highly urbanized to fully rural areas. Spurred by the national post-apartheid objective of addressing service backlogs and a constitution that recognized water as a human right, Ethekwini pioneered a policy providing free basic water to all its inhabitants. This started with 6000 litres of free water per household per month. After extensive consultation the amount of free water has been raised to 9000 litres per household per month, but only for low-income households. This free water is however provided through different means: a full pressure system, a semi-pressure system, public tap points and water tanks. Along similar lines sanitation services are provided through water borne sewage, ventilated pit latrines, ablution blocks and dry toilets such as the Urine Diversion toilets. Localities within the Urban Development Line (UDL) will receive full service (full pressure water provision and water borne sewage). In the peripheral urban areas and in rural areas full service provision is considered too costly, and thus not foreseen, because EWS also aims for cost recovery. Through this progressive and innovative policy EWS has been able to reduce its water backlog to 15% of what it was in 1996, and the sewerage backlog to 50% of the same year. It is interesting to note that both the approach to water as a human right, and the discourse on the differentiated service provision and its spatial rationale as expressed in the UDL, are shared among actors across the city. This is not to say there is no critique. Some civil society organizations argue that the neoliberal aim of cost recovery and the commodification of water means that not everybody will be able to afford water, because the free water allowance is insufficient for larger households, or for households affected by HIV/AIDS or TB, where more water is needed. Others call the differentiated service provision a continuation of the apartheid, since the rural poor that receive communal services and non-water borne sewerage systems are mainly black.[3] Despite these criticisms Ethekwini has received national and international recognition for its policy, which should be attributed to the strong leadership of EWS and its department head. Though there are other municipal departments with responsibilities in water governance (such as environmental planning and climate change, or stormwater and catchment management, or disaster risk management), EWS functions relatively independently. Umgeni water does hold power over the city, as they decide on availability and pricing of water. However, Ethekwini also holds power over Umgeni, being its largest customer.

A similar 'differentiated service provision' is encountered in Dwarka, but here it is not the result of an explicit policy. Rather, it is the outcome of a planning process which failed from the outset, resulting in differentiated provision to different types of housing.

In all case study cities informal water provision plays a role, but this is by far the strongest in Dwarka. Because of the large gap between supply and demand, many households have to rely on private tankers and bottled water. In Delhi as a whole, there are approximately 250 private suppliers who deliver water through water tankers. Their 1,200 private water trucks operate across Delhi and charge Rs.89 –100 or more per 1,000 litres of water. The supply of water to areas like Dwarka relies on such water trucks. These trucks do not assume responsibility for water quality. The suppliers get water by drilling bore wells or tube wells and heavily rely on the ground water for their business. It does not take much to venture into this

3 For an extensive discussion, see Chance2Sustain opinion paper 6, Sutherland and Lewis (2012) Water and Sanitation Service Delivery in eThekwini: a Spatially Differentiated Model.

business, and the private water providers have become a powerful actor in water provision (Preliminary Fieldwork report Dwarka, unpublished).

Green and brown agenda tensions

Green and brown agenda tensions were present in all cases. The most important clash between green and brown agenda issues is visible in conflicts between the protection of waterheads and developmental needs. This takes different forms in the different countries. In Brazil, Conservation Units (UC) protected by the Law for Spring Protection impose restrictions onto the plans of land development and occupation. Twenty-two municipalities in the Alto Tiete Basin have conservation units. In some municipalities they cover almost 100% of the territory – such as Saleopolis with 98% - but even in Guarulhos 30% of the territory falls under this restricted use category. There is a clear correlation between territory under the conservation code and level of development: Saleopolis ranks 328th in terms of GDP within Sao Paulo State, whereas Guarulhos ranks 2nd. Municipalities which want to develop are also not compensated for the environmental services they provide. Similar conflicts can be found in Durban, with the DMOSS protected areas, which are perceived as anti-developmental by some actors. In Peru, there is practically no protection of the headwaters. A substantial percentage of mining concessions are located in these headwaters, and pollution by the mining industry is a major issue. Consequently, water conflicts in Peru are mainly about mining issues. The lack of protection is thus highly contentious. In Delhi, too, there are a number of green and brown-agenda clashes. Slum clearance in the Yamuna riverbed have taken place in order to achieve a 'clean and green' Delhi. This overruled the Delhi Slum Policy. The dramatic decline of ground tables in Delhi can be considered a result of the 'unfinished brown agenda', which leads people to drilling boreholes and consequently to the overexploitation of the aquifer.

Growth and diversitfication in participatory spaces

The change from a sectoral to a networked approach to water governance has led to the creation of a new range of

Table 2: Housing Typology and & source of drinking water in Dwarka

Housing Type	Population (2006)	Source of Supply	Distribution System to Reach Individual Households
DDA Flats	66500	Piped Water Supply & Individual meter system, after the formation of RWA's they also depend on private tankers	Common Underground Tank, Over Tank at individual flat level.
CGHS	192,500	Piped water supply, bore wells & heavy dependency on private water tankers. Society provided meter for water along with common meters for public space.	Common underground tank. Rainwater harvesting system, and OHT for blocks.
Plotted Development	28000	Piped water & Individual borewell	Individual overhead tanks
Transit Camps (relocated population)	17500	Tankers (DDA) & private operators	Tankers, illegal bore wells & Hand pumps
Urban Villages	45500	Tankers (DDA), illegal bore Wells	Tankers, illegal bore wells and hand pumps
Unauthorised Colonies	325500	Tankers (DJB) & Private operators	Tankers, illegal bore wells, and hand pumps

Source: Preliminary Fieldwork report Dwarka, unpublished

participatory spaces in the different countries. As argued above, the participatory spaces are highest in number, most advanced in terms of institutionalization, and most varied in their structure and functioning, in Brazil. Along with the water councils responsible for resource management at the different levels, the basin committees and the subcommittees have been created. We have already described how discussions between the PCJ and AT basin committees has led to defining a charge on water rights, which illustrates that the influence and power of these committees can be significant. Yet, their actual influence in the AT basin is still limited, given that they are not yet fully capable to reach their potential. Deliberation is developing, but still hindered by asymmetric access to information, differences in knowledge and a dominance of expert knowledge. This does not only affect civil society members in the committees, but is also a disadvantage for smaller municipalities lacking sufficiently qualified personnel. The high turnover of committee members and ambiguity over the rules of the game/objectives of the committees also negatively affect their effectiveness. Consequently the basin committees have been more successful in voicing opinions and building agreements on public issues than in strengthening state enforcement and controlling private interest groups. There is no question that this whole process has very much frustrated more progressive groups seeking deeper inclusion in decision-making processes, and increasing equal rights and better access to good quality water for all citizens. However, this same process has in many ways shacked old hierarchical power structures and started to bring some significant changes in the way water business is conducted. As mentioned above, the National Water Authority in Peru and its decentralized regional water authorities are a very recent creation (2009). In Arequipa the basin committees have been recently formed. To what extent it will be able to replace the earlier informal decision-making structure of the so-called Multi-Sectorial committee remains to be seen. The basin of the River Rimac still falls under the National water authority, and an inter-basin council to coordinate governance of Lima's three rivers (Rimac, Chillon and Lurin) is still in the process of creation. In all three cases participation is in water governance, not in drinking water supply. Lima's water company SEDAPAL interacts with users as clients. This same rationale of 'clients' or 'customers' has inspired public participation in Ethekwini. Public participation – also in basic services – is mandated by national law. Ethekwini started its public participation in 1997 in response to critical challenges such as the blockage of pipes, misuse of water, vandalism and high levels of non-revenue water, which by many were considered legitimate responses in times of apartheid. EWS thus started to introduce education and awareness programmes along with service provision. EWS has adopted a logic of attending to its clients whose voices should be heard. Citizens in Ethekwini have been able to participate in so-called Water Dialogues, in the "Raising Citizens' Voices" focus groups and user platforms. Some attribute the relatively low number of service delivery protests in Ethekwini compared to other South African cities to the success of these programmes. It should be noted that the Ethekwini model focuses on the participation of ordinary citizens in service delivery-related affairs, and for instance has led to the changes in the free water allowance. This is very different from the attempts to develop a multi-stakeholder participation in water governance as documented in the Latin American cases. In the Indian case both forms of participation are virtually absent.

Participatory Learning and Integration of Knowledge

The strongest case of both learning and integrating information and knowledge is found in eThekwini. EWS does not have an overarching policy, in order to allow for maximum flexibility and foster learning by doing. Employees get the message that they are allowed to make mistakes, and are encouraged to be innovative. The urine diversion toilets and ablution blocks clearly are such an experiment, where certainly things go wrong. EWS is seeking ways to improve its shortcomings. In a similar vein, EWS has revised the free basic water policy after heavy criticism. Instead of providing all residents with 6,000 liters per month for free, this has been changed into 9,000 liters for indigent households. The information and knowledge substantiating the spatial differentiation in the differentiated service provision is built on an integrated knowledge management system. eThekwini has a very well developed GIS system, dedicated to supporting strategic planning and providing strategic information to policymakers, as well as providing information to citizens. The eThekwini Municipality as a whole has established the Municipal Institute of Learning (MILE)[4] as a space of knowledge exchange. The Water and Sanitation unit was an early adopter of GIS (in 2000/2001) and is very confident in its data (Baud, Scott et al. 2013). Information in this system comes from and is shared among the different departments of the Municipality. The information available is trusted, and provides a basis for action, but is highly technical and codified. "Lay knowledge" is incorporated insofar as it concerns complaints about malfunctioning infrastructure[5]. We can characterize this as being shared within the Municipality, but not as a 'participatory' knowledge production in the manner it is

4 http://www.mile.org.za/Pages/default.aspx

5 Tap points, ablution blocks have unique identifiers complaining customers have to provide, hence they can be directly tagged in the GIS database.

used in resilience literature, namely as a co-production between different sorts of actors.

Such processes of participatory construction of knowledge with a wider variety of actors we encountered both in Brazil and in Lima. The Brazilian river basin councils offer an excellent opportunity to exchange different approaches to water, and integrate knowledge from different sources. In practice it turned out to be more difficult, since technical knowledge still dominates the discussion in the basin. Management and policy documents were developed based on codified knowledge, provided by the experts, and CSOs representatives could not participate on equal footing, because they lacked the necessary knowledge.

In Lima, the mandated basin council is not yet functioning, but two processes that foster learning and knowledge on water and how to respond to the expected effects of climate change ran in parallel in recent years. In the first one, initiated by a German-Peruvian research programme[6], a small group of actors (including representatives from the water company Sedapal, NGO representatives, a representative from the Cities for Life Forum, and German specialists) gathered to run scenario-building processes for the water sector. Initially this was a relatively closed process, focusing on scientific and technical knowledge. This gradually broadened in terms of actors (more actors from the private sector, other NGOs, municipal officials and politicians became involved), in themes being dealt with (more attention was paid to water as a social-ecological good) and with more inclusion of practice-based professional knowledge. Interestingly enough, part of the products of this first process of social construction of knowledge were taken up by the Municipality of Lima Metropolitana once a new, more human rights-oriented local government came to power. The new government not only changed the discourse to a more pro-poor discourse, it also embarked on developing a climate change adaptation strategy. Through the influence of the Cities for Life Foro, the discourse on water as a social ecological good, or a 'pro-life' discourse became part of the discussion too. The results of the LiWa project and the outline of the different scenarios the city has to face have by now been debated in a wide variety of settings, from more closed to fully open to the public, in technical gatherings and in political debates. A group of professionals has built a shared knowledge base as an outcome of this process. The resulting strategy is currently under discussion in the Municipality, but the ground for implementation has been prepared in numerous discussions.

In Arequipa, the situation is very different. The knowledge base is fragmented, and some less powerful actors acknowledge they protect their information 'because knowledge is power too'. Representatives from the water authority ANA realized this too, and they are working on a knowledge system that aims to process reliable and up-to-date data input by different organizations in order to have a solid knowledge base when decisions have to be taken. As a minimum, public entities will have open access to this knowledge. But this initiative is very recent, and has not yet yielded results.

Even in Ethekwini, with its strong human rights discourse on water, it is sectoral and technical knowledge (including a strong spatial knowledge base) that prevails. In all other cases the sectoral approach to water is even more dominant, and challenges in water provision are addressed through technical and infrastructural fixes. Only in Delhi and Ethekwini alternative approaches are taken up. In Delhi the harvesting of rainwater is compulsory in all new structures over 1000m2. Unfortunately this state policy is not implemented. Ethekwini considers water recycling. The future provision of water to all case study cities depends on large new infrastructural works, because in all cities demand largely outstrips current supply.

…….and climate change awareness

Though the plausible climate change scenarios for all cities show important alterations in current weather patterns, there is little awareness of these processes among many actors in the water governance arena. In Delhi/Dwarka it is virtually absent, and climate change is by come considered an invention of the West, with no real relevance for Delhi. In Arequipa, climate change is an especially important concern for the authorities responsible for the basin level, and they fear the water scarcity expected to result from it. Yet for the major deciders (the mining company as well as the water company) eventual water scarcity can be resolved through infrastructural solutions. In Durban the situation is more nuanced. Main actors in the water and sanitation department are sceptical about climate change, hence do not have a climate change focus in their work. Yet Durban is also known as a 'climate change champion', based on the work of the department on Environmental Planning and Climate Protection. This department has adopted a pro-poor adaptation approach in its work. The Stormwater and Catchment Management department is actively including climate change predictions for Durban in their stormwater management plans and policy.

6 LIWA - http://www.lima-water.de/en/index.html

4 Emerging Issues: Shifting Locus of Power?

The changing nature of water governance has also led to changes in the locus of power in water governance. In Ethekwini the position of EWS has clearly been strengthened as a leader in its field, and has even set examples for national policies. Yet the bulk supplier Umgeni Water is also a powerful player. It commercialised bulk water supplies. At the same time, Umgeni Water relies on eThekwini as its major client, with the Municipality accounting for 85% of its bulk water custom, making these two entities mutually dependent (Loftus, 2006; Meyer, 2012). According to Loftus (2006) this relationship places pressure on the human rights discourse for water provision, as bulk water has been commodified and brought into the circuits of capital as an accumulation strategy for Umgeni Water. Though in Delhi the locus of power is with a public authority (Delhi Jal Board), the private water trucks have emerged as an important parallel provider.

Arequipa is a different case, where the locus of power lies predominantly with the mining company, because they finance a substantial part of urban water infrastructure (a water plant, extension of the network to hitherto un-served areas). More recently, they decided to finance a waste water treatment plant, which originally was supposed to be financed by the local government.

In Lima the locus of power is more dispersed. It is clear that national government actors still play a major role, as already evidenced by the fact that the para-statal water company falls under the Ministry of Housing, and not under the Municipality's responsibility. As shown, Lima heavily depends on water being transferred from the Mantaro basin, on the other side of the Andes. Consequently, water provision in the city depends on national infrastructure. This national infrastructure is financed through public-private (or more accurately, private-public) partnerships. In times of scarcity, it is not SEDAPAL that can decide on the waterflow to Lima. The electricity company holds the key to the dams, and decides on the flow based on the needs for power generation.

In Guarulhos there are four major players that dominate the waterscape. The Sanitation Company of the State of Sao Paolo (SABESP) supplies water and collects/treats sewage in 350 municipalities in the state, and sells water to many more (including to Guarulhos' provider SAEE), and has a vested interest in the state's water system. The Department of Water and Electricity (DAEE) is the regulatory state agency in charge of giving companies and municipalities water concession use rights, and regulating the entire water system (levels of reservoirs, water withdrawal quotas etc.) DAEE holds the secretariat of 18 out of 21 of the basin committees. Two other important players are CETESB (environmental regulation) and the Secretary of Sanitation and Hydrologic resources.

So: the shift to water governance has created room for new actors to dominate in various forms. Yet most dominating actors still adhere to the traditional, sectoral and technical approach to water. This implies that the disciplinary framework (hydrology, sanitary engineering) based on scientific and normative knowledge still dominates. And the interests of the dominating actors align with interests of more powerful forces.

All cases present with different levels of severity and uncertainty that there are evident urban environmental challenges, especially related to hydro-climatic risks as a consequence of climate change. Simultaneously there is clear trend towards new institutional paradigms aiming at integrated water governance, with different levels of democratization of its practice (stronger in Latin America than in India). The rationale behind this change is an attempt to articulate different actors and different levels of scale.

But simultaneously megaprojects are planned and executed by means of exceptional procedures, bypassing regular planning procedures, fragmenting the city, creating pockets of poverty in some cases and exclusion in others. In several case-study cities the relevant megaprojects (Parque Via Rimac in Lima, Tietê Linear Park in Guarulhos, Dube Trade Port in Durban) were promoted through a discourse of competitiveness, modernity, a reach to become a global city or an important hub (Durban). In this discourse the megaprojects are the drivers, and not the already developed long term city visions. They tend to bypass regular procedures, often without proper EIAs. It is worth analyzing who initiates these projects. In Peru, they are clearly driven by the private sector, who has the official right to propose projects to national government. In the Peruvian case, classifying them as private-public investments does more justice to reality than using the traditional "public-private partnership". It is not uncommon that the implementation of such mega-projects is also surrounded by stories of escalating budgets and accusations of corruption. The mega-projects often form part of a wider network of infrastructural projects (such as the intertwined provisioning of water and generating electricity through dams and hydropower plants). Yet it is

the public sector that has to deal with the consequences of the mega-projects, which have often been approved without them having a voice or giving their consent (Dube Tradeport in Durban). In Durban this leads to city growth towards the North, that now needs to be provisioned at high costs.

In Latin America in particular, there is a clear trend towards more participatory forms of water governance. This has led to a proliferation of actors, increasing diversity among them, and hence more approaches to water and more types of knowledge being included in water governance. We also found in all case studies that community knowledge was not included, either because local citizens were not invited (Peru), or because they could not participate on equal footing (Brazil), or were mainly treated as customers (South Africa). In general, decision-making power remains with those actors that already held these powers before the democratic transition, except in South Africa, where at least for water provision Municipalities now have much more room to manoeuvre. Yet, even there the alignment with capital tossed its toll, as indicated by both the strong emphasis on cost recovery in service provision, and the commodification of water by the bulk supplier. Similarly, within the Brazilian bulk supplier SABESP, economic considerations play a major role. In Peru, issues of water governance and water provision are intertwined with the interests of the extractive economy, and its major infrastructure is dominated by interests of hydroelectric power and the mining sector. Whether agreements developed in participatory spaces in the longer run will be able to offer a counterweight to the traditional powers remains an open question.

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City Fieldwork Report

Water Governance and Climate Change in Metropolitan Lima, Peru

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1 Introduction

Main focus

The following document summarizes the first part of a study that aims to understand water-related vulnerabilities in metropolitan cities. This report discusses the interactions between water governance and climate change, perceptions of risk and levels of risk acceptance, through a multilevel analysis of the institutions involved (government, civil society and private sector), and a multi-scalar analysis of the spatial dimensions (a dialogue between the metropolitan city, the local/neighborhood level (see part II of this report) and the macro-region). This report is the result of action research with a political ecology focus; it aims to contribute to the social construction of knowledge.[3] Many information sources have been used and the interaction with several actors and informants is documented during a two-year period of analysis (2010-2012).

The methodology included organizing a series of inclusive scenario workshops and interviewing with the main actors from Metropolitan Lima and its greater territory . The process has permitted the research team to explore different types of knowledge (tacit, expert, codified) as well as the dominant discourses regarding development and water issues (explicit and implicit) as revealed by each actor. The different research instruments that have been applied can be found in Table 1 of Appendix 2.

As mentioned, several workshops were organised which permitted the construction, analysis and transfer of inclusive scenarios[4]; producing a dynamic interaction on issues like climate change, water, and risk and vulnerability of the territory and river basins of Metropolitan Lima.

This study is based on the work carried out by three projects. The first project, developed by The Cities for Life Forum (financed by Avina) together with the Metropolitan Municipality of Lima (MML), developed a climate diagnosis for Lima and a proposal for a City Adaptation Strategy for Climate Change during 2012. The second project is the LiWa research project[5] which has developed several inputs related to water and climate change in Lima since 2008. The Cities for Life Forum (FCPV) is the national counterpart of LiWa, together with a number of German universities and research institutes. The third project is Chance2Sustain[6], funded by the EU, whose fourth Work Package is coordinated by FCPV.

The following report is developed as both a discourse analysis based on each actor discourse (conscious or unconscious) and an evaluation of the opportunities for the actors' reconciliation and/or concertation, such as:

I. **Water focuses**: "merchandise", "human right", "right of the nature" and/or "sectoral".

II. **Development focuses**: "pro-growth", "pro-poor", "pro-life" and "sectoral" (which is often also pro-investments?)

The analysis of risk perception and its acceptance level will be presented at a local-neighborhood level and the scenarios agreed upon by the different actors will be presented and evaluated.

3 See WP 4 Conceptual Framework of chance2sustain for an extensive explanation.

4 Scenarios are narratives of plausible futures and there are many different versions, from very quantitative/complex modeling to purely qualitative – and everything in between. They can be developed by scientists/experts or different stakeholders. The objectives can vary among informing or directing policy, raising awareness, generating knowledge, or a mixture of these. Within the Chance2Sustain project, inclusive scenario building entails bringing together as many relevant actors as possible. While drawing on available quantitative information, the scenarios are qualitative in nature. It is an iterative process of integrating information and knowledge gathered through actor analysis. The objective is integrating the knowledge of actors (social construction of knowledge); contributing to policy making at city level and in some cases even involving action as well as testing what kind of visualization (maps/GIS/3D) supports the scenarios' analysis and transfers.

5 www.lima-water.de

6 www.chance2sustain.eu

2 Peru, Water, Climate Risk, and the Situation of Lima

Peru is located on South America's central Pacific coast (see figure 1 and 2 in Appendix 1) in the Andean Region. According to the National Census of 2007, the population of Peru amounts to 27,412,157 inhabitants.

Urbanization is perhaps the most important phenomenon in Peru's modern history. It started during the 1940's, alongside the industrialization process experienced in the whole South American region, and peaked during the second half of the 20th century as a result of the migration of many impoverished and landless peasants. Currently, urban areas continue to grow at a moderate rate due to natural increase, yet, they are still growing faster than rural areas.

The vast majority of Peru's agricultural land is located on the coast where 73% of the population is settled. However, only 1.7% of the country's total water sources are to be found at the coast, which is further exacerbated by a permanent rain deficit. This has led to the development of big investments into transferring water from the Atlantic basin to the Pacific basin through the Andes.

Cities on the coast, particularly Lima, have seen large rural-urban migration flows due to increasing labor demand, expectations of better living conditions, and the impoverishment of rural areas. According to the 2007 census, Peru has an urban population of 20,810,288 inhabitants, which is 75.9% of the total national population. Between 1940 and 2007, Peru's urban population increased 9.5 times, while its rural population grew only 1.6 times. Governments have not been able to provide adequate services for the poor populations of migrants and newcomers. In 2007, 36% of households in Peru did not have access to potable water and 52% did not have access to adequate sanitation services.

Climate change risks and impacts

Peru is among the 10 most vulnerable countries to climate change in the world[7]. It is a country highly influenced by the presence of the El Niño-Southern Oscillation (ENSO) that is characterized by seldom warm waters during periods of more than 4 months. Another important feature of climate change is the de-glaciation process. Peru has experienced one of the world's highest rates of glacier decline. During the last three decades, between 20% and 30% of its glacier surface has disappeared, making the reserve capacity of water sources in the country vulnerable. Since some of the country's permanent rivers are fed by the rapidly decreasing glaciers, water resources in Peru are very vulnerable.

National scenarios on climate change

Plausible climate change scenarios at national and basin level have been established for the year 2030. One of these scenarios involves high emissions (A2), estimates transformations on precipitation levels and decreases in the estimated extreme precipitation for the next 30 years, as well as increases in minimum and maximum temperatures.

Policy responses

Peru is a highly centralized country and most decisions are taken at the national level. It is currently facing its seventh decentralization attempt after the creation of regional governments and a massive process of resource transfers to regional and local governments.

Even though the National Planning System was deactivated during the 1990s, there are current attempts to recover it through the creation of the CEPLAN[8], however, it is still weak and lacking funds for its development. Ministries with a sectoral approach and regional and local governments (district and provincial) have the power to develop and implement coordinated development plans, spatial planning, basin management schemes, and climate change strategies at the regional level, as well as urban development strategies at the provincial level, and environmental and risk management plans at both levels of government.

Since 1965, there has been a gradual evolution in the context of environmental management in Peru, including the creation of environmental management bodies at the national

7 Tyndall Centre for Climate Change Research (2004). W Neil Adger, Nick Brooks, Graham Bentham, Maureen Agnew and Siri Eriksen, New Indicators of Vulnerability and Adaptive Capacity. Tyndall Project IT1.11. Technical Report 7. Reino Unido: Tyndal Centre.

8 www.ceplan.gob.pe

level[9] and the approval of several environmental management laws. The General Law of Integrated Hydric Resources[10] has appointed the Ministry of Agriculture as the authority responsible for the concession of water rights. The institutional framework for the management of water resources has been expanded through the creation of the Ministry of Environment and the National Authority of Water (ANA[11]) in 2008.

The Climate Change National Commission (CNCC)[12] is updating the Climate Change National Strategy (ENCC), whose main focus is adaptation, risk management and water. The Action Plan for Climate Change Adaptation and Mitigation, developed by the Ministry of Environment (MINAM) and the CNCC, was disseminated in 2012 for consultation, but has not yet been approved.

Regional strategies to face climate change have been developed within this framework, designing instruments for adaptation and mitigation and generating bases for permitting Provincial Governments to elaborate their own programs and projects focusing on climate risk.

2.1. The Case of Metropolitan Lima

2.1.1. The Lima Macro-Region

The Lima macro-region is the articulation of networks of cities and towns settled along the four river basins that compose the Metropolitan Lima and Callao conurbation: Rimac, Chillón and Lurin at the Pacific side, and the Mantaro basin on the other side of the Andes.

Within this territory and dependant on these water sources, 7 hydropower plants generate 68% of the (hydro) electric energy (supplied through an interconnected system), which sustains the economic and social activities of Lima and, indirectly through its role as capital city, many of those of the whole country.

As a capital city, Metropolitan Lima is developing far beyond its political and administrative boundaries by, for example, occupying part of the neighboring Huarochiri province (within another regional government). Lima is responsible for more than two-thirds of the industrial production of Peru (nearly 7,000 factories)[13]. Furthermore, in it are concentrated most of the financial services, national trade (and also international trade due to the presence of the Callao port and Jorge Chavez international airport), while Lima is also home to the National Government. At the same time, a large poor populations[14], although not significant in relative terms, is concentrated in Lima.

The dynamic of urbanization and metropolization, as in the case of Lima, has involved a redefinition of the role of territories (urban and rural) and spatial planning. Changing practices have resulted in the integration of cities on a macro-regional level through innovative coordination bodies.

Poor water management, natural resources, and risks

Lima has exceeded the capacity of its river basin resources to provide for its needs. Its current and future potable water demand is dependent on the Mantaro Atlantic Basin and the lagoons and wetlands of Pasco (including the Huascacocha and Punrun lagoons which form part of the five stages of the "Marcas" projects that represent approximately 23% of the supply) (Bardossy et al. 2011). Together with the decrease of glaciers and the excessive use of groundwater (10% to 30% is in emergency), this results in a critical scenario of water stress. This has resulted in very low water reserves per inhabitant in Lima (33 m3) compared to other Latin American cities (SEDAPAL 2011).

The rapid growth of the city, together with the change of use of agricultural areas, urban watersheds and slope areas, has resulted in the loss of ecosystems and local flora and fauna. As a result, only a few productive agricultural areas remain, especially in the Lurin River Valley in the South of the city which is constantly threatened by pressures from the industrial and housing sector.

9 Among them, we can mention the creation of the Ministry of Environment (www.minam.gob.pe), the National System of Environmental Management and the transfer of environmental competences to regional and local governments (provincial and district).

10 Law N° 29338, General Law of Integrated Hydrological Resource Management of Peru -IRGS, Integrated, creating concertative councils to manage water for all purposes (agricultural, population, mines, industries) at Central, Regional and river basin level, but lacking the participation of consumers at household level (urban or rural).

11 www.ana.gob.pe

12 Peru has signed the Framework Convention on Climate Change, and one Peruvian scientist is a member of the IPCC.

13 Concerted Development Regional Plan of the Municipality of Lima, 2012. Still pending approval, underconsultation, see http://www.planlima.munlima.gob.pe/documentos/diagnostico-propuesta-del-plan-regional-desarrollo-concertado-lima

14 According to INEI (2007), about 16% of the total population of Lima is poor.

Moreover, patterns of land occupation of coastal areas, floodplains, unstable hillsides (up to slopes of 20 degrees) and dry stream beds that can activate suddenly, constitute high risks. In such settlements, the population, housing, and economic activities are exposed to various risks, which makes for a highly vulnerable area, as can be seen in figure 4 in Appendix 1.

Soil contamination by inadequate disposal of domestic and non-domestic solid wastes are concentrated in 9 landfills; 4 of them located in the Chillon basin, 2 in the Rimac basin, and 3 in the Lurin basin (SIRAD project 2010)[15]. Water pollution caused by industrial and mining waste in the three basins and the discharge of 83% of wastewaters in the rivers and the sea without any treatment, clearly exacerbate the problem.

2.1.2. The Metropolitan City of Lima

In general, cities are the territorial expression of an economic development model that tends to occupy space in a certain way. The famous quote from Margaret Thatcher; "there is no such thing as society, there are individual men and women and their families"[16] is a synthetic expression of the social and economic model that constitutes the urban paradigm applied in Lima since the 1990s. Business and individual competitiveness prefigure the current development model both in Peru and Lima, to a much greater extent than solidarity, collaboration and joint responsibilities.

In Lima, separation and specialization of land use in pursuit of efficiency (and urban security) have led to a segregated and fragmented city. More than 8 million people live in Metropolitan Lima (Lima and Callao), which represent 30.26% of the national population. According to the last census, Lima has grown 2.1% per year (more than 160,000 new inhabitants per year) (INEI 2007).

Lima is located in the coastal dessert plains next to the Andes, occupying three valleys: Chillón, Rimac and Lurin. As it receives only 9 mm of annual rainfall (SENAMHI 2010), Lima is the second-driest metropolitan city in the world after Cairo in Egypt. During the seventies, Lima experienced rapid growth due to a number of migration waves, leading to the development of massive informal settlements which now occupy the northern, eastern and southern "cones" of the city. Together with formal urbanization in the Rimac and Chillon area, this resulted in the loss of agricultural areas, as can be seen in figure 5 in Appendix 1.

By 2025, Lima will be a megacity of more than 10 million inhabitants. Its population and density is growing predominantly in its northern, southern, and eastern peripheries. Its growth is no longer expansive or horizontal, Lima is densifying and growing by occupying the Andean foothills (both formally or informally). Its central areas, with the largest real estate investment and construction, is characterized by low population density and is a low-risk area. Interestingly, a higher height of buildings has been authorized exactly where the population density is lower (INEI 2007), while in the areas where more people live per room (3.8), a lower construction density and altitude of buildings exists. As a result, peripheral Lima is overcrowded and characterized by vulnerabilities, pollution and insecurity, while central Lima has the best residential conditions, equipment, infrastructure, environmental quality, green urban areas, security, and a relatively lower population density (but a higher constructive density).

Water and sanitation

The water supply of Lima is provided by four river basins: Chillon (22%), Lurin (14%), Rimac (41%) and Mantaro[17] (23%). These rivers are fed by Andean glaciers, wetlands and rainfall from the highlands.

Even though the figures are not reliable (MML 2012), it can be estimated that 86% of the households in poor areas and 99.5% of the households in rich areas are connected to the potable water network. The overall average for Lima is 93%, which means that almost 1 million inhabitants do not have access to a safe drinking water supply (40.7% in peri-urban areas). These households consume less than 25 liters of water per day while those who are connected to the water network have an average consumption pattern of 250 liters per day. Despite consuming 10 times less water (FOVIDA 2005), these people are forced to pay 10 times more than regular users because they are supplied by alternative private services, mainly water vending trucks. Within the serviced group there are also deep inequalities. In some districts the average water consumption is 60 to 70 liters per day, while in others it rockets up to 400 liters.

15 SIRAD refers to an INDECI project Resources Information System for Disaster Relief, see http://sirad.indeci.gob.pe/login/?next=/, accessed 23rd of March 2012

16 Prime minister Margaret Thatcher, talking to Women's Own magazine, October 31, 1987, UK

17 The Mantaro basin is located at the other side of the Andes (Atlantic basin). The transfer of its waters to the Pacific basin has been achieved by the development of large-scale dam infrastructure projects: the "Marcas" projects (Koei/SEDAPAL 2010).

84% of the population is connected to the sewerage system, meaning that approximately 1.4 million inhabitants are not connected. Nearly 85% of the wastewater is discharged directly into the ocean, of which 15.1% is treated and only 8.55% is reused.[18] There is a clear deficit of sewage treatment infrastructure, and rainwater drainage infrastructure is almost non-existent.

As discussed, Lima is located in the lower part of the three basins of the Rimac, Chillon and Lurin rivers and is part of a region with a great variety of ecological zones; from sea shore to the highlands, predominantly the "Yunga" (500 to 1500 m.a.s.l.) and "Quechua" (1500 to 3500 m.a.s.l.) regions (GEO Lima and Callao 2005). The Rimac river, Lima's main water provider, covers a distance of at least 200 km from the High Andes at 5000 m.a.s.l. to reach the Pacific Ocean, passing through the city of Lima.

Lima has a warm climate and moderate humidity conditions (SENAMHI 2008). Its mean annual temperatures fluctuate between 18.6°C and 19.8°C, with a maximum record of 34°C. Combined with intense humidity ranging from 81% to 85%, a higher thermal sensation is felt. Despite its high humidity, Lima's climate can be characterized as desert. With only 9mm of annual rainfall and an almost permanent fog effect during winter, a phenomenon of green coastal hillsis generated 3 to 4 months a year.

The climate of the basins where Lima is settled depends on the interaction of the Andes Mountains with four semi-permanent climatic factors: the south-east Pacific Ocean Anticiclone, the topography, the continental effect and the Humboldt Current. One resulting characteristic of Lima is that it only has two defined seasons: winter and summer.

Poverty, inequalities, non-efficient services and vulnerability

Even though relative poverty has diminished to less than 16% of the population (INEI 2007), inequality still persists. While there is an "A" socioeconomic stratum that represents 5.2% of the population, the two lowest strata "D" and "E" contain around half of the population (44%), who still live in vulnerable conditions (APEIM 2010) with almost no variation in 2012.

Poorly built houses (quality of materials, construction technologies and technical supervision) located on hillsides, active ravines, sandy areas, and low-lying coastal areas represent 79% of the housing deficit (355,000 houses), considered as the qualitative deficit. Over a third of these (124,000 houses) cannot be recovered, 50% (177,000 houses) lack basic services and 15% are overcrowded (MVCS 2011).

The "Barrio Mío" program, financed by the MML, has developed an urban poverty map (see figure 6 in Appendix 1) based on information from the 2007 census and systematic fieldwork for gathering geographical data of those dwellings settled after the referred census. The program defined the poorest populations according to their unsatisfied basic necessities, but it also incorporated the GINI inequality index as used by the UNDP.

Figure 4 (see Appendix 1) shows flood risks (including riverbank bursts, mudslides, landslides and rising river levels), identified by our ongoing research for the entire Lima macro-region. As can be seen in figures 4 and 6, the poorest areas coincide with the areas of greatest vulnerability.

Additionally, there are a significant number of buildings on flood plains and dry stream beds that may suddenly activate, which together with buildings with basements that do not have rainwater drainage or pumping facilities, create high-risk areas. For instance, in 1970 during an extreme rainfall event caused by an ENSO[19] (17mm of rain in five hours, almost twice the rain of a whole year) 2,000 houses collapsed and the "Via Expresa" (a highway below the surface level[20]) flooded. This divided the city in two, which required the establishment of an air bridge in order to satisfy the city's needs.

While Lima has moderate human vulnerability, it combines a high Human Development Index (0.66) with a large percentage of its population located in districts affected by multiple climate hazards (between 1 and 6 types of hazards) (Calvo / FCPV 2012). This shows that the HDI has not taken into consideration climate risks. This is a task of the Climate Change Adaptation Strategy, whose spatial analysis is still in the process of validation.

In a following report we will extensively present and analyze the development, analysis and transfer of climate and governance scenarios, developed during this research, as well as the vulnerability and mapping analysis which is still on-going.

18 In Peru, water tariffs do not necessarily incorporate sanitation or sewage tariffs. Their regularization is still part of an on-going process managed by SUNASS.

19 "El Niño" Phenomenon, Southern Oscillation

20 There are currently 3 more highways of this kind and none of them have adequate rainwater drainage infrastructure.

3 System of Institutions and Actors

Peru is still highly centralized and the most important decisions are made at the national level of government, based on sector-specific management. For example, water and sanitation services, energy provision (mainly hydro-power), and land titling through COFOPRI[21], are fully dependent on the national government, or are at least regulated by it.

Consequently, large investments or large-scale projects related to water, sanitation and hydro-power, are in the hands of different entities of the national government and are not coordinated or discussed with city authorities, as will be discussed in the next section.

3.1. Management and Planning of the Territory and the City

In the case of Metropolitan Lima City, incorporating the provincial municipalities of Lima[22], Callao[23] and Huarochiri, development and spatial planning are quite complex and fragmented, it is managed by three different province municipalities, one of them with the same name of the city but not managing its entire territory. So, in the case of Lima Province it is managed by the Metropolitan Planning Institute (IMP) which depends on the MML.[24] Even though the territory and population of the Provincial Municipality of Callao (MPC) are much smaller, its importance is based on the international airport and the Callao port located here. The MPC has its own planning bodies and mandates. Also, the city has expanded its boundaries to a small part of the territory of the Provincial Municipality of Huarochiri, to its boundaries with the San Juan de Lurigancho district. All of them are part of the city governance, but independently develop plans on their own. Until 2011, IMP was only in charge of updating the Zoning Plan and Land Use Plan, proposed by the District Development Plans for Lima Province Municipality. In some cases these plans presented proposals of integrated urban development, and in other cases they were limited to the regulation of land uses, height of buildings and urban parameters. With the Metropolitan Ordinance 1617 from July 2012, the MML has, through the IMP, recovered its power on land zoning (together with the Urban Development Office). The Municipalities of Callao and Huarochiri kept these powers, but without developing or updating any urban development plan on their own.

As a result of non-regulation and limited planning in the country since the nineties, Lima lacks some main instruments for spatial planning, such as the Territory Management Plan (POT).[25] In addition, there is a temporal gap between the Metropolitan Development Plan for Lima and Callao 1990-2010[26], and the new plan, expected to be produced by the current administration in 2014. Callao is the only region in the country that has achieved the goal of having developed a POT. The IMP is currently elaborating the POT for the Chillon, Lurin and Rimac river basins, which was expected to be finished by the end of 2013.

The Ministry of Housing, Construction and Sanitation is the regulatory body of the National Government charged with providing support and advice to municipalities through agreements and supervisions.[27] The General Direction of Territory Planning (DGOT) of the Ministry of

21 www.cofopri.gob.pe

22 That at the same time has Regional Government competences for its provincial jurisdiction

23 This territory also has a Regional Government that acting in parallel

24 www.imp.gob.pe

25 The current Lima province administration has recently approved the final version of the Concerted Development Regional Plan (2012). This instrument proposes the development guidelines for the city and will be the basis for more specific planning schemes. Since it is in the approval phase, it is still not possible to assess to what extent environmental and climate change aspects will be incorporated.

26 The PLANDEMET implied both Lima and Callao. It expired in 2010 and its update has not started yet (neither by the IMP nor the MPC).

27 The city also intervenes in planning and investment proposals, such as the promotion of big social housing projects and the elaboration of the Urban Development Plan for the expansion area of Huarochiri. The Deputy Ministry of Housing and Urbanism has promoted the implementation of the Program for the Generation of Urban Land that will urbanize 570,000 ha of desert areas in 18 cities of the country to be ceded to real estate enterprises interested in social housing development.

Environment is in charge of territory planning (regional and provincial) and is promoting and developing technical guidelines for formulating a POT for regional and provincial governments, as well as Ecological and Economic Zoning (ZEE). At present, the planning schemes are not effectively coordinated with each other.

Real estate private investments are important in the city. They Investors are mainly represented by CAPECO[28] and put high pressure on the development of real estate projects on well-located urban land in consolidated central areas, and the redevelopment of industrial estates, military quarters or any other remaining open space, even including public parks. They also promote city expansion through the development of second home projects on low-density beach and agricultural areas at the north and south of the city. More recently, social housing projects in lower-middle and middle income areas have also begun to be realized.

Informal expansion and self-construction was originally led by organized movements of the settlers, but more recently land traders have become an important actor.[29] Informal settlements occupy new urban and peri-urban territories, mainly on hillsides[30] and peripheral desert areas, but are also created through the subdivision of individual house and densification, and overcrowding of existing low-income neighborhoods. These settlements occupy desert areas[31] on the northern, southern and eastern peripheries and have configured an informally led and uncontrolled urban sprawl. The strong local groups have consolidated, also developing strong connections with politicians in power.

In addition to this quite dispersed, complex and confusing spectrum of institutions deciding over the same Metropolitan City, there also exist - under the same jurisdiction of the Provincial Municipality of Callao - the Callao Regional Government. The Provincial Municipality of Lima entitles the mandates and competences of a Regional Government over its own jurisdiction (the so-called Metropolitan Government of Lima – MML)[32] and a third Regional Government, the so-called the Regional Government of Lima (from now on the Lima "provinces" Regional Government)[33] also exists. This is a different entity which also has "Lima" in its name, where Huarochi, Canta and Cañete province municipalities (and upstream Chillón, Rímac and Lurin rivers) belong. This "Lima provinces" Regional Government covers the territory of the mainly rural areas of the former Lima "*departamento",* which predates the creation of regional governments in the country two decades ago. All of them have their own development, spatial and urban planning systems and still coordinate very little among each other. Therefore, territory planning and the city are in a grey area of competencies.

3.2 The Lima Macro-region: The River Basins, Water and Risk

The basins

It is necessary to understand the territory of the main water-supplying basins of Metropolitan Lima in order to define the scale of analysis of the Lima macro-region. The major basins supplying water to the city of Lima are the Rimac, Chillon and Lurin river basins. The Lima macro-region is managed by 3 Regional Governments and 11 Provincial Municipalities[34]. The Regional Governments are in charge of leading the inter-basin Hydric Resource Management Council for Rimac, Chillon and Lurin, which is currently being instituted within the framework of the General Law of Water Resources. The ANA has constituted the Local Water Authority (ALA) of Chillon, Rimac and Lurin[35] as the real administrator and granter of water rights of the three rivers of Lima; positioning the Council as the "concertation", consultation and planning body. Although the Mantaro river is an important water supplier through the large dam and hydroelectric projects promoted by SEDAPAL and EDEGEL, the ALA Mantaro, as well as its Inter-basin council, has no contacts with the Rimac basin authorities.

28 www.capeco.org.pe

29 75% of houses in Lima were developed in such a way (Escalante 2012).

30 Some of them are settled on 20 degree slopes, which represents high risk and many difficulties for water provision.

31 Public desert land that has no kind of previous investment.

32 The MML is a Local Provincial Government that has Regional Government competences. This is a unique case established by the Organic Law of Municipalities.

33 Which is not the Metropolitan Government of Lima. It is a different entity whose jurisdiction includes the medium and high basins of the Chillon, Lurin and Rimac rivers.

34 It is composed by the provinces of Lima, Callao, Huarochiri, Canta, Cañete and 6 others.

35 The ANA has granted 5,416 water rights for agricultural uses and 71 rights for non-agricultural uses (for human consumption, mining, industries, energy production, fishing and mixed uses).

Regarding issues on river basins and their territories, there are two sector entities (MINAG[36] and MINAM), 5 Regional Governments (those 3 already mentioned together with Pasco and Junin that are related to the Mantaro upper-stream river basin and the Andean wetlands and lagoons in Pasco), 1 Provincial Government with regional competences, at least 7 Provincial Municipalities and more than a hundred District Municipalities.

Water and sanitation management

Human consumption of water and sanitation are under the responsibility of a public company named SEDAPAL[37] that belongs to the Ministry of Housing, Construction and Sanitation (directly dependent on the Deputy Ministry of Construction and Sanitation). SEDAPAL is the main entity in charge of the provision of water and sanitation services in Lima, together with a number of formal and informal potable water supply companies that attend to those areas without connection to the public network.

SEDAPAL developed an optimized master plan for the management of water and sanitation services in Lima and Callao, and recently extended its services to the urban area in Huarochiri. The company is the main entity in charge of the provision of water services, also in areas without water supply infrastructure. SEDAPAL is attached to FONAFE of the Ministry of Economy, and normatively depends on the Vice-Ministry of Construction and Sanitation. It is responsible for managing the entire system of water and sanitation in the city and the MML has no influence on its decisions, not even to prioritize or limit water and sanitation investments in high risk areas, or enforcing regulations for limiting city expansion. SEDAPAL has been responding to demands according to the requirements and priorities of the Housing Ministry and its water users (from formal investors to invaders) but not to those from the city administrations. This only occurs in the case of Lima because in all other municipalities in the country, water and sanitation companies depend directly on Provincial Municipalities.[38] The Ministery of Housing has openly refused to consider the incorporation of representatives of the Municipality of Lima on the board of directors of SEDAPAL, as well as the possibility of being transferred to the Municipal Government, as part of the decentralization effort, as has been the case in other cities.

Regarding the management of non-potable water, decisions are taken by the ANA, the ALA, Irrigation Boards, SEDAPAL and EDEGEL (a private energy company)[39].

Environmental management

Environmental management is applied through the General Law of the Environmental Management System[40] that established Environmental Commissions at the national, regional and municipal level (province and district). The Municipalities of Lima and Callao, and the Lima Regional Government have established their own Environmental Commissions, while maintaining a level of coordination with the Ministry of Environment and International Cooperation Agencies.

Although these spaces are still incipient and not fully institutionalized, they allow for coordination and consultation, which is very useful for the city's environmental management. In September 2012, the MML approved its Environmental Policy with the participation of the Metropolitan Environmental Commission and a few years ago the Callao Provincial Municipality did the same. In both cases, water and climate risk are prioritized in their proposals.

Energy dependency on water

Energy provision for the city is in the hands of the private company EDEGEL. It generates and commercializes hydroelectric energy (through 5 plants[41]) and thermal energy (through 2 plants). The company is being supervised by the National Government through OSINERGMIN, but there is no level of coordination or consultation with the municipality

36 Ministry of Agriculture, www.minag.gob.pe

37 www.sedapal.gob.pe

38 The Tumbes region is an exception since the water service has been fully privatized.

39 www.edegel.com. According to the concession contracts, this company has the right to control the water flow from the dams that feed the hydropower plants, but also the city. During the 2004 drought this issue configured a critical state of water rationing to the city. According to informants from SEDAPAL, EDEGEL opened the sluicegates in order to get water for electric generation, which resulted in the reserves going straight to the ocean, leaving the city unsupplied.

40 Law Nº 28245: Establishing the national environmental management system of Peru - SNGA, Based on a set of environmental management commissions and their technical groups, where governmental bodies at Central, Regional and Local level, as well as sector ministries, civic society, private sector and academics have mandates and/or commitments on environmental issues. These laws made *concertacion* processes mandatory.

41 About 68% of electricity provision of the country comes from hydroelectric plants.

on prioritising or limitations to service provision in areas of the city where the municipality have to consider the consolidation or limitation of urban uses, or the provision of energy in case of emergency in such a way that the functioning of vital services for the city could be guaranteed.

Risk Management and Climate Change

The National System of Risk Management SINAGERD[42] provides clear power to Regional and Local Governments regulated by INDECI[43]. This means that 5 Regional Governments, 11 Provincial Governments and 1 Provincial Government with regional competences are able to develop risk management plans for each of their jurisdictions. Not surprisingly, risk management in the region and the metropolitan city is incomplete and not that effective.

Although both the Regional and Local Governments (provincial and district) have the authority to lead Civil Defense Councils and to develop and implement risk management plans, true institutional capacity and resources for prevention are still limited. There are still vulnerable groups, and people continue to occupy high-risk areas. Investments in the city do not consider prevention or consider Hazard Maps *ex-ante*. Horizontal coordination (inside each level of government) as well as vertical coordination (inter-sectoral at national level and between different level of government) are still in their infancy, as has been consistently demonstrated by the severe damage caused by most natural (or manmade) disasters, which have occurred in the city during the past few years, with a few exceptions.

Even though there is still a long way to go, it can be said, at least, that things are improving. The Technical Group on Climate Change in Lima and Callao have been created and are functioning; they need to be strengthened but do exist. Climate Change Adaptation Strategies in Callao (2011) and in Lima (2012) still need to be approved and their priorities need to be incorporated into Municipal and Regional budgets. This was made possible thanks to the commitment of their respective regional authorities and the contribution of different National Government organizations operating in Metropolitan Lima that have started to remove sectoral constraints. Civil Society Organizations, Universities, the private sector, the UNDP and MINAM also continue to actively participate and share their information and knowledge. It is important to mention the contribution of research projects such as Chance2Sustain[44] (from the Cities for Life Forum), the LiWa project[45] (that includes the participation of The National University of Engineering UNI, "Fomento de la Vida" FOVIDA, SEDAPAL, Cities for Life Forum and the University of Stuttgart together with a number of German institutions) and citizen movements against climate change, MOCCIC as well as activities promoted by PUCP[46] beside others.

3.3. Generation and Management of Information

Entities in charge of generating climatic, physical and socio-economic base information, useful for measuring and analyzing city vulnerability and adaptation, belong mostly to the national level of government and depend on ministries from different sectors. However, the access and management of information is hindered by deficiencies within the system to generate up-to-date scientific and technical information; existing information is often not accessible, too expensive and/or outdated.

There is a lack of staff to manage geographical information systems in public entities. The staff is generally composed of product-specific contracted consultants without considering the updating and monitoring of adequate and consistent long-term data. As a result, information is not reliable, and in some cases base maps do not coincide or are not georeferenced, which undermines spatial analysis.

Furthermore, academic research institutions are limited by the tremendous lack of resources, and academic curricula are not related to information demands from Local and Regional Governments. Among these research institutions, we can mention SENAMHI[47] (part or MINAM), which is the most important entity generating climate and meteorological information.

The Callao Regional Government is the only region in the country which has a strong and updated territorial information server[48], connected to the internet for free downloading and printing of all available data. While municipalities generate limited information about local management, entities like INDECI, with the support of international cooperation, have developed systems such as SIRAD that provides information for emergency care in

42 www.cenepred.gob.pe

43 www.indeci.gob.pe

44 www.chance2sustain.eu

45 www.lima-water.de

46 www.pucp.edu.pe/climadecambios

47 www.senamhi.gob.pe

48 http://sitr.regioncallao.gob.pe/sitr/index.aspx

case of earthquakes and tsunamis. The information has been gathered and systematized through a georeferenced system but it is publicly available only in a hardcopy format. The Focal Cities project, financed by IDRC and developed by IMP and CENCA, has developed a hazard map by consolidating previous SIRAD maps and by adding flood hazards. However, not all of the information can be accessed, downloaded and printed, and georeferenced spatial information is not accessible either.

Thus, there is a need to establish and operationalize a platform for cooperation and exchange of information and spatial data about the metropolitan city and the macro-region.

Ongoing Initiatives

Initiatives at the local and regional level have been limited in the design of strategies and plans, including the development of regional strategies on Climate Change for Callao (2009-2019) and Metropolitan Lima (2012-2025). These strategies are still under development and their implementation remains uncertain.

There are several programs and projects from national entities promoted by MINAM; from the MML (GSC/SMA, SERPAR, PGRLM); from the MPC and the Lima and Callao Regional Governments[49]; from District Municipalities (for instance, the Climatic Pact between San Borja, Pueblo Libre and Miraflores, signed on September 2012); from research projects held by SENAMHI, IMARPE[50], SIRAD (INDECI), Chance2Sustain, LiWa (with amongst others the participation of SEDAPAL, MML, FOVIDA, UNI and FORO) and several universities (PUCP among the most renowned); from technical cooperation projects held by UNDP and AVINA; and from Civil Society institutions such as The Cities for Life Forum and the MOCCIC.

While historically, each actor in the city tended to work within a sector-based approach with no integrative focus on the key issues of the metropolitan city, change has come over the last few years. Spaces of inter-sectoral and multi-sectoral coordination have slowly started to emerge. The case of the Metropolitan Environmental Commission, the re-establishment of the Metropolitan Assembly and the process of creation of the Inter-basin Council of Chillon, Rimac and Lurin are a few examples. However, their level of institutionalization will require changes that go beyond the shift in municipal and regional administrations.

49 The Regional Strategy of Climate Change of Callao has been approved and its second update is in progress.

50 www.imarpe.pe

4 Preliminary Conclusions

Key actors

This review, presented at a stage when the analysis is not yet complete, reveals that the Metropolitan Municipality of Lima, the Callao and Lima Regional Governments, the Ministry of Environment (MINAM), with the Climate Change National Commission (CNCC), and the National Service of Meteorology and Hydrology (SENAMHI), the water company SEDAPAL, SUNASS, the regulatory water entity of Peru, ANA and the ALA (Chillon, Rimac and Lurin), represent the main actors in climate change and water governance in Metropolitan Lima and the macro-region with the private sector, civil society and academic sector as minor actors.

4.1. Is the Sectoral Integration and Articulation of the Management of the City and the Macro-Region Feasible?

The National government's focus on deregulation has led to weak local and regional institutions. As discussed in the previous chapter, in the case of Lima, actors are dispersed, fragmented and weakened. They furthermore compete against each other, are uninformed and are unwilling to share information (particularly geographical information; e.g. GIS format files are very well "protected"). They lack resources and have poor coordination with each other regarding their decisions, investments and actions.

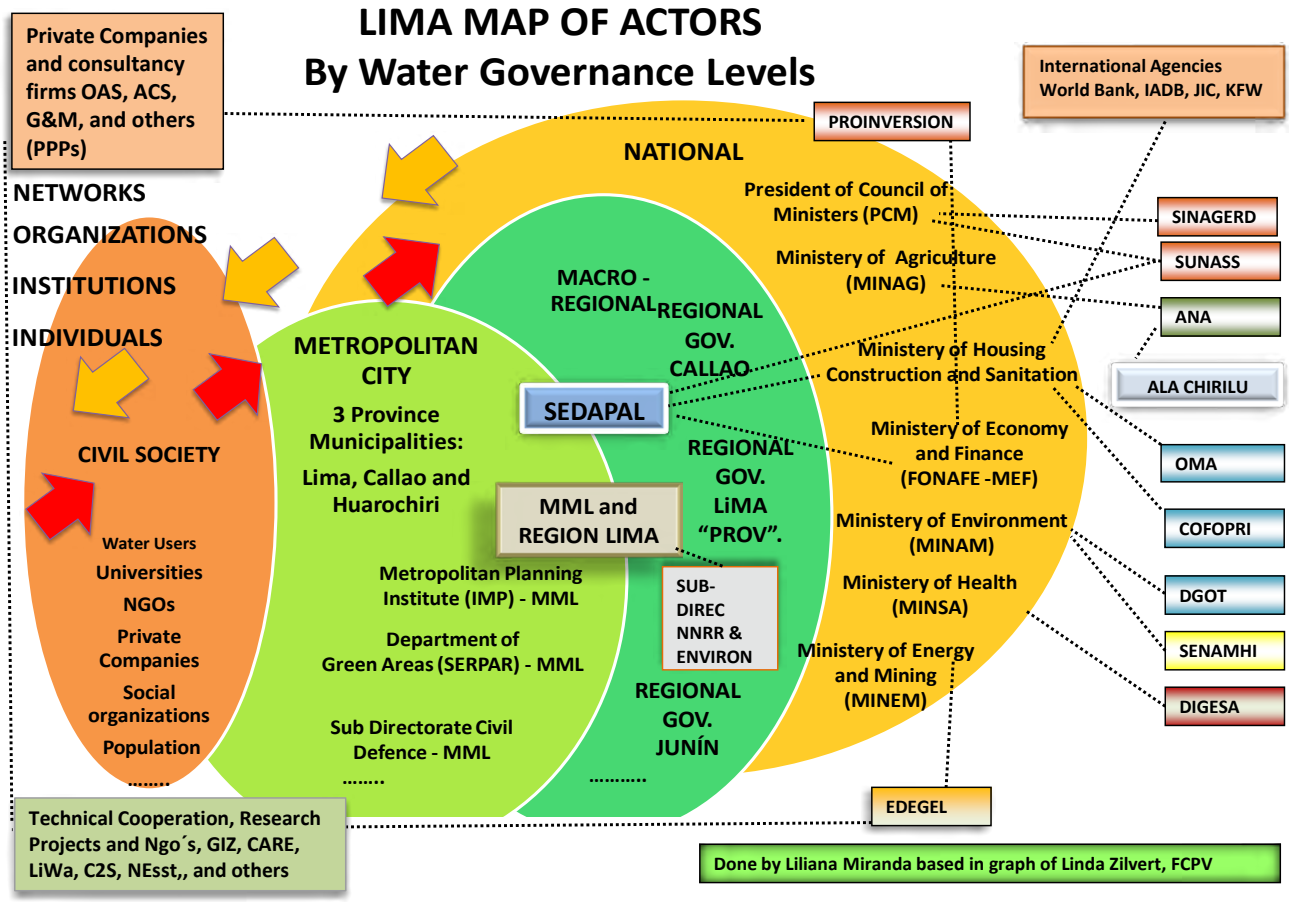
In the case of Lima, after the announcement of the establishment of the Inter-basin Council of Rimac, Chillon and Lurin, a management and *concertative* institutional body for coordination and consultation is expected, involving the authorities of the city of Lima, the whole macro-region as well as the central government, private sector and civic society. This should ensure that decisions and investments could be linked not only to the procedures of granting rights associated to the access to water resources, but also to the coordination and scaling up of the needed budget for implementation of priorities agreed upon by those representatives.

For example, among the main challenges of Metropolitan Lima, the following were identified by the Round Table on Water and Climate Change (developed by LiWa in 2011): Natural resources and ecosystems (source and basin protection, both in quality and quantity, and integrated water resource management); governance (institutional strengthening, authority, leadership, regulation, conflict resolution, dialogue, alliances); tariffs (internationalization of costs, sustainable water tariffs, inclusion of external effects); spatial planning (POT for controlling sprawl); efficient use of water resource (minimizing losses, sustainable sanitation, reuse of waste waters); and finally education and capacity development (raising awareness, water culture).

A key question for the future of the metropolitan city and the macro-region is how to integrate and harmonize urban growth, risk management, nature conservation and water management by social and eco-efficient use of the limited available resources?

4.2. Is Metropolitan Lima Prepared to Face Climate Change?

With respect to climate change, there is a persistent sectoral approach that dominates over a more territorial and integrative stance. Adaptation is not perceived as a challenge of sustainable development (beyond risk or environment). Knowledge tends to stay where, and with whom, it has been generated, inclusive processes enhance opportunities to accept and internalize future proposals and coordinated actions.



Territorial and geographic information facilitates an integrated understanding of complex processes that occur in a single territory in relation to water, the city, nature and climate change. In that sense, both the scenario workshops and GIS maps have been established as raising awareness and as a form of knowledge. Although they require to be validated by experts and the community, they can be considered input for the social construction of a new territorial knowledge, contributing to a more holistic, integrative and long-term approach.

Development approaches from governmental actors in Lima often continue to apply, consciously or not, a dominant "pro-growth" and/or "pro-sector" discourse. However, at the metropolitan level and its related sectors, "pro-poor" and "pro-life" focuses have become more relevant.

The water system reveals great complexity at the city level and macro-region level. There exists a multiplicity of actors and interests that imply many types of uncoordinated actions that occur in a physical and geographic space that is also complex and full of risks related to the expected impacts of climate change.

This situation requires a detailed analysis and a greater emphasis on informed dialogues held by key actors. Only a few actors have the capacity to comprehend the whole system due to this great level of complexity. Most actors are diverse, weak, and dispersed, while deciding on the development of the city with a short-term vision and a low level of coordination and planning.

Non-human actors, ecosystems, and the natural resources they contain, are rarely considered in dialogues and decision making processes, unless environmentalists, who usually belong to minority groups, explicitly introduce these topics.

Lima has different authorities with defined powers and responsibilities with overlapping spatial management at different and multiple scales, involving the metropolitan city and the macro-region (including water resources, water and sanitation services, risk management and climate change). This situation results in fragmentation, disarticulation and weakening of the role of the state.

Municipalities in Lima do not participate in decision-making processes on water and sanitation investments in the city. Their intervention and decision capacities on the city's development, or where to locate or consolidate infrastructure in relation to the degree of exposure to natural hazards, are very limited. Their intervention is limited to recommendations on water savings or reusing treated wastewater for irrigating urban green areas.

A prevalent attitude of resistance to accept risk in general, and climate risk in particular, has been identified. In some cases climate change is discredited by public, private and civil society actors by using extremist or apocalyptic adjectives.

There is weakness and discontinuity of policies from politicians and private leaders: they are influenced by a predominantly short-term view based on electoral periods and/or investment interests. It is often assumed that there are limited resources for adaptation purposes and long-term investments in environmental issues are still low priority. Nevertheless, climate change requires a long-term view and its thematic integration in the national, regional and local planning system through spatial planning should be considered.

Even though there are still opportunities for coordination and participation (that need to be institutionalized), there is no system that congregates all public, private and civil society actors for generating information and coordinating specific actions on the long term. Therefore, it can be argued that the main vulnerability of Metropolitan Lima is merely institutional, since city and territory management is delinked from water and climate risk management. Institutions from Metropolitan Lima have limited capacities to develop, lead and promote a process of climate change adaptation.

The city requires one single democratic authority – without implying recentralization- with enough creativity and power to adequately handle this level of complexity. The option to build a coordinated and institutional space, open for *concertation* in order to plan and govern the city with a long-term unitary vision is urgent. Lima requires creativity and political leadership for changing institutional paradigms and redefining its government and intervention ambit, both as a metropolitan city (Lima, Callao and Huarochiri) and as a macro-region, linking its basins and hinterland (Chillon, Rimac, Lurin and Mantaro). Within this space, a number of consensual agreements for an inter-sectoral coordination and integration of territory, soil, water and risk management can be promoted for ensuring sustainability.

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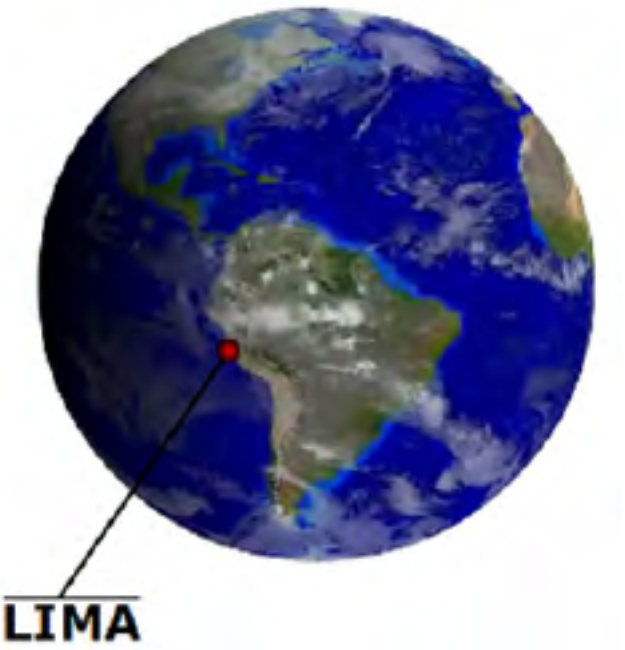
6 Appendices

Appendix 1: Figures

Figure 1: Location of Peru

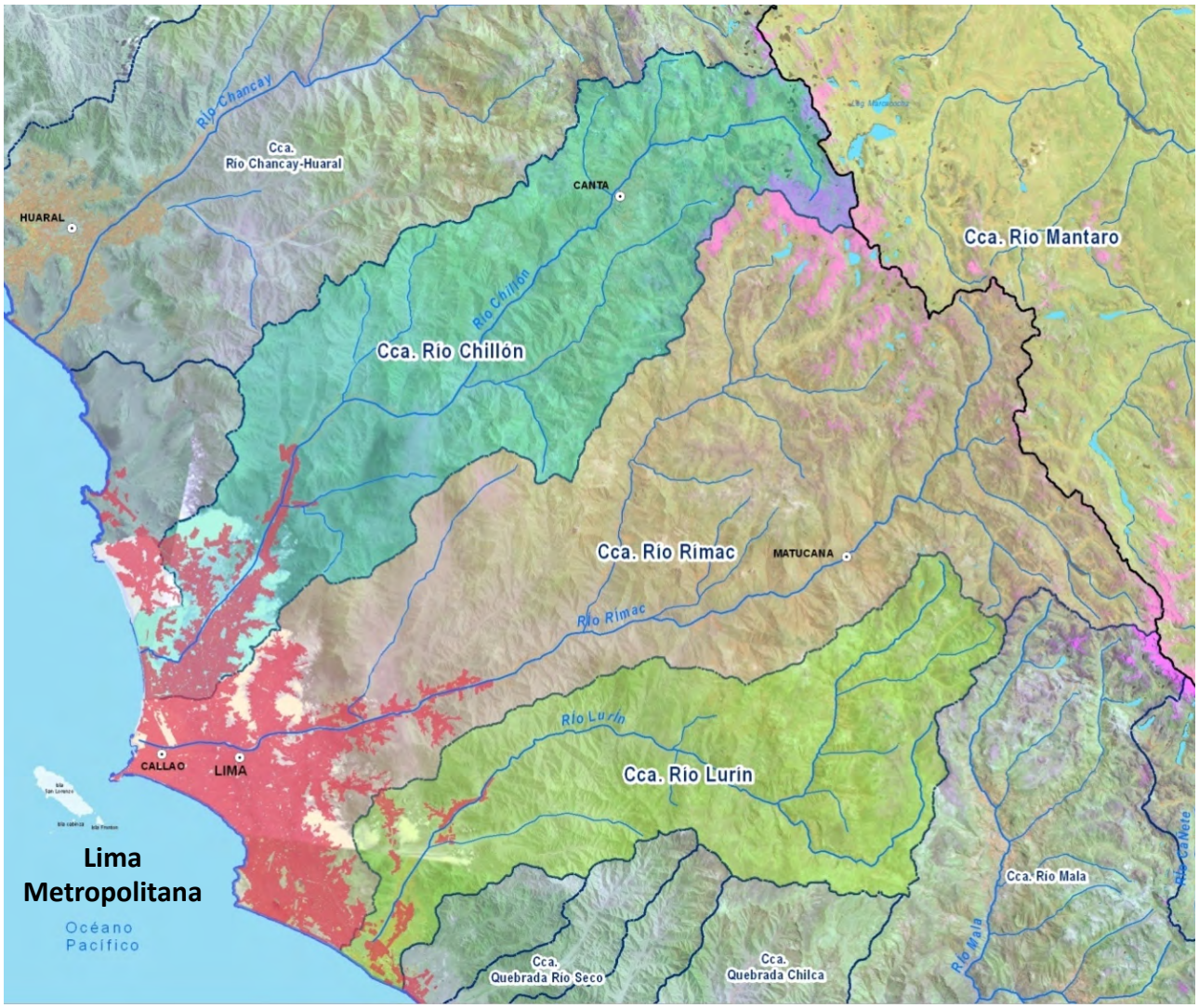


Source: Google Maps

Figure 2: Location of Lima

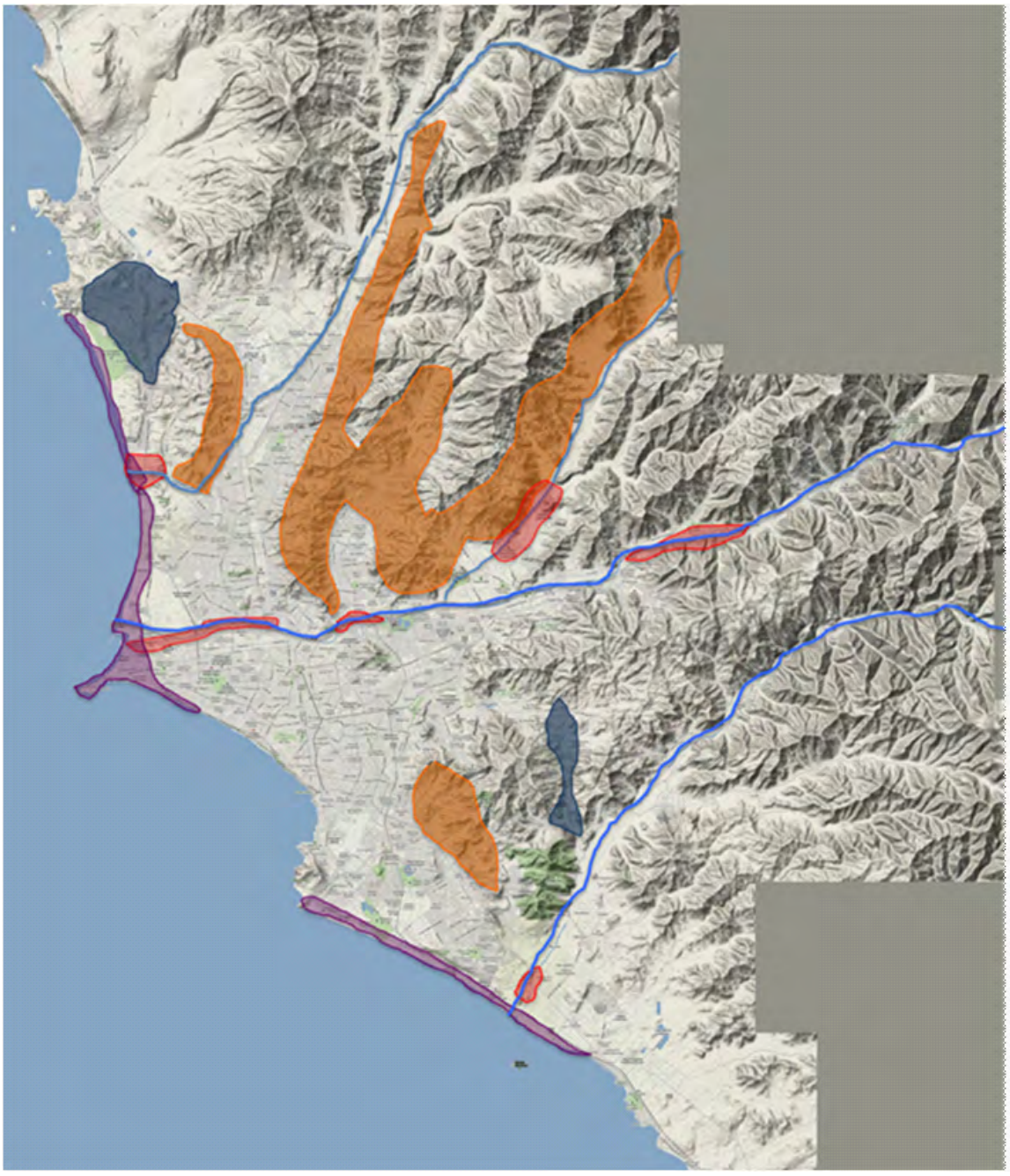
Source: Google Maps

Figure 3: Metropolitan Lima and its four basins



Source: Climate Change Adaptation Strategy of Metropolitan Lima, unpublished document, 2012

Figure 4: Key Actor´s Vulnerability perception to climate change in Lima, Peru



Coastal flooding zone (Sea Level Rise)

Lack of Infrastructure zone (water/drainage)

Housing on slope terrain (land slides)

River overflow zone

Author: Kaiser, JP. (2013)

Map Source: Moncloa C. (2010), google.es

Interviews: 7 interviews during 2012 and 2013, Preliminary results of ongoing research.

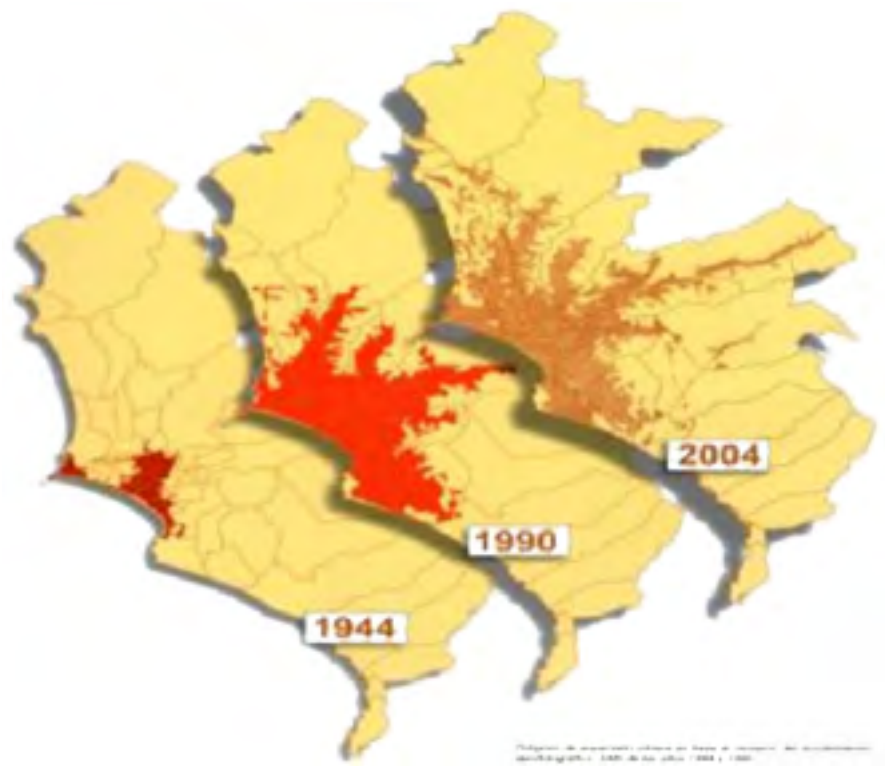
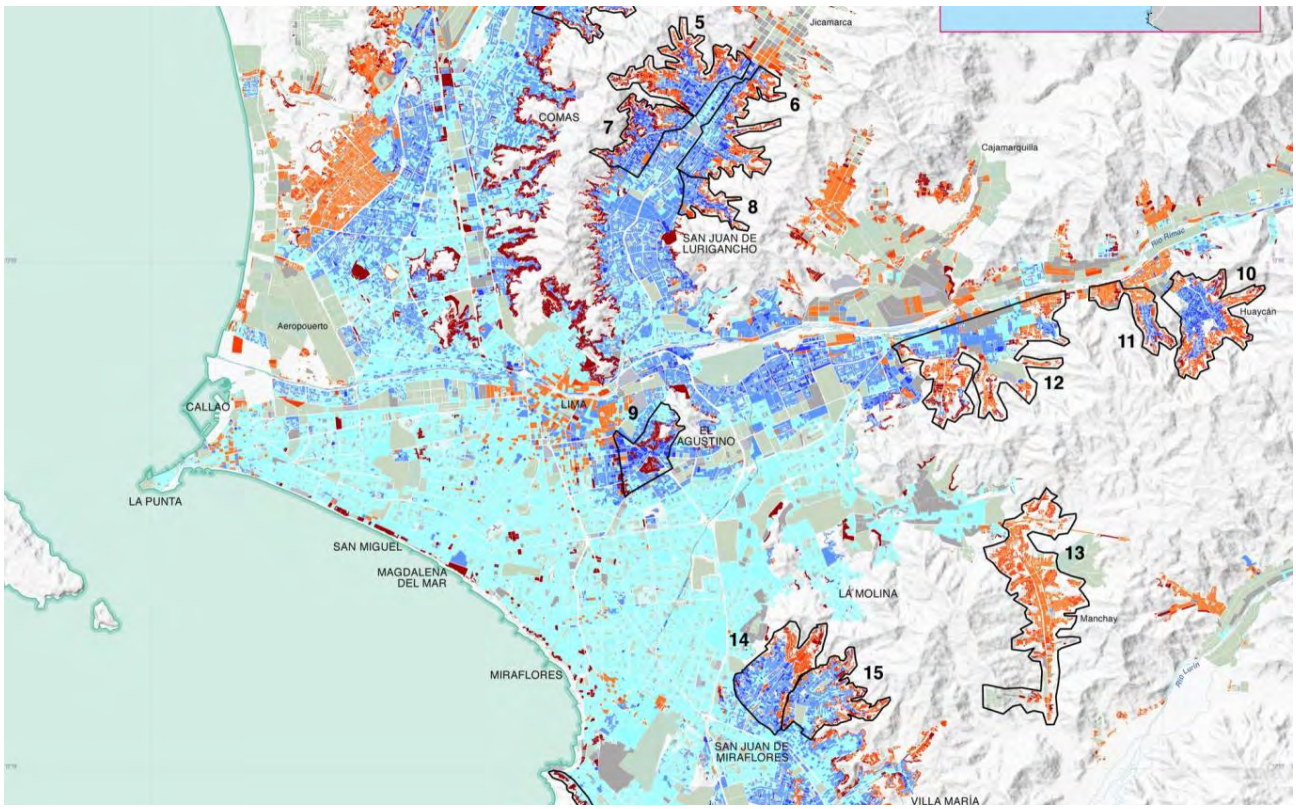


Figure 5: Urban expansion of Lima

Source: IMP, urban expansion polygons based on the aerophotographic mosaic SAN from 1944 and 1990

Figure 6: Urban Poverty Map – Barrio Mio MML Programme
INEI CENSUS 2007



Poor
Middle class
Very Poor highly vulnerable

Appendix 2: Tables

Table 1: Actors and their networks in urban ICT initiatives

• National	• Norms, rules, policies and plans (Climate change, Urban Development, Water and Sanitation, Risk and Vulnerability, SCV, etc.) as secondary data
• Macro regional From river basin, water shed to the ocean	• High level seminars and round tables, as possible • Key actors interviews (politicians and beaurocrats) • Newspaper search: discourse analysis • Aero satellite photographs, google earth, geoeye • (Water) Large scale projects overview • Key actor´s interviews (politicans, experts, opinion leaders)
• Metropolitan City	• Census, water cadastre (consumption and connections as possible) • Scenario´s workshops (building, analysis and transfer) • Hydro climatic vulnerability mapping • Key community (urban and river basin/rural) leader´s interviews and their photos (vulnerability perception)
• Local	• Participatory vulnerability mapping • Focus groups (exchanging urban/rural perspectives)*

* Pending to be done

Table 2: Map of actors

Level	Institutions / Agencies		Brief Description	Sector
NATIONAL GOVERNMENT	**PCM** **Presidency of the Council of Ministers**	**SUNASS** **National water and sanitation services**	Decentralized public body attached to the PCM with official public law, and with administrative, functional, technical, economic and financial autonomy. Its function is to regulate, supervise and monitor the provision of sanitation services, impartially safeguarding the interests of the state, investors, and user. They regulate all companies providing water and sanitation services-EPSs and regulate issues such as tariffs and duties of the EPSs. www.sunass.gob.pe	Planning and water management
		SINAGERD **National system for disaster risk management**	Created in February 2011, aimed at identifying and reducing risks associated with hazards, minimizing effects and avoiding the creation of new risks, and preparing and addressing hazards through management guidelines. Its governing body is composed of the PCM, the National Council for disaster risk management, the National Assessment Center, Prevention and Disaster Risk Reduction (CENEPRED), public authority, and technical lead, to coordinate, facilitate and oversee the development and implementation of the National Disaster Risk Management. www.cenepred.gob.pe	Risk management
	MINAG **Ministry of agriculture**	**ANA** **National water authority**	The general water law established the MINAG as the authority responsible for granting water rights for water use, and the Ministry of Health was granted responsibility for water resource management (as it depends on the National Water Authority through the river basin councils). www.minag.gob.pe	Planning and Integrated Hydric Resources management
	MINSA **Ministry of health**	**DIGESA** **Environmental health directorate**	The general water law established the MINSA as responsible for water quality. This is executed through DIGESA, which is the technical and regulatory body concerning basic sanitation, occupational health, food hygiene and protection of the environment. www.digesa.sld.pe	
	MINAM **Ministry of the environment**		Created in May 2008 as the governing body of the national environmental sector that coordinates at local, regional and national government levels. Through the General Directorate of Spatial Planning (DGOT), the development of spatial planning and economic ecological zoning is being regulated and promoted. Besides, the National Commission for Climate Change (CNCC) established the National climate change strategy (2003). www.minam.gob.pe	Land planning (Environmental)

Level	Institutions / Agencies		Brief Description	Sector
NATIONAL GOVERNMENT		**SENAMHI** **National meteorology and hydrology service**	Decentralized government agency which conducts studies and scientific research in the areas of meteorology, hydrology, agrometeorology and environmental affairs for the benefit of the country. It was created in 1969 and its main purpose is to make daily weather forecasts, assess and classify the country's climate and water resources and conduct necessary investigations for the benefit of better use of resources. www.senamhi.gob.pe	Risk / Climate Change
	Ministry of housing Construction and sanitation	**DGOT** **General Directorate of spatial planning**	Developing studies of natural risk management through national urban planning and zoning programs. In the specific case of Lima, studies are conducted in 3 out of the 43 districts. It should be noted that according to the existing rules, these are powers of the local government www. vivienda.gob.pe	Land management
		National Directorate of urban planning	Directorate whose mission is to consolidate sectoral and institutional development, facilitating strategic partnerships with all actors involved in the urban territory (municipalities, regional governments, neighborhood organizations, NGO's, private enterprises, etc.), and promoting urban interventions that benefit the general habitat, with priority on improving the living conditions of the poor population. It is being implemented by the Land Management Program (TMP). http://www.vivienda.gob.pe/direcciones/urbanismo_vision.aspx	
		SEDAPAL **Potable water and sewage service for Lima**	Depends directly on the Vice-Ministry of Construction and Sanitation and is responsible for managing the system of water and sanitation in the city, as well as the quality of soil. www.sedapal.gob.pe	Water management and planning
		COFOPRI	Organization responsible for land titling, dependent on a national government entity. www.cofopri.gob.pe	Land management
	MINEM **Ministry of energy and mines**	**EDEGEL** **Electricity generation company of Lima**	The energy supply depends on a private enterprise that is regulated by the national Government (EDEGEL), www.edegel.com	Water management and planning
	Ministry of economics and finance	**MEF**	Responsible for planning, directing and controlling matters related to budget, treasury, debt, accounting, tax policy, public investment and economic and social policy. www.mef.gob.pe	

Level	Institutions / Agencies		Brief Description	Sector
REGIONAL GOVERNMENT	**Municipality of Metropolitan Lima (*)**	**Metropolitan planning institute-IMP**	Decentralized agency of the MML, created in 1991, with legal and administrative and technical and economic autonomy, acting as the hub of the regional system and metropolitan planning. It developed the Metropolitan Urban Development Plan 2040. www.munlima.gob.pe/imp/q_somos.html	Regional planning
		Urban development management of the MLM	Responsible for formulating and evaluating specific urban plans, and monitoring the processes of authorizations, certifications, awards and human settlements (concerning urban development within the framework of the applicable legal provisions). www. munlima.gob.pe	Land management
		SERPAR-MLM	Decentralized agency of the Ministry of Housing to meet the needs of recreational, cultural and sport facilities, to socially promote the preservation of the environment, not only in Lima, but also in other cities in Peru. It is developing the ecological strategy of Lima and other studies and instruments linked to the issue of land management. http://www.serpar.munlima.gob.pe/	Land management / Landscape and green areas
		Environment managemnet MLM	Ensures the protection and conservation of the environment in metropolitan Lima by regulating the management of municipal solid waste, supervising and monitoring levels of environmental pollution, and managing the implementation of appropriate corrective action. It formed the Municipal Environmental Commission (CAM), involving different local actors.	Environmental management
	Regional Government of Callao (**)	**Environment and natural resource management**	Corresponds to specific sectoral functions related to protected areas and environmental protection. It participates in the meetings of regional managers, broadcasting resolutions on matters within its competence. www.regioncallao.gob.pe	Environmental management
		Planning management	Specific functions in prospective strategic planning, investment, budget, taxation and spatial planning, administration and adjudication of State-owned land. www.regioncallao.gob.pe	Land management and planning
		Sub-management of green areas	www.regioncallao.gob.pe	Land management
		Management of national and civil defense	Body of senior management support, committed to ensure the well-being and security of the entire population. It aims to direct, assess and implement the National Defence Planning and Civil Defense in Region Callao, derived from the National Plans. www.regioncallao.gob.pe	Land Mmanagement

Level	Institutions / Agencies		Brief Description	Sector
GOVERNMENT AT THE LOCAL LEVEL	**District municipalities**	**Management and/ or sub-management of urban development**	Through an Ordinance of Metropolitan Lima, as a temporary office, manages the urban planning functions within its jurisdiction. Proposals for its validity depend on the approval of the IMP of the MLM and exercising them through urban development. The executive bodies manage the services of the city and the green areas. In each municipal district, there are variations in the management and sub-management that are part of the organizational structure.	Land management
		Management of city services and green areas		
		Environmental sub-management		

Source: Linda Zilvert, FCPV, 2012

(*) For the city of Lima, the Metropolitan Municipality of Lima has the power to regulate and implement planning and management regarding territorial zoning, green areas and sanitation services related to solid waste.

(**) It overlaps in jurisdiction with the Provincial Municipality of Callao and it is developing due to important economic revenues (mainly port Canon), and important studies on economic ecological zoning and the Zoning Plan.

Table 3: Principal Actors of the Climate Governance and Water in the Metropolitan City of Lima

Main Actors	Action Scale (National / Regional / Watersheds / Local) (State / Private)	Function	Level of Influence in Decision-making
MINAM	• National • State	Watershed and territorial management	High
MINAG	• National • State	Watershed and territorial management	Very High
CENEPRED – PCM National Disaster Risk Management System	• National • State	Planning, Coordination, Supervision	Medium
SUNASS – PCM National Superintendence of Water and Sanitation Services	• National • State	Normative, Regulation, Supervision, Auditing	Very High
INDECI	• National • State	Risk Management	Average
ANA – MINAG National Water Authority	• National/Watersheds • State	Water Management, Normative, Regulation, Supervision, Auditing	Very High
DIGESA – MINSA General Directorate of Environmental Health	• National • State	Normative, Regulation, Supervision, Auditing	High
SENAMHI – MINAM National Service of Meteorology and Hydrology	• National • State	Research, Advice	Low
DGOT – MINAM Directorate General of Land Use Planning	• National • State	Normative, Advice, Supervision	Low
National Directorate of Urban Planning – MVCS	• National • State	Urban Land Management, Normative, Supervision, Auditing	Average
SEDAPAL – MVCS Service of Water Supply and Sewerage for Lima	• Regional /Provincial • State	Water Management, Regulation, Supervision, Auditing	Very High
COFOPRI – MVCS Office for the Formalization of Informal Property	• National • State	Regulation, Formalization	Low
FONAFE – MEF National Fund for Financing the Business Activity of the State	• National • State	Normative, Regulation, Supervision, Auditing	Low
EDEGEL Company for the Generation of Electricity for Lima	• Regional /Provincial • Private	Water Management, Production, Commercialization	Average

Main Actors	Action Scale (National / Regional / Watersheds / Local) (State / Private)	Function	Level of Influence in Decision-making
Metropolitan Municipality of Lima • Associate Management of RRNN and Environment (PGRL) • Metropolitan Planning Institute (IMP) • Department of Urban Development • SERPAR	• Regional /Provincial • State	Urban Land/Watersheds/Territory Management and Planning, Risk Management	Average / Low
Regional Government of Callao • Department of RRNN and the Environment • Planning Management • Associate Management for Green Areas • National Defense and Civil Defense Management	• Regional /Provincial • State	Urban Land/Watersheds/Territory Management and Planning, Risk Management	Low
Regional Government of Lima ("provinces") • Management for the RRNN and the Environment • Planning, Budget and Territorial Improvement Management	• Regional /Provincial • State	Urban Land/Watersheds/Territory Management and Planning, Risk Management	Low
Local Government Districts (Lima 42, Callao 7, Huarochirí 1) • Urban Development Management and/ or Associate Management • City Services and Green Areas Department • Department of Environmental Management	• Local • State	Urban Land/Watersheds/Territory Management and Planning, Risk Management	Low
ALA Local Water Authorities	• Local • Public / Private	Water Management	Average
Committee for Water Users	• Watersheds, Sub-Watersheds, Local • Private	Water Management	Average
NGO Non-Governmental Organizations Promoting Development	• Regional/Provincial/ Local • Civil Society	Promotion and Execution	Low
Private Sector	• Regional/Provincial/ Local • Private	Investment, Promotion, Execution, Risk Management	Average
Population	• Regional/Provincial/ Local • Civil Society	Execution, Users, Risk Management	Low
Academics Universities, Professional Colleges, etc.	• Regional/Provincial/ Local • Civil Society	Research and Promotion	Low

Developed by Liliana Miranda and Jean Paul Kaiser, 2013

City Fieldwork Report

Water Governance in the Context of Climate Change in Arequipa

By Anthony Jo Noles[1], with support of Renato Cáceres López
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Table of Contents

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1 Arequipa: Context, Policy and Legal Framework

1.1. Arequipa in the Chili River Basin[4]

The city of Arequipa is located in the southwest of Peru and is the capital of the province of Arequipa, it is situated in the territory of the Chili River Basin. Its altitude ranges from 0m to 6055m above sea level (See map 1, 2 and 3).

The Chili River Basin is almost entirely regulated, receiving a referral from the neighboring basin of Alto Colca, which is part of the Cusco region.

The average volume of water in the regulated basin is around 507 million cubic meters per year (MCM / year). It is the source of water for all the uses of the basin: providing drinking water for over 880,000 people, water to irrigate over 30,000 hectares of land, water to generate 172 MW of electricity, and providing water for several local industries and mining.

The upper part of the basin is located in the National Reserve of Salinas and Aguada Blanca; a critical ecosystem that provides the environmental services of collection, infiltration, regulation and storage of most of the water in the basin.

The basin is very rich in biodiversity. Despite being an arid area, it has five natural regions (according to the scheme of Pulgar Vidal), 469 species of flora, 43 species of mammals, 135 species of birds, 7 species of reptiles, 6 species of amphibians and 5 species of fish.

One of the key environmental problems is microbiological contamination of the river basin, caused by the lack of treatment of wastewaters.

As a consequence of the external geodynamics, the basin is at risk of flooding, landslides and soil creep, soil

4 This section has been developed based on the document „The river Chili: arid basin with mining presence."

Map 1: Map of Peru

Source: Google Earth

Map 2: Map of Peru

Source: Google Earth

collapses, mudflows, the clogging of rivers and erosion of banks. There is also a high risk of seismic and volcanic activity (See Appendix 1 for more details on natural hazards in the city of Arequipa).

Conflicts over water resources in the basin are based on a divided management and the lack of coordination. The most significant conflict today is between agricultural use and the energy sector. Should all demands from the energy sector be granted, there would be no water left for other uses from September-October until the end of each year.

1.2. The City of Arequipa

Arequipa is located at coordinates 16 ° 23'55 .76 "S and 71 ° 32'12 .78" W, at an altitude of 2,335 meters. Its area covers natural regions known as Yunga and Quechua.

The climate of Arequipa is predominantly dry between fall and spring. The average relative humidity is 46%. Temperatures do not rise above 25°C and rarely drop below 10°C. The rainy season runs from December to March, and manifests itself in the form of little rains in the afternoons. In the winter (June, July), temperatures drop to an average of 10°C.

Arequipa is the second most important city in Peru and center of immigration from its neighboring regions in the South of Peru. According to the 1940 national census and the population projection for 2010, the city's population has increased tenfold (cited in Chance2Sustain 2011) and its growth has a significant positive trend.

71.3% of the 1.15 million people living in the region (formerly Department) of Arequipa are concentrated in the metropolitan area of Arequipa. Based on an annual average growth rate of 2.4% (2000-2004), the population is expected to reach over one million by 2015 (INEI 2001), .

Due to the rapid population growth, the socio-spatial segregation has also increased over the past 20 years; while the poor occupy the desert areas of the northern and southern parts of the city, the higher income population mainly occupies agricultural land located close to the city center; an area known as "La Campiña" with a more appealing climate and landscape.

Water and Sanitation

As already indicated, the Chili River serves the city of Arequipa. 10% of the city's population lacks a safe drinking water supply, 5% is not connected to the sewage system, and

6% has no electricity. Furthermore, existing services are often of poor quality (Coordinated Development Plan 2008-2021).

The lack of a proper sewage system negatively affects the environmental quality of the Chili River. According to the Regional Environmental Authority (ARMA) the Chili River receives 1100 liters/s of wastewater from 38 discharge points in the city. These points include 25 points discharging domestic wastewater, 8 points industrial wastewater and 1 point agricultural wastewater (ARMA 2011). Consequently, data on water quality monitoring indicates the presence of more than 3,500,000 MPN/100 ml of total coliforms and 1,300,000 MPN/100 ml of fecal coliform (ARMA 2011), the latter exceeding the Standard Environmental Quality (ECA) 1,300 times. Because this polluted water is used downstream to irrigate crops, there is a high incidence of intestinal diseases (both acute and chronic) among the population. Because farmers are not able to sell products such as the well-known onions from Arequipa, it also causes economic losses, calculated at US$75 million a year.

Poverty, inequality, inefficient services and vulnerability

The city of Arequipa has relatively high human development levels compared to other Peruvian cities. However, in 2004, the poverty rate was 37%, and 10.6% of the population lived in extreme poverty. The corresponding Gini coefficient amounts to 0.37[5]. According to Barrantes et al. (2012),

> *"inequality is currently reduced due to the authorities' support of private investment processes related to mining and export agriculture. This was made possible through effective public systems formed, in a more authoritarian rather than democratic way, by the domestic political coalitions. All is driven by human capital formation processes, supported by important educational offering"[6].*

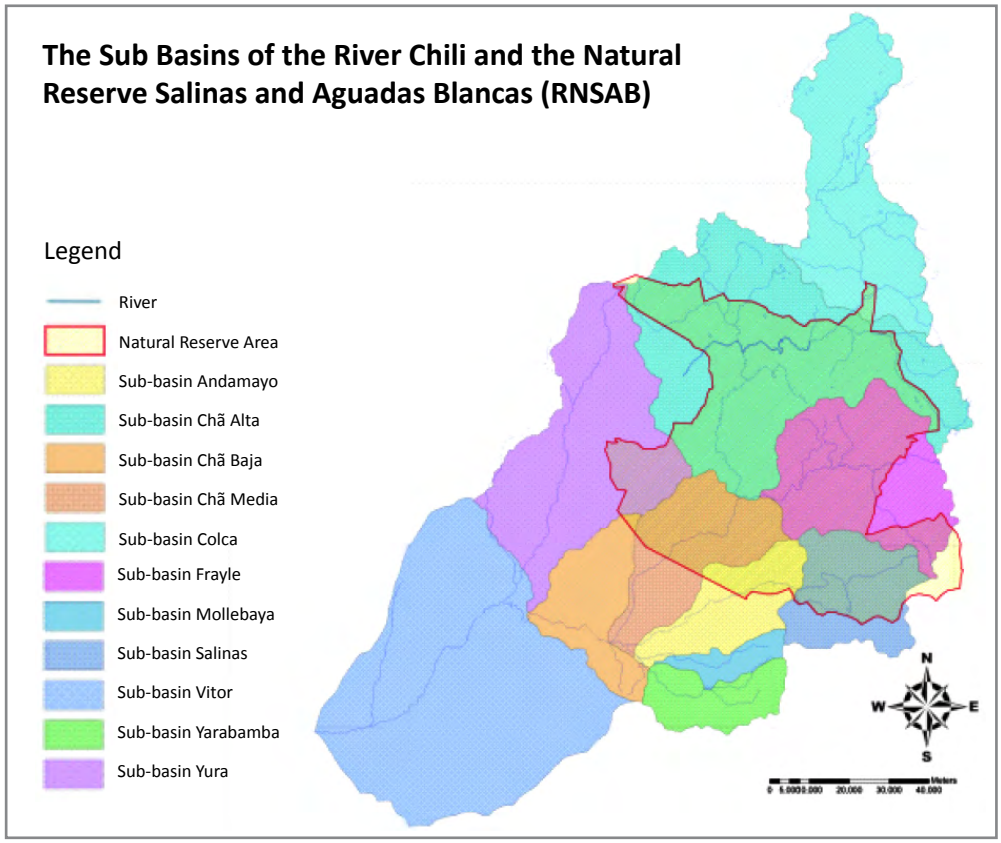
Like elsewhere in the country, the lower income population has been forced to settle in areas that are lacking basic services. In relative terms, they pay a much higher price for their water, which is provided by private tank trucks, with its suitability for human consumption not guaranteed.

Map 4 shows the various risk factors in the city of Arequipa, including mudflows, landslides, and mudslides.

5 In 2008 it was 0,43 in Lima, and 0,48 in Peru (Peru Country report Chance2sustain, unpublished)

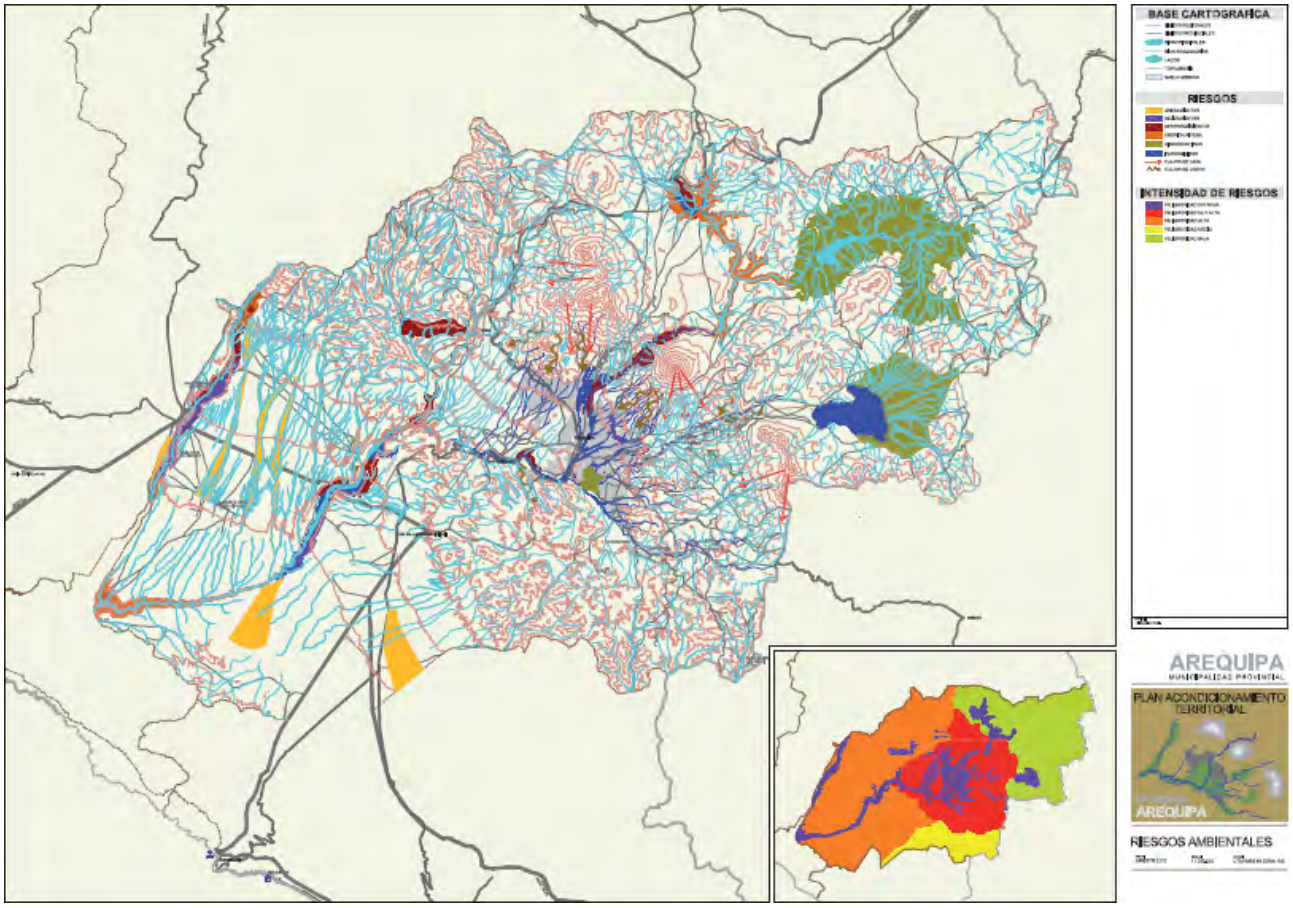
6 Quoted from an interview with Barrantes published in La Republica on 19.08.2012, our translation. http://www.larepublica.pe/19-08-2012/aumento-la-desigualdad-en-cajamarca-pesar-de-haber-bajado-el-nivel-de-pobreza accessed 23 of March 2013.

Map 3: Map of Peru



Source: IRECA-UNSA/ Labor. River Chili: arid basin with mining presence

Map 4: Risk Map of Arequipa



Source: Development Plan of the City of Arequipa 2008-2021

2 Water, Climate Risk and Arequipa

Risks and impacts of climate change

In the Second Communication of Peru to the Convention of the United Nations to Combat Climate Change (UNFCCC) in 2010, The Ministry of Environment (MINAM) states that Peru is "particularly" vulnerable to climate change, because it scores positively on 4 out of the 5 characteristics recognized by the convention (MINAM 2010), as can be seen in Table 1.

Although the characteristics recognized by the UNFCCC refer mainly to the physical environment, there are also criteria related to the vulnerability of the population and their livelihoods. In 2001, the National Environmental Council (CONAM), predecessor of the current Ministry of Environment, cited the following as causes of vulnerability of the country to climate change:

- Peru has 28 of the 35 existing climates in the world, and 84 out of the 114 life zones.
- A large percentage of the population is engaged in agriculture, fishing and other activities which are directly affected by the weather.
- 51% of the Peruvian population lives in poverty, 21% in extreme poverty[7].
- There is a low adaptive capacity due to limited institutional, financial, human and technological resources.
- Peru has over 70% of all tropical glaciers.

7 Poverty levels have dropped significantly since this report to the UNFCCC was published

Table 1: Peru's vulnerability to climate change

Features mentioned by the UNFCCC	Peru
Countries of low altitude and other island states	-
Countries with low-lying coastal areas	✓
Arid and semi-arid zones; forested areas and areas liable to forest decay	✓
Areas exposed to floods, drought and desertification; countries with areas prone to natural disasters	✓
Developing countries with fragile mountainous ecosystems; countries with areas of fragile ecosystems, including mountainous ecosystems	✓

Source: Second Communication of Peru to the UNFCCC United Nations to Combat Climate Change (MINAM 2010)

The main evidence of climate change for the country is associated with the retreat of glaciers and snow - Peru has lost 22% of its glacier area in the last 25 years. Consequently, rainfall patterns are changing and recurrent emergencies caused by extreme weather events[8] are becoming more frequent. While climate change may have some positive implications for some areas, such as more favorable temperatures for certain crops in the high Andes and the presence of new aquatic species for human consumption in the coastal areas, the negative consequences can be severe. Consequences such as reduced availability of drinking water supply and water supply for productive activities, possible migration from rural areas to cities, emergence of new diseases in tropical areas, impacts on agricultural productivity and biodiversity, and the increase and intensification of water conflicts, show a grim picture that necessarily requires the identification and implementation of policies and practices that contribute to the development of planned adaptation processes.

Regional scenarios on climate change

According to the Regional Strategy on Climate Change of Arequipa 2030:

- The projection of temperature changes indicate that the variations in maximum and minimum temperatures tend to be close to 4 degrees Celsius, and may result in increase as well as decrease. Both the winter and summer would tend to be atypical.
- Trends in temperature and the eventual occurrence of El Niño, indicate that there might be a favorable period of rainfall in the region, with relative abundance of water in 2008-2012, and a critical period between 2013-2016. The favorable periods, which used to last for 6 to 9 years, have subsequently contracted to 4 to 6 years. At the same time, the return frequency of critical periods may be reduced from 6-9 years to 4-7 years. Altogether there will be a reduction in rainfall, especially in the highlands, affecting not only the recovery of water cycles, but also the holding capacity of snow; as a result the glacier surface will continue to decline by a rate that can exceed 50% of the current rate, until the glaciers disappear. This in turn will affect the climatic variation factors, reducing the capacity for water retention in the territory. The areas of greatest social impact can be, generally, the lower and middle parts of the valleys of the Andes, but the ecological impact will be felt in all areas.

Moreover, the project CAMINAR[9] identified a negative trend in recorded precipitation data (1964-2000) in some of the weather stations in the basin of Chili (Jimenez et al. 2010), as can be seen in Appendix 2.

Policy Responses

National Level

In the last four years, Peru has experimented with a process of updating and improving the regulatory and institutional frameworks, which mostly focused on environmental and water management. The process is still ongoing following a series of demands from various sectors. A number of incidents evidencing the inefficiency and limitations of state capacity have marked the need for new strategies and a paradigm shift.

8 According to the First National Communication, the natural emergencies increased six fold in the 1990's, 72% of these were due to weather emergencies

9 Catchment Management and Mining Impacts in Arid and Semi-Arid South America.

In Peru, the focal point for climate change policies is the Ministry of Environment (MINAM), which replaced the National Environmental Council (CONAM). This new entity was created in 2008 in search for a stronger environmental authority and the capacity to attend to the large and diverse environmental problems in the country. With its operation center in Lima, it lacks levels of representation at regional and local levels. This leaves the responsibility for environmental problems in each region and/or city to those actors who have the mandates, roles and specific responsibilities for the environmental management in their jurisdictions, according to the respective organic laws from 2003 that established and regulate them.

Water as a resource has as its executive and regulatory management agency the National Water Authority (ANA), a state agency that was founded in 2009. It was established as a result of more than 20 years of discussions and various legislative proposals that allowed the update of the National Water Law of 1969. The National Water Authority initiated a paradigm shift from sectoral water management, to an integrated management approach that regards the basin as a territory to be managed.

As to climate change, the policies and interests of the past administration (2005-2010) assumed climate change as an "opportunity" to attract investment, especially to the Amazon region, based on the REDD[10] proposals. This also affected water management by identifying a number of hydroelectric projects that were to generate power for Brazil. This, coupled with other reasons and political mistakes, caused conflicts, which reached their most violent peak in Bagua (2009) when both police officers and indigenous people were killed in a clash in the Amazon rainforest. The current administration is perceived to have a greater interest and has performed more direct actions in relation to adaptation processes, especially since its second year in office. It recognizes the vulnerability of the country to this global phenomenon, and contributes to the participatory development of regional climate change strategies and plans for adaptation and mitigation.

Since 2011, Peru has been working on updating of the National Climate Change Strategy. In 2010 it published and adopted the Action Plan for Mitigation and Adaptation to Climate Change (Ministerial Resolution No. 238-2010-MINAM) and in mid-2012, the National Plan for Risk Management and Adaptation to Climate Change for the agricultural sector for the period 2012-2021 was published.

10 REDD refers to Reducing Emissions from Deforestation and Forest Degradation, a financial and incentive mechanism developed in the framework of the UN Climate negotiations.

The current administration is providing, with some limitations, a more extensive and effective implementation of the National Climate Change Strategy. Yet, according to the Citizens Movement against Climate Change (MOCICC 2009), little progress has been made since its adoption in 2003, as only around 13% of it has been implemented.

With respect to water governance in a context of climate change, a slow process of building new institutions under the new approach of managing water at the level of the river basins is encountered. Today, three years after the signing of the new Law on Water Resources, Peru has installed only four Water Resources Councils, of which the Chili River Basin is one. The process is barred by the diversity of contexts in which it has to function at sub-national level. There are conflicts between regions, some of them of historical nature (water does not respect political and administrative boundaries), and there are conflicts between stakeholders in the basins who want to see their productive and political interests guaranteed in this new territorial governance approach. Climate change in relation to water management and governance has thus been taken up with some limitations and not necessarily as a national priority, compared to other "local" problems.

Regional and city level

Arequipa has also fostered an interesting change in the institutional framework for regional environmental management. Its proposal unifies various sectoral environmental management units in a single, centralized institution, called Regional Environmental Authority (ARMA); taking advantage of the human, financial and technological resources that are scattered in the region. Since it is a recent development, it remains to be seen whether the change will contribute to better and more efficient environmental management.

With regard to climate change, the Regional Government of Arequipa, through the Regional Council, approved the Regional Agreement No. 043-2008 GRA / CR-AREQUIPA. This document gives priority to the development of the regional strategy on climate change. Two years later the regional climate change strategy was approved (Regional Agreement No. 143-2010-GRA/CR-Arequipa). Despite these agreements, little has been done with regard to policy and legislation at city level, neither have there been efforts to change attitudes and practices towards more sustainable water use.

The regional climate change strategy establishes that: "the trends in the temperature and precipitations indicate that the effects of climate change in the region will tend to

worsen in the next years, in both breadth and intensity, taking the average temperature increase in the areas of the snowy peaks of the region as main manifestation to between 2 and 4 degrees Celsius, accompanied by the reduction of periods of favorable rain and an increase in the cycle of return and length of critical periods. These scenarios are certainly subject to uncertainty because of the concurrence of uncontrolled variables" (Regional Government of Arequipa 2010).

Given the scenarios, there are five strategic axes of intervention:

a. the inclusion of climate change policy in local/ regional development planning,

b. the development of institutions that operate the monitoring system of risks in the regional territory,

c. the protection of water sources and biodiversity,

d. the promotion and development of scientific (socio-economic) research with respect to vulnerability and adaptation to climate change and;

e. training, awareness and dissemination at all levels.

The strategy puts special emphasis on the implementation of an integrated water resource management approach in order to ensure efficient and sustainable use of water in the region, as well as in the process of land use planning – using instruments such as the ecological economic zoning – and informed citizen participation.

In addition, a Regional Environmental Commission (CAR) of Arequipa was founded in 1999. It is a body for coordination and *concertación*[11] of regional environmental policy. Its primary function is to develop and coordinate the Environmental Action Plan of Arequipa. In recent years this participatory space has weakened. A similar trend has been reported from other regions during the process of institutional change from CONAM to MINAM, due to the decision of the latter to operate as a centralized institution and not to work with decentralized offices.

There also have been interventions from NGOs with projects such as, amongst others, CAMINAR, ADMICCO[12], and Characatos Mejoran Reciclando[13]. NGOs have a strong interest in the promotion of policies for water management and adaptation processes whose central focus is water management in Arequipa, as well as managing solid waste. They have received clear support from the regional and local government, which improved the technical and political aspects of their work.

11 There is no proper translation for the Spanish term *concertación*. It implies a process of deliberation that goes beyond deliberation. The participating actors deliberate until agreements are reached.

12 Promoting the adaptation and mitigation of climate change in coastal areas and reduce the vulnerability of the population with fewer resources

13 Metal Recyclers Improving

3 System and Institutional Actors

Planning and Management of Land and the City

As indicated, the city of Arequipa is the capital of the province of Arequipa, but it is also the seat of the government of the region of Arequipa, and therewith the seat of many sub-national offices of ministries and other institutions. The province of Arequipa is further divided into 19 districts. Fifteen of these districts form part of the city of Arequipa. Ten of these districts are distinctly urban, five others more peri-urban.

The Provincial Municipality of Arequipa is the authority that has the mandate and competencies to develop the planning and management of the city at the metropolitan level through its various arms. The districts, however, have specific functions in their jurisdiction, but must respect the guidelines that come from the metropolitan level.

Arequipa has been developing a series of tools to plan its territory since the beginning of this decade. However, it lacks a territorial plan, and together with other social and political-institutional factors, this led to disorder and increased vulnerability in the city (MINAM 2011).

A Poorly planned city growth, population growth and the need for housing for those citizens with limited resources

have resulted in new settlements being established through land invasions of state- or privately owned land near the Misti Volcano[14] or in the gullies[15]. This increases their vulnerability, as these are considered high-risk areas (Lombardi et al. 2012).

Arequipa, Basin, Water and Risk.

The Chili River Basin provides the water supply for the city of Arequipa, while also providing water for agriculture, power generation, and industrial activity.

According to the existing regulatory framework, water management at the basins level nationwide is the remit of the National Water Authority (ANA), which has local offices called Administrative Water Authorities (AAA), and in each basin is the Local Authority of Water (ALA). Regional governments have the role of promoting the creation of Water Basin Resources Councils (CRHC)[16] as multi-actor spaces for concerted water management. Members of these councils are the user organizations (agricultural and non-agricultural) and regional and local governments of the basin. The CRHC of the river Chili is one of only four such organizations that to date have been created in the country. Its formation is partly due to the existence of the so called *Comité Multisectorial.* This multisectoral committee, though not sanctioned by national regulation, was effective for protection and regulation of water uses. Although an informal institution, it was accepted by all stakeholders, which allowed its operation. However, it only focused on the distribution of water resources between all users (agricultural and non-agricultural) from the volumes registered year by year in the basin. The actors that informally decided on the distribution of water are now part of the newly formed council.

Water and sanitation

Public companies are responsible for drinking water and sewerage, with their boards made up of the provincial and district municipalities. In Arequipa, this is called SEDAPAR[17] and supplies not only the city of Arequipa, but also the provinces of Caylloma, La Union, Condesuyos, Castilla, Islay, Camana and Caravelí. There are 33 municipalities on the SEDAPAR board, both provincial and district. SEDAPAR has a Strategic Plan 2008-2012 for the management of water and sewerage (SEDAPAR 2008).

Arequipa has 7 sources for its waters supply, the main one is the Chili River (La Tomilla), and the others are La Bedoya spring, Sabandia spring, Congata spring, and infiltration galleries in Sachaca and Charcani.

The only water treatment facility in Arequipa is “Chilpina” at Socabaya district. It only treats 7.9% of the total volume of water produced. In remote districts and towns the treatment is minimal or nonexistent and wastewater is discharged into waterways, contributing to environmental degradation.

Environmental Management

The highest authority for environmental management is the Ministry of Environment, which is responsible for implementing and enforcing the laws and other environmental standards in the country. It is not a decentralised institution, and therefore it operates from Lima.

In Arequipa, the Arequipa Regional Environmental Authority (ARMA) is the Regional Government agency (Regional Government of Arequipa 2011). Locally, the Provincial Municipality of Arequipa exercises its function with the Environmental Sub Management Office, part of the Citizen Services Management. In these levels of government, the Organic Law of Regional Governments and Municipalities establishes the exclusive and shared legal competences.

In the institutional framework for environmental management, there are also participatory bodies such as the Regional Environmental Commission and Local Environmental Commission. These bodies, the regional governments (in the first case) and municipal governments at provincial level (in the second case) bring together actors from various sectors, including business and civil society, to coordinate environmental management efforts.

Energy

The electric power for the city of Arequipa and its industry is produced by the private company EGASA[18]. Energy is produced from hydroelectric and thermal power plants.

14 Misti (5,822 m) is a stratovolcano in southern Peru, located near the city of Arequipa. It is located at the foot of the valley to Chili (2,400 m.) and has become one of the greatest symbols of the city.

15 The streams which get flooded during the rainy season cause different kinds of damage for people living in surrounding areas.

16 Concejos de Recursos Hidricos de Cuencas

17 Servicio de Agua Potable y Alcantarillado de Arequipa

18 Empresa de Generación Eléctrica de Arequipa

Arequipa has six hydroelectric power plants: Charcani I, II, III, IV, V and VI, at the banks of the Chili River: they generate 53% of the total installed capacity (which is 175.82 MW). On the other hand, thermal generation is supplied by three plants: Chilina in Arequipa (49.81 MW installed capacity); Mollendo, in the city of the same name (31, 71 MW installed capacity) and Pisco, Pisco (Ica) (74.80 MW installed capacity), providing a total of 156.32 MW. The first two use oil, while the third one works with natural gas.

Risk management and climate change

At present, the regulatory political order establishes specific and well-defined functions to regional and local governments through the National Risk and Disaster Management System (SINAGERD). Thus the region, the province and the 19 district governments construct and implement risk management plans for their jurisdictions and they also lead the Civil Defense Councils.

The weakness of the national institutions (a structural problem in Peru), and the weak culture of prevention among society, as well as the weak policies for social inclusion of the poorest and most vulnerable citizens, imply that even when prevention and risk management instruments exist, a significant share of the population is exposed to numerous risks.

Among the key initiatives that have contributed to small advances in this domain, is undoubtedly GRIDE Sur[19]. This is a multi-actor space for exchanging experiences and capacity building, which sought to contribute to the reduction of disaster risk in southern Peru. It did so through a concerted intervention among local and regional actors, especially civil society organizations involved in promoting a risk management approach to local development.

Generation and Management of Information

Arequipa has institutions and authorities that show significant skills and competencies, and information management is one of the city's greatest strengths.

However, the challenges of climate change, and great uncertainty about the potential impacts (positive and/or negative) of this phenomenon, require improvements in all processes.

There are also large gaps and limitations of information on various aspects. These aspects require attention, and should be given priority in setting the research agenda. Academics have a major responsibility in this respect.

Some of these gaps and limitations are related to:

- Historical data and hydrometeorological forecast in many parts of the region; "downscaling" the SENAMHI20 generated scenarios for the region is required and the existing network needs to be expanded and made denser.
- The availability of information on quantity and quality of groundwater (hydrogeological data) is one of the main weaknesses; given the context of climate change in arid areas, this groundwater can be a potential source of future reserves.
- There is a great need for a more thorough investigation of the possible impacts of climate change on many ecosystems which are important for the water cycle, for example in the sub-basin of Salinas y Aguada Blanca.

It is necessary to point out that there is a great distrust of the authorities (at national and regional level) for sharing the information they possess. Some also make access difficult by charging high prices for it.

Given the fact that Arequipa is a mining region, the National University San Agustin of Arequipa has access to significant financial resources for research from the so called 'canon minero' (mining royalities). However, these are not being utilized effectively, not only in Arequipa, but in all mining regions.

Moreover, the Regional Environmental Information Systems work with limitations in the best case, or as occurs in many regions, are not operational. This platform should be a priority, in order to make all the existing data available to the entire population, and in particular, to researchers who will be able to generate new and more reliable information for decision-making.

Ongoing Initiatives

A number of initiatives are underway which might impact water governance in the near future. One of them is the recent creation of the Water Resources Council of Chili Basin, already mentioned above. This council will have the highly significant responsibility of assessing, planning

19 See http://www.labor.org.pe/detalle_noticia.php?cod_not=351

20 Servicio Nacional de Meteorología e Hidrología

and monitoring water use in the basin. Incorporating climate change scenarios and promoting the adaptation process for water management is one of their duties. This will require the use of tools and information, which unfortunately are not yet available, with those available not of the required quality.

There are two infrastructural initiatives. The first one is the Siguas II project; an agricultural frontier expansion project on the coast of the Arequipa region[21] where in the 1980s one of the major irrigation projects in the Peruvian coastal desert was developed. The planning of the second phase has now stopped because due to a heated conflict between the regional governments of Cuzco and Arequipa. To make this project viable, diverting water from the Apurimac river basin (which serves users in the Cuzco region) would be required. At the end of 2012, President Humala had to intervene in the conflict.

The second infrastructural project is smaller in size. In recent months, after a heated discussion between the social actors and local authorities, consent was given for the construction of a wastewater treatment plant project expected to solve the serious problem of pollution of the Chili River. The Cerro Verde mining company will finance the project entirely.

Last but not least is the ADMICCO project, which originated in civil society. It is intended to develop climate change scenarios for the Chili neighboring basins (Tambo and Colca-Majes), which will contribute to the generation of information on the Chili River Basin.

21 The project will make 38,500 hectares available for agro-industry. Intended as a second stage of the Majes project, it will produce 600 MW of hydroelectric power plants of Lluclla Lluta, and includes the construction of the Angostura Dam (1,140 thousand cubic meters), making it one of the largest dams in Peru. The project also foresees the development of a diversion tunnel of 18.4 km long that will transfer 30 m^3 of water per second.

4 Key Actors

The fieldwork carried out thus far allowed the development of an overview of the actors according to their influence on, and interest in, water governance and climate change in Arequipa. This was done in a participatory exercise, in which a number of local actors developed an inventory of the relevant actors and went on to rank them. The participants identified three groups of actors (see table 4): those who show an interest in reducing the risks from climate change (dark blue area on the right); those who show medium interest (blue area in the center); and those showing less interest (light blue area on the left).

The vertical axis identifies the degree of influence the actors are perceived to have on water governance and climate change. In the upper right area, we identified the actors Presidency of the Regional Government of Arequipa, ARMA, Water Modernization Management Project –ANA, Ocoña Caplina AAA, ALA Chili and MINAM. These are the key actors identified so far as having to lead the process of reducing the effects of climate change, because they combine a high interest with a high level of influence.

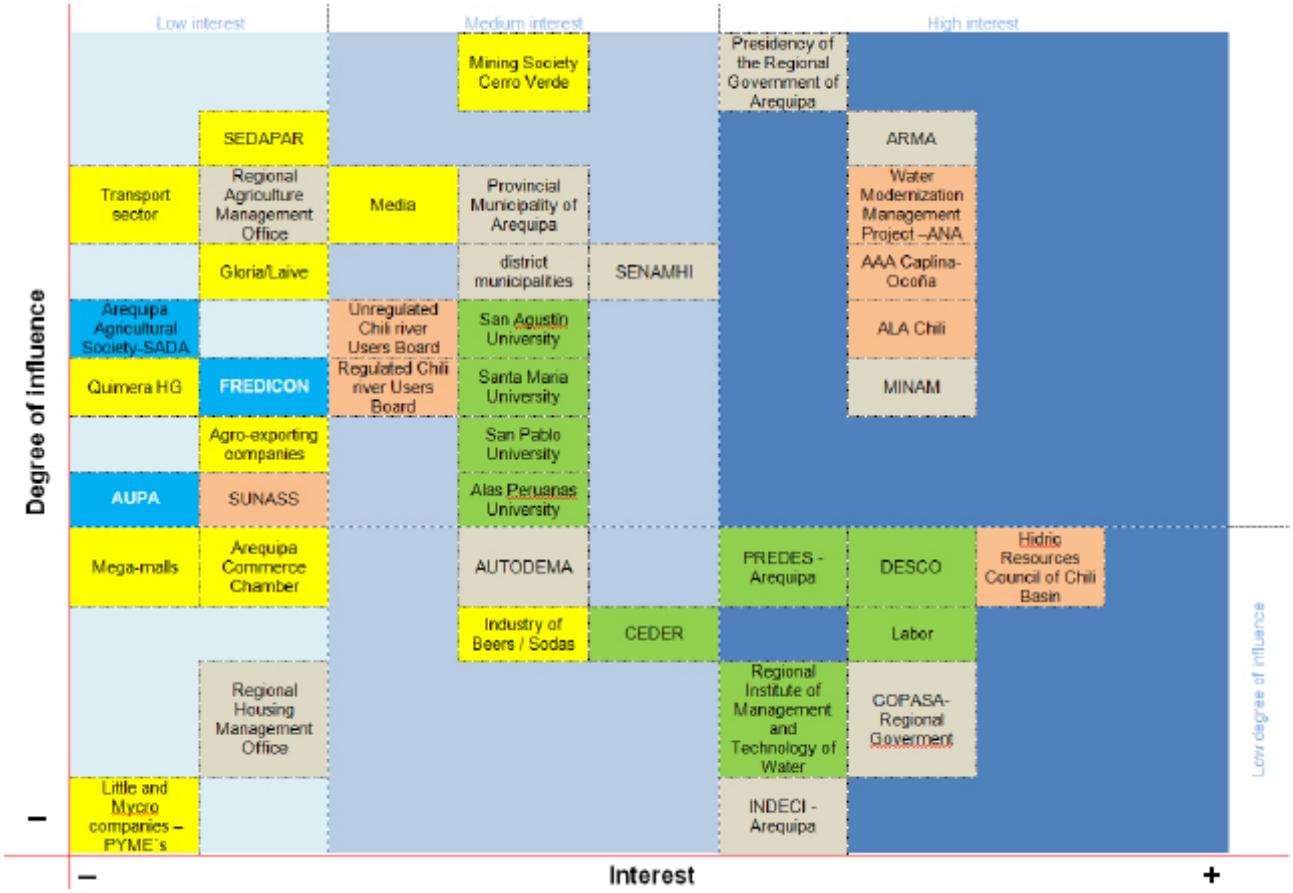
The following actors are positioned in the bottom right: Water Resources Council of Chili Basin, DESCO, PREDES-Arequipa, Labor, COPASA-Regional Government, Regional Institute of Management and Technology of Water and INDECI-Arequipa. Although these institutions have a great interest in issues of climate change, at present they have limited influence; however, their technical capabilities provide support to leaders. Among them, the Water Resources Council of the Chili Basin deserves special mention. Although at present this institution has little influence because of its recent creation, its influence may increase in the foreseeable future, moving it to the upper quadrant.

In the upper-middle section, some key players can be found: Mining Society Cerro Verde, Provincial Municipality of Arequipa, Media, SENAMHI, district municipalities, San Agustín University, Santa Maria University, San Pablo University, Alas Peruanas University, Unregulated Chili river Users Board, Regulated Chili river Users Board and FREDICON. These are actors that have shown medium interest in reducing the effects of climate change, but we must recognize that some of them carry out activities which contribute to it, regardless of their level of interest in

reducing its effects. At the bottom part of the middle section are institutions which have a similar set of interests, but less influence (AUTODEMA, Industry of Beers / Sodas, CEDER).

On the left, in the light blue area, the following actors are positioned: SEDAPAR, Transport sector, Regional Agriculture Management Office, Gloria / Laive, Arequipa Agricultural Society-SADA, Quimera HG, Agro-exporting companies, AUPA, SUNASS and others. They have shown little interest in reducing climate change risks (Mega-malls, Arequipa Commerce Chamber, Regional Housing Management Office and Little and Mycro companies – PYME´s).

Table 4: Actors in relation to water governance in the context of climate change



Prepared by Denis Rojas

- Degree of influence: decision capacity impact on the city and / or sector, persuasiveness capacity on other players and / or capacity using its resources (financial, human, technological, etc..) to face risks in water resources due to climate change.
- Interest: Reflect on proposals and / or practices intended to reduce risks caused by climate change on water resources.

5 Is Arequipa Prepared to Face Climate Change?

To face climate change, or in other words, to adapt to climate change, from a governance point of view, an efficient and transparent two-way process is required (from top to bottom and from bottom to top). In this process, the three major development actors - the state, the civil society, and the business sector - show certain characteristics. These characteristics can be, but are not limited to, the following:

- Authorities have incorporated climate change and risk management as priority elements in their development planning, and have tools for decision-making in participatory adjustment processes;
- Civil society has a proactive environmental citizenship in climate change management;
- The business sector implements a production model based on eco-efficiency, with a great sense of corporate responsibility.

From our point of view, and considering the available information from other projects and the limited research conducted on this topic, we can say the following:

Regarding authorities:

- Among Peruvian cities, Arequipa is a city which has been at the forefront in development management and especially of environmental management. Since the early 1990s, government authorities have been building (with a participatory approach) a series of instruments which have identified problems, and evaluated and proposed solutions. Whether these alternatives – reflected in plans, programs and various projects - are implemented or not, depends on the capacity of management, short-term vision, availability of resources, and political will. These are still issues that must be addressed. What is very clear is that a political and institutional framework exists which promotes the incorporation of climate change in development management.
- With funds from international cooperation, a climate change strategy has been adopted, in which regional scenarios have been identified, which is an important advance. However, such information remains general and highly aggregated. The next step to be taken is to reduce the scale of information to the river basins, which will be a medium-term process. The process of updating development plans should incorporate such updates, in order for smaller-scale information to support decision-making.
- Water management in the basin, even if it promotes the integrated management of water resources, retains a certain agricultural sector bias, and this is not unique to Arequipa. This situation often leads to the exclusion of other players in water management, for example nature (or the ecosystems) as a water user.
- At the level of city management, it is still necessary to use the work that has been done at the regional level in order to identify and implement adaptation options. Downscaling information to the local level is still needed. This is more urgent in relation to some sectors and actors, such as EPS22, which has recently incorporated climate change among the factors to evaluate in risk management.
- Arequipa, due to the intervention of actors such as NGOs has technological tools based on geographical information systems for managing the territory. Even so, it is necessary to enlarge and deepen their use and interpretation.

Regarding civil society:

- National surveys and surveys in some major cities such as Arequipa, show that the awareness of the importance of climate change among the population is growing. Despite this progress, there is still limited knowledge of the causes, evidence and impacts of climate change.
- Many citizens and a large section of the authorities share the perception that climate change is an “environmental issue”, without regarding its potential to increase risks and affect local development planning.
- Special cases are the non-governmental development organizations (NGOs), which in Arequipa, as well as Peru as a whole, have been one of the major players to place climate change on the public agenda, not only as an abstract theme, but with projects and experiences. With the support of international

22 Empresas Proveedoras de Servicios

cooperation, NGOs are developing adaptation processes in diverse fields. Some limitations of this type of intervention are the dispersion and limited capacity of political incidence and communication of some organizations, the weak sustainability of their projects and their magnitude (usually pilot projects).

- In Arequipa, civil society organizations, including NGOs, are accepted and have a good standing with the population. Some of them, like DESCO and Asociación Civil Labor, have been actively participating in raising awareness of the problems associated with risk and climate change.

Regarding the business sector:

- The approach of social responsibility is a theme that has been given consideration for some years, especially from the mining sector, in response to various conflicts.
- The global financial crisis did not affect Peru significantly. The business sector has identified the need to be efficient in the management of their products, waste and energy and water consumption. This should, however, be attributed more to reducing operating costs than to social responsibility.
- The mining sector in regions like Arequipa can and should take a leadership role in climate change governance. In Arequipa, the case of the mining company Cerro Verde is interesting. In return for water being made available for its project on sulfides and expansion of its production, the company contributed significant resources to increase water storage capacity in the basin, as well as for the treatment of drinking water. As discussed above, it recently committed itself to fully finance the development of a sewage treatment plant project. This has been taken by some sectors as an example of good practice by a mining company, in a context of high community resistance against the mining projects, and frequent conflicts resulting from them. In general, the role of the mining company Cerro Verde is appreciated among different actors, as well as the population in Arequipa. Some actors question the agreements reached with the company, especially the agreement on the water reserved for mining activities. They argue that according to the terms of the current agreement, the company is protected against droughts. While the company can take the water it is entitled to from the water treatment plant, the other actors and sectors will be limited to what remains of the available water. In addition, critics argue that – mainly due to the lack of transparency and the informality in the decision-making of the Multisectoral Committee which decided on water distribution- the mining company has been receiving water to which it was not formally entitled23.
- Most investors are yet to develop a medium- and long-term vision to identify themselves as potentially affected subjects of climate change. This could allow a more decisive approach by the business sector, and also their participation (not only for presence, but proactively) in the adaptation process.

Arequipa has authorities, organizations and companies working on water management, a theme that has high priority on the agenda of both the city and the region. However, it is still necessary to build capacity on climate change issues, as well as on its effects on water and other aspects of development. In addition, specialist instruments should be created and managed, in order to develop ways of communicating research findings and proposals to the public. There are also environmental management experiences that may contribute in the adaptation process.

Projects like Chance2Sustain, with similar ones being developed in the city and surrounding areas, can provide more clues about the priorities for intervention, and thereby provide tools for more effective response.

23 See http://www.elbuho.com.pe/anteriores/web447/politica4.htm

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7 Appendices

Appendix 1: Description of Natural Hazards in the City of Arequipa

Tables 1: Hydrologic risks

Annex 4: Tables 7 and 8 **Description of natural hazards in the city of Arequipa**

Hydrologic risks								
Type	**N°**	**Geographic Location**	**District**	**Mechanism**	**Causes**	**Consequences**	**Conjunctural Measures**	**Structural Measures**
Floods & Water Erosion	01	River Chili floodplain	Metropolitan Area	River overflow	Occasional rainfall High solids loading	Agriculture land occupation Loss of topsoil Collapse of structures Building affectation	Growing annual species Structures alleviate	Preserve and enhance riparian vegetation Not build without protection
	02	Rivers Socabaya and Mollebaya floodplains	Southern Metropolitan Area	River overflow	Occasional rainfall	Agriculture land occupation Loss of topsoil Collapse of structures Building affectation	Growing annual species Structures alleviate	Preserve and enhance riparian vegetation Not build without protection
	03	Chachani creeks to the Metropolitan Area	Northern Metropolitan Area	Runoff creek	Occasional rainfall	Collapse of structures Building affectation	Structures alleviate Eradicate buildings	Not build without protection
	04	Misti creeks to the Metropolitan Area	Central Metropolitan Area	Runoff creek	Occasional rainfall	Collapse of structures Building affectation	Structures alleviate Eradicate buildings	Not build without protection
	05	Añashuayco creek on the right bank of river Chili	Uchumayo	Runoff creek	Occasional rainfall Extractive material drag	Collapse of structures Erosion	Structures alleviate Eradicate buildings	Not build without protection Manage solids removal
	06	Socabaya riverbanks downstream Chiguata	Eastern Metropolitan Area	Water lateral erosion	Deforestation	Cleaning of riverbanks	Preserve the conditions	Preserve and enhance riparian vegetation

Type	N°	Geographic Location	District	Mechanism	Causes	Consequences	Conjunctural Measures	Structural Measures
Mudflow	07	Course of Andamayo and creeks upstream Chiguata	Characato Chiguata	Sediment transport	Occasional rainfall Slope or the river beset Aqueous soil saturation Deforestation	Agriculture land occupation Collapse of structures Building affectation	Eradicate buildings Facilitate natural drainage	Construction of dams Reforestation of the watershed
	08	Chachani creeks to the Metropolitan Area	Northern Metropolitan Area	Sediment transport	Occasional rainfall Smelting of snow	Collapse of structures Building affectation	Eradicate buildings Facilitate natural drainage	Construction of dams Urban channeling
	09	Misti creeks to the Metropolitan Area	Central Metropolitan Area	Sediment transport	Occasional rainfall Smelting of snow	Collapse of structures Building affectation	Eradicate buildings Facilitate natural drainage	Construction of dams Urban channeling
	10	Cerro Verde's mine dewatering creek	Tiabaya Uchumayo	Sediment transport	Eventually ruptured tailings dam	River Vitor pollution Agriculture land occupation Collapse of structures	Regular monitoring of the tailings dam	Mining sludge treatment

Tables 2: Geological and Geotectonic Risks

Geological and Geotectonic Risks								
Type	**N°**	**Geographic Location**	**District**	**Mechanism**	**Causes**	**Consequences**	**Conjunctural Measures**	**Structural Measures**
Detachmen	11	Right riverbanks upstream Uchumayo	Uchumayo	Rapidly falling rocks by gravity	Disintegration of rock by erosion of the substrate surface	Breaking large blocks that fall into the river Valley expansion	Growing annual species Structures alleviate	Preserve and enhance riparian vegetation Not build without protection
	12	Urban border at the slopes of Misti	Alto Selva Alegre Cayma	Rapidly falling rocks by gravity	Occasional rainfall	Agriculture land occupation Loss of topsoil Collapse of structures Building affectation	Growing annual species Structures alleviate	Preserve and enhance riparian vegetation Not build without protection

Type	N°	Geographic Location	District	Mechanism	Causes	Consequences	Conjunctural Measures	Structural Measures
Landslide	13	Course of Andamayo and creeks upstream Chiguata	Eastern Metropolitan Area	Slow movement of land masses downslope	Occasional rainfall Slope or the river beset Aqueous soil saturation Deforestation	Agriculture land occupation Collapse of structures Building affectation	Eradicate buildings Facilitate natural drainage	Construction of dams Reforestation of the watershed
Earthquak	14	Detachment, landslide and built up areas	Whole province	Mainly due to regional volcanism	Ground instability in combination with other factors	Building affectation Agriculture land occupation Collapse of structures	Not build without protection	Eradicate buildings and infrastructure in sensitive areas
Lava flows	15	From Pichu Pichu to Polobaya, Pocsi, Yarabamba and Quequeña catchments	Characato Chiguata Mollebaya Pocsi Polobaya Yarabamba Quequeña	Volcano with low activity and reduced concentration	Lava tongues slight slope and far from population centers	Agriculture land occupation	Early Warning System	Emergency plans
	16	From Misti to Chiguata catchment	Characato Chiguata Sabandía	Important activity volcano and high activity	Lava tongues steep and upcoming towns	Impact on smaller populations Agriculture land occupation	Early Warning System Not building on flow courses	Emergency plans Evacuation plans Eradicate buildings on flow courses
	17	From Chachani to Arequipa catchment	Northern Metropolitan Area	Moderate activity volcano and relative concentration	Lava tongues steep and very close to population centers	Affectation of the metropolitan area, which would have to cross	Early Warning System Not building on flow courses	Emergency plans Evacuation plans Eradicate buildings on flow courses Prevent alternate flow courses
	18	From Chachani to Yura catchment	Cerro Colorado Yura	Moderate activity volcano and relative concentration	Lava tongues moderate slope and distant from population centers	Impact on infrastructure Agriculture land occupation	Early Warning System	Emergency plans

Type	N°	Geographic Location	District	Mechanism	Causes	Consequences	Conjunctural Measures	Structural Measures
Hydromorphism	19	Confluence of rivers Socabaya and Mollebaya	Southern Metropolitan Area	Land of sand and silt in the water table is shallow	The ground is unstable and vibrates intensely on seismic events	Soils with settlement problems and cohesion Instability in buildings	Structures alleviate Not build without protection	Foundations lower levels until consistent layers

Appendix 2: Trends of Precipitation Basin Chili 1964-2000

Tables 2: Geological and Geotectonic Risks

mm	Aguanda Blanca	Chiguata	El Fraile	El Pañe	Huanca	Imata	La Calera	La Joya
Jan	↔	↔	↔	↑	↔	↔	↔	↔
Feb	↔	↔	↔	↔	↔	↔	↓	↔
Mar	↔	↔	↔	↔	↔	↔	↔	↔
Apr	↓	↓	↔	↔	↓	↔	↔	↔
May	↔	↓	↓	↔	↓	↔	↓	↔
Jun	↔	↓	↔	↔	↓	↔	↔	↔
Jul	↔	↓	↔	↓	↓	↔	↓	↔
Aug	↔	↓	↔	↔	↓	↔	↔	↔
Sep	↔	↓	↔	↔	↓	↔	↔	↔
Oct	↔	↓	↔	↔	↔	↔	↔	↔
Nov	↔	↓	↔	↔	↓	↔	↔	↔
Dec	↔	↔	↔	↔	↔	↔	↔	↔
Total	↓	↓	↔	↔	↓	↔	↓	↔

mm	La Pampilla	Las Salinas	Pampa de Arrieros	Pillones	Socabaya	Sumbay	Ubinas	Vitor
Jan	↔	↔	↔	↔	↔	↔	↔	↔
Feb	↔	↔	↔	↔	↔	↔	↔	↔
Mar	↔	↔	↔	↔	↔	↔	↔	↓
Apr	↔	↔	↓	↔	↔	↔	↔	↓
May	↔	↔	↓	↔	↔	↔	↔	↓
Jun	↔	↔	↔	↔	↔	↔	↔	↔
Jul	↔	↔	↓	↓	↔	↔	↔	↓
Aug	↔	↔	↔	↓	↔	↑	↔	↔
Sep	↔	↔	↓	↔	↔	↔	↔	↓
Oct	↔	↓	↔	↔	↔	↔	↓	↔
Nov	↔	↔	↓	↔	↔	↔	↔	↓
Dec	↔	↔	↔	↑	↔	↔	↔	↓
Total	↔	↔	↓	↔	↔	↑	↔	↓

↔ tendency to keep the precipitation
↓ trend of decreasing precipitation
↑ trend of increasing precipitation

Source: Ribeiro L, Nacimiento J, Buxo A. 2008

Appendix 3: Arequipa Instruments by Scale of Analysis

National	• Norms, rules, policies and plans (Climate change, Urban Development, Water and Sanitation, Risk and Vulnerability, SCV, etc.) as secondary data
Macro regional **From river basin, water shed to the ocean**	• High level seminars and round tables, as possible • **Key actors interviews (politicians and burocrats)** • **Newspapersearch: discourseanalysis** • Aero satellite photographs, google earth • (Water) Large scale projects overview • **Key actor´s interviews (politicians, experts, opinion leaders)**
Metropolitan City	• Census, water cadasdre (consumption and connections as possible) • **Scenario´s workshops (building, analysis and transfer)** • **Hydroclimaticvulnerability mapping**
Local	• **Key community** (urban and river basin/rural) **leader´s interviews and their photos** (vulnerability perception) • **Participatoryvulnerabilitymapping** • Focus groups (exchanging urban/rural perspectives)

Appendix 4: Description of Stakeholders in Water Governance (modificated from Chili River: arid basin with mining presence)

Table 5: Major Stakeholders – Co-Deliverers

Type of stakeholder – co delivers	Scale of Action (National/regional/ river basin/local)	Function (policy/ regulatory/ operational services)	Thematic Network	Power level in decision making process (sub basin)
Arequipa's Public Service of water, outlet and sewer (SEDAPAR S.A.)	• Regional Level	• Regulatory • Operational Services	• Water System Regulation	• Very High
Electric Power Generation Company (EGASA)	• Regional Level	• Operational Services	• Proper management of water for the electricity generation.	• Very High
Local Water Authority of Chili River - ATDR - Chili (ALA)	• Local Level • Basin/Sub Basin	• Policy • Regulatory	• Water management and coordination with other water users. • To impose economic sanctions.	• Very High
Majes Autonomous Authority - AUTODEMA	• Local Level • Basin/Sub Basin	• Regulatory • Operational Services	• To implement storage operations and maintenance of water infrastructure. • To generate information about water volume in dams and meteorological information.	• High
Chief of Salinas and Aguada Blanca . National Reserves Natural Resources National Quartermaster (MINAM)	• Local Level • Basin/Sub Basin	• Regulatory	• Reforestation (increased plant cover) • Resource and documentation management, research and planning.	• Very High
Regional Agriculture's Office	• Regional Level	• Regulatory	• To promote Agricultural organizations • To promote irrigation and other projects that exploit the land • To develop technology training, extension and exchange	• Very High
Environment Ministry - (South Macro Regional Coordinator)	• National Level • Regional Level	• Regulatory	• Promotion (Sewage and desertification) • Technical Planning • To Convey technical proposals on water issues.	• Very high
Regional Environmental Authority - ARMA	• Regional Level	• Regulatory	• To evaluate and give suggestions about water.	• Very High
Arequipa's Provincial Municipality - Environmental Submanagement	• Local Level	• Regulatory	• Chili River´s Pollution control. • To give licenses to establishments that emit wastewater.	• High

Type of stakeholder – co delivers	Scale of Action (National/regional/ river basin/local)	Function (policy/ regulatory/ operational services)	Thematic Network	Power level in decision making process (sub basin)
National Superintendence of Sanitation Services - SUNASS	• National Level	• Regulatory	• Complaint's orientation • Resolution on second instance of billing complaints. • Pricing and verification of companies' compliance	• High
Geological Mining and Metallurgical Institute - INGEMMET	• National Level	• Regulatory	• Work and studies Development about: hydrology, geology and risk maps.	• Medium
Meteorology and Hydrology National Service SENHAMI	• National Level	• Regulatory	• To monitor rivers and downloads. • Meteorological stations network • Issued rain and temperature forecast.	• Medium
Regional Health Management - Environmental Health Executive Management.	• Regional Level	• Regulatory	• To provide monthly reports on water quality (Chili River) • To give microbiological and physical chemical analysis.	• High
Environment Special Prosecutor	• National Level	• Regulatory	• To Make visits to the River Chili • Tracing • Prevention	• Very High
Irrigation Sub Sector Program – PSI	• Regional Level • Local Level • Basin/ Sub Basin	• Operational Services	• Irrigation infrastructure • Incentive programs (irrigation technology) • Learning programs for water users.	• Medium
-AGRO RURAL- National Hydrographic Basin Management and Soil Conservation - PRONAMACHS	• National Level • Basin/ Sub Basin	• Operational Services	• To visit peasant communities • Construction of micro dams on communities • Upland reforestation.	• Medium
Regional Office of Housing, Construction and Sanitation	• Regional Level	• Regulatory	• To execute housing and sanitation programs according the request of Municipalities.	• Low
Regional Education Office	• Regional Level	• Regulatory	• Environmental education planning	• Medium
Regional Energy and Mines Office	• Regional Level	• Regulatory	• To regulate small and artisanal mining • Project Planning • To Perform hydro energetic resource inventories • Regional energy needs registration • To develop regional energy balance.	• Medium

Table 6: Major Stakeholders – Professional and Local Organizations

Type of stakeholder Professional and Local Organizations	Scale of Action (National/regional/ state/river basin/ local)	Function (policy/ regulatory/ operational services)	Thematic Network	Power level in decision making process (sub basin)
Communities in the area of the National Reserve Salinas and Aguada Blanca	• Regional Level • Local Level • Basin/ Sub Basin	• Operational Services • Auto regulatory	• Afforestation with native plants and dams' infrastructure.	• Very High
Users Association of District Chili Irrigation.	• Local Level • Basin/ Sub Basin	• Auto regulatory • Operational Services	• To improve irrigation infrastructure • Programming and budget according to law • Training partners	• Very high
Cerro Verde Mining Company	• Regional Level	• Operational Services	• Water infrastructure construction and financing. • Water recycling (no emissions)	• Very high
Arequipa's Chamber of Commerce and Industry	• Regional Level	• Operational Services	• Business training through courses, business and legal advice.	• Medium
Regional Institute of Environmental Sciences - UNSA	• Regional Level • Basin/Sub Basin	• Operational Services.	• It studies the regional environment (physical, social, economic and biological, besides realizes flora and fauna inventories)	• Low
Peruvian Engineers College, Arequipa Departmental Council, Environment and Ecology Committee	• Regional Level • Basin/Sub Basin	• Operational Services.	• Training and awareness on environmental issues (Rio Chili)	• Medium
Liberty Radio	• Regional Level	• Operational Services.	• diffusion for the proper management and care of the River Chili • Awareness campaigns	• Low
Yaraví Radio	• Regional Level	• Operational Services.	• diffusion for the proper management and care of the River ChiliAwareness campaigns	• Low
Research, Education and Development Centre - CIED	• Regional Level • Local Level • Basin/Sub Basin	• Operational Services.	• Assistance southern rural unicipalities associations • Support for productive projects.	• Medium

Type of stakeholder Professional and Local Organizations	Scale of Action (National/regional/ state/river basin/ local)	Function (policy/ regulatory/ operational services)	Thematic Network	Power level in decision making process (sub basin)
DESCO - RNSAB Partial Administration Contract (2007 -2011)	• Regional Level • Local Level • Basin/Sub Basin	• Operational Services.	• Promotes the management of pasture for camelids • Improve vegetation cover and production systems.	• Medium
Arequipa Mayors Association	• Local Level • Basin/Sub Basin	• Operational Services.	• Development to improve water resources management.	• High
South East Area Rural Municipalities Association	• Local Level • Basin/Sub Basin	• Operational Services.	• Development of water supply project (Basin Management)	• Medium
Arequipa Agricultural Society (SADA)	• Regional Level • Local Level • Basin/Sub Basin	• Operational Services.	• Participation in environmental and water issues	• Low
Uchumayo Environmental Management and Sustainable Development Commission.	• Local Level • Basin/Sub Basin	• Operational Services.	• Participation in environmental actions	• Low
J.V. Urban Security. Congata Uchumayo	• Local Level	• Operational Services.	• Water treatment projects promotion in Congata	• Low
Asociación de Urbanizaciones y Pueblos de Arequipa - AUPA	• Local Level	• Operational Services.	• Environmental courses and events promotion	• Low

City Fieldwork Report

Water Governance in Guarulhos (Brazil) and its Sub-Basin

By Adriane Gomes Rodrigues Batata, John Sydenstricker-Neto

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1 Introduction

Water governance is a contested matter and it becomes quite complex if examined in its various dimensions. It combines biophysical and social processes to an extent that it is hard, if not impossible, to disentangle what is "natural" from what is "human-made" nature. To apprehend hydrological realities seen as social constructions, social, economic, political, and cultural dimensions should be considered. The links between these dimensions define and confine the knowledge forms and contents that are present or absent, valued or dismissed, in making sense of water issues and defining the means to use it and to rule over its use.

Metropolitan areas around the world are suitable sites for examining the relations at play and identifying how the social-biophysical arena is historically defined, produced, and transformed. The São Paulo metropolitan region in Brazil is not an exception, and due to its size (in terms of its area, population, and economy) more issues are brought to the discussion because of significant problems, conflicts, and tensions.

This first fieldwork report analyzes water governance in the region of Guarulhos in the São Paulo metropolitan region in Brazil. Although the report should be considered work in progress, we do provide an overview of the organizational and institutional structures as well as the major stakeholders involved in the process. Major issues – challenges and opportunities – in the planning, managing, and monitoring of water resources are addressed. Special attention is given to the Alto-Tietê-Cabeceiras Sub-basin Committee, which is one of the most important forums for participation, discussion and, to a certain extent, deliberation on water-related issues in a region of over 20 million inhabitants. The region is known for its large economy as well as its social inequality. This discussion is put in perspective and contextualized within the broader scope of water resources in the country and in the state of São Paulo.

2 General Context

2.1. Brazil and the Paraná Hydrographic Water Basin Region

Brazil occupies an area of 8.5 million km^2 and is ranked the eighth largest economy in the world with a GDP (in 2009) of R$ 3.675 trillion (US$ 1.84 trillion). It has a population of over 190 million people (in 2010) and a hydrographic network with more than 12% of the world's fresh waters (2002; IBGE 2012). In spite of the abundance of water resources, they are not evenly distributed and the country faces problems concerning water usage. The Brazilian territory is divided into 12 hydrographic regions (figure 1), including basins with different drainage patterns and climatic, geological and hydrological characteristics linked to different socio-economic realities.

The hydrographic region of Paraná spreads over an area of 879.8 thousand km^2 and includes the municipality of Guarulhos (state of São Paulo), which is one of the research sites of the Chance2Sustain program. Within the Brazilian territory, this region covers practically the whole state of São Paulo and Paraná, and significant areas of the states of Mato Grosso do Sul, Goiás, Minas Gerais and the Federal District, plus a portion of the northern part of Santa Catarina. Among the six big rivers of this hydrographic region, the Tietê is of special interest since it cuts through the Metropolitan Region of São Paulo (RMSP).

This metro region encompasses around 32% of the Brazilian population and presents the highest levels of economic development in the country (ANA 2012). Approximately 90% of the region is constituted of urban areas, including the RMSP, as well as important cities like Brasília, Curitiba, Goiânia, Campinas, Campo Grande and Uberlândia.

Brazil is a federation of 26 states in addition to a federal district. Each state is divided into municipalities,

Figure 1: Brazilian hidropraphic regions

Source: WWF-Brasil 2006

Figure 2: Sao Paulo metropolitan region and state of São Paulo

Source: Wikipedia. no date. Adapted by authors.

adding up to 5,565 for the whole country. The federation, states, and municipalities constitute the three levels of government. A distinctive peculiarity of Brazilian federalism, defined by the 1988 Constitution, is the autonomous status of municipalities, creating a tripartite structure including federation, states, and municipalities. Fiscal and administrative decentralization at municipal level are combined with a strong centralization of decision-making power at the federal level, creating a very complex, bureaucratic, and often confusing power structure. Water governance is no exception to this institutional context.

2.2. State of São Paulo and its Watershed Committees

The state of São Paulo is the most developed and populous in Brazil with a GDP of roughly US$ 542.2 billion (in 2009) and a population of 41.26 million (in 2010). The highest urban concentration lies within the RMSP (figure 2) with its 39 municipalities, occupying an area of 7.946 km². In 2010, the RMSP's population reached 19.7 million (2,476 inhab/km²), with the municipality of São Paulo ranking the highest with 11.2 million inhabitants (7,383 inhab/km²).

The concentration of productive activities and of large urban centers tends to put pressure on the availability of water resources. Besides an increase in water demand for different purposes (residential, industrial, agricultural), there are significant volumes of improperly collected and treated effluents that end up polluting the watercourses. Furthermore, there is the issue of urban drainage, highly affected by the sealing of ground surfaces and the occupation of easily flooded lowland areas.

The diverse realities in terms of hydrological and geological patterns pertaining to the basins within the hydrographic region, such as land occupation and use, the discrepancies between water availability and consumption patterns, and the treatment of the resources, present altogether significant challenges for water governance. In this context, the São Paulo State Policy for Water Resources was created, which established the State System of Management of Water Resources (state bill n°. 7.663/91) (Sao Paulo 1991). This bill preceded the corresponding

Figure 3: 21 Watershed Committees – State of São Paulo

Source: CBH-PCJ. no date.

federal legislation sanctioned in 1997 (federal bill n° 9.443/97) (Brasil 1997).

Within this system, the basin is considered the most important and appropriate territorial unit for the management of water resources. It focuses on technical definitions and understandings concerning the drainage area of the main river and its effluents, comprising a Management Unit for Water Resources (UGRHI). The decision-making board, formed by the Committee of the Hydrographic Basin (CBH), is an important management and planning instrument. The Committee is a collegial body that allows the governance of water resources to be employed in a very broad sense and represents an arena for debates, propositions, and decisions at the basin level.

The state of São Paulo is divided into 22 UGRHIs, with two of them being managed by a single committee (21 CBH for the whole state). The RMSP is almost entirely within the CBH-Tietê (36 municipalities including São Paulo). For the remaining three municipalities, two (Guararema and Santa Isabel) are part of the Paraíba do Sul River Committee, and the municipality of Vargem Grande Paulista is included in the CBH covering the Sorocaba river and the medium portion of the Tietê river (figure 3).

2.3. The Alto Tietê basin and the Alto Tietê-Cabeceiras Sub-basin

With an overall area of 5.868 km^2, the Alto Tietê basin is drained by the Tietê river and extends from its springs in the municipality of Salesópolis up to the Rasgão dam located in the municipality of Pirapora do Bom Jesus. This basin corresponds to the UGRHI 6 and is managed by the Committee of the Alto Tietê Hydrographic Basin (CBH-AT). The Alto Tietê basin serves 21 million people (in 2010), of which nearly all reside in urban areas. The basin is used by diverse sectors, such as the industrial, commercial, and service sectors. Similarly, land use is extremely diversified.

Table 1: Characteristics of the Alto Tietê basin (UGRHI 6)

	Alto Tietê Basin - UGRHI 6
Drainage area	5,868 km^2
Number of municipalities	36 of the 39 municipalities in the RMSP
Land use	North and south of the areas where water reservoirs are located intended for public supply, there are Conservation Units protected by the Law of Spring Protection. At the headwaters of the Tietê river, the area is mainly dedicated to horticulture, forestry, and mining production of non-metallic products for construction. Industrial production is more prominent in the Municipalities of Santo André, São Bernardo, São Caetano, Diadema, Mauá, and Guarulhos.
Water use	Public and industrial supply, collection of domestic and industrial effluents, power generation, fishing, irrigation, and recreation.
Main economic activities	Industries including metallurgy, pharmaceuticals, automotive, chemical, textile, etcetera.
Main issues	Inadequate sewage services and risk areas prone to flooding, landslides (the central portion of the basin covers around 700 of such areas), *inadequate areas for discharging solid residues, existing sites of* erosion and siltation as a consequence of inadequate land occupation.
Population (2010)	21,154,988 inhabitants
Level of urbanization (%)	98.86
Population density (inhb/km^2)	2,476

Source: (CETESB 2006; SEADE 2010), and update of data by authors

On the one hand, land use includes Conservation Units (UC) protected by the Law for Spring Protection, which imposes restrictions on land development plans and occupation; twenty-two municipalities have UCs and, in some cases, this law regulates (along with other codes) 100% of the municipal area. In Salesópolis, it covers 98% of the area and in Guarulhos 30% of the area. On the other hand, some areas of dense industrial use exist, as in the municipalities of Santo André, São Bernardo, São Caetano, Diadema, Mauá, and Guarulhos. Among the main problems of this basin are inadequate sewage systems, and risk areas prone to flooding, landslides, siltation, and erosion arising from inadequate land occupation. Table 1 summarizes the main characteristics of the Alto-Tietê basin (UGRHI 06).

The basin region is very diverse in socioeconomic terms. The municipality with the highest GDP of the state and of the country (São Paulo 2009, US$ 17,636 per capita) contrasts with municipalities like Salesópolis - a touristic area that lives off agriculture and was ranked 328th (US$ 4,721/per capita) on the state's GDP ranking.

An indicator for portraying such variability in the State of São Paulo is the Índice Paulista de Responsabilidade Social (IPRS) (Paulista Index of Social Responsibility)[1]. This indicator conforms to the Human Development Index (HDI) approach that is adopted by the United Nations Development Program (UNDP), screening the dimensions of income, longevity, and schooling. However, the set of variables differs and is larger, for example incorporating dimensions concerning income, health indicators (mortality rates for specific and more vulnerable groups), and data on education (for a greater number of age groups). In addition to municipal planning, the IPRS was organized according to a typology (cluster analysis) with five groups capturing wealth and social vulnerability. These groups range from group 1 with the best socioeconomic level to group 5 with major issues regarding their economic level and social vulnerability.

IPRS data for 2008 (SEADE 2012) reveal that only 22.2% of the municipalities fall within group 1 and have levels of municipal wealth and schooling higher than the state average and longevity slightly above the state average. The second best group (group 2) includes 50.0% of municipalities, which are characterized by economic dynamism but have lower levels of longevity and schooling. Yet, in one of the most developed regions of the country, 25% of municipalities fall within groups 4 and 5, both with low economic levels and longevity and schooling ranging from below state average to the lowest level.

Due to the socio-environmental diversity, the territorial extension and the complexity of issues and challenges for monitoring and managing the Alto Tietê river basin, the Alto Tietê Committee of the Hydrographic Basin (CBH-AT) was subdivided into five subcommittees (see table 2 and figure 4). This subdivision was realized with the purpose to allow better managing of the Alto Tietê basin by broadening discussion forums and locally-based approaches for

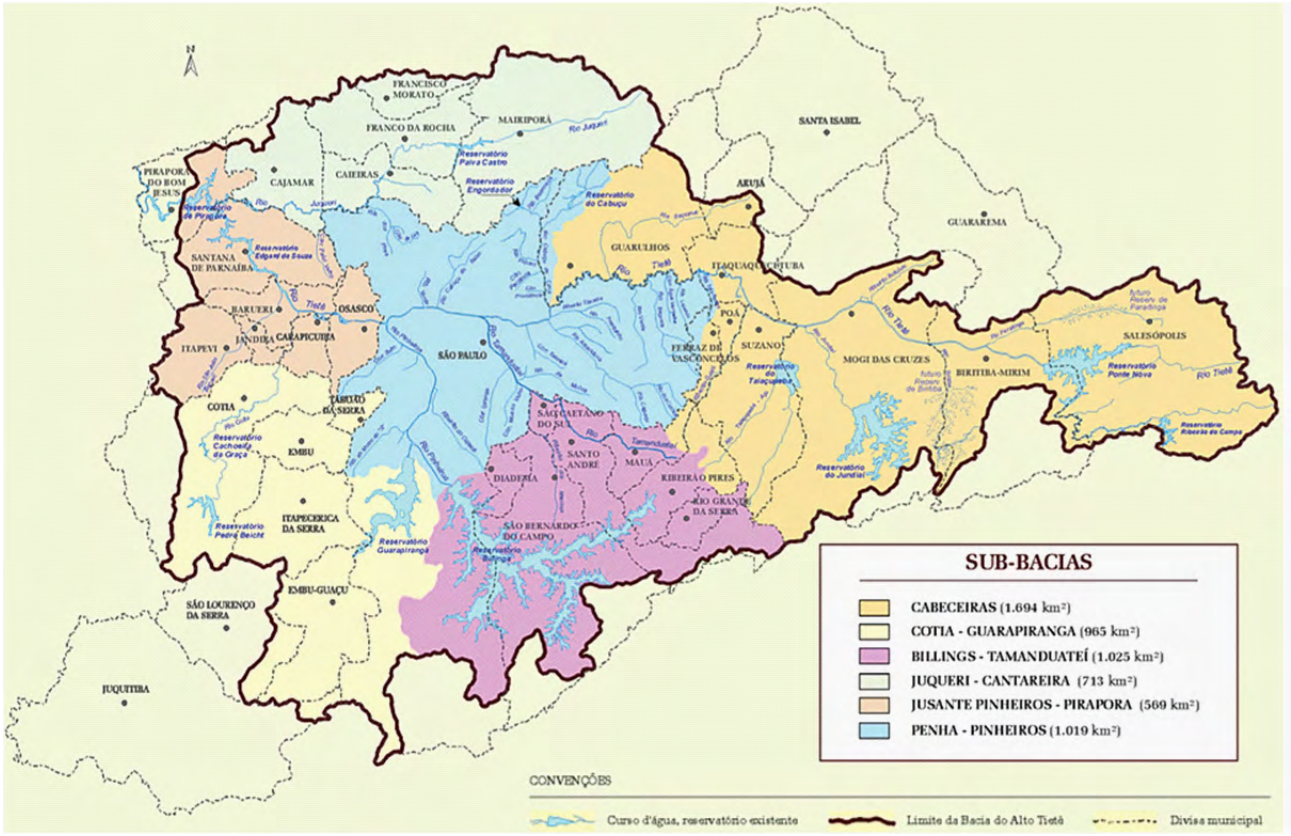
1 See http://www.seade.gov.br/projetos/iprs/

Table 2: Division of the CBH-AT according to the sub-committees and municipalities

SUB-COMMITTEES	NUMBER OF MUNICIPALITIES	MUNICIPALITIES
Juquerí-Cantareira	5	Caieiras, Cajamar, Francisco Morato, Franco da Rocha, Mairiporã;
Tietê-Cabeceiras	9	**Arujá, Biritiba Mirim, Ferraz de Vasconcelos, Guarulhos, Itaquaquecetuba, Mogi das Cruzes, Poá, Salesópolis, Suzano;**
Cotia-Guarapiranga	7	Cotia, Embu, Embú-Guaçú, Itapecerica da Serra, Juquitiba, São Lourenço da Serra, Taboão da Serra;
Billings-Tamanduateí	7	Diadema, Mauá, Ribeirão Pires, Rio Grande da Serra, Santo André, São Bernardo, São Caetano;
Pinheiros-Pirapora	7	Barueri, Carapicuíba, Itapevi, Jandira, Osasco, Santana de Parnaíba, Pirapora do Bom Jesus;
TOTAL	35	Total of 36 municipalities, including the Municipality of the city of São Paulo which integrates all sub-committees.

Source: (SigRH Sao Paulo 2012)

Figure 4: Alto Tietê basin and its sub-basins



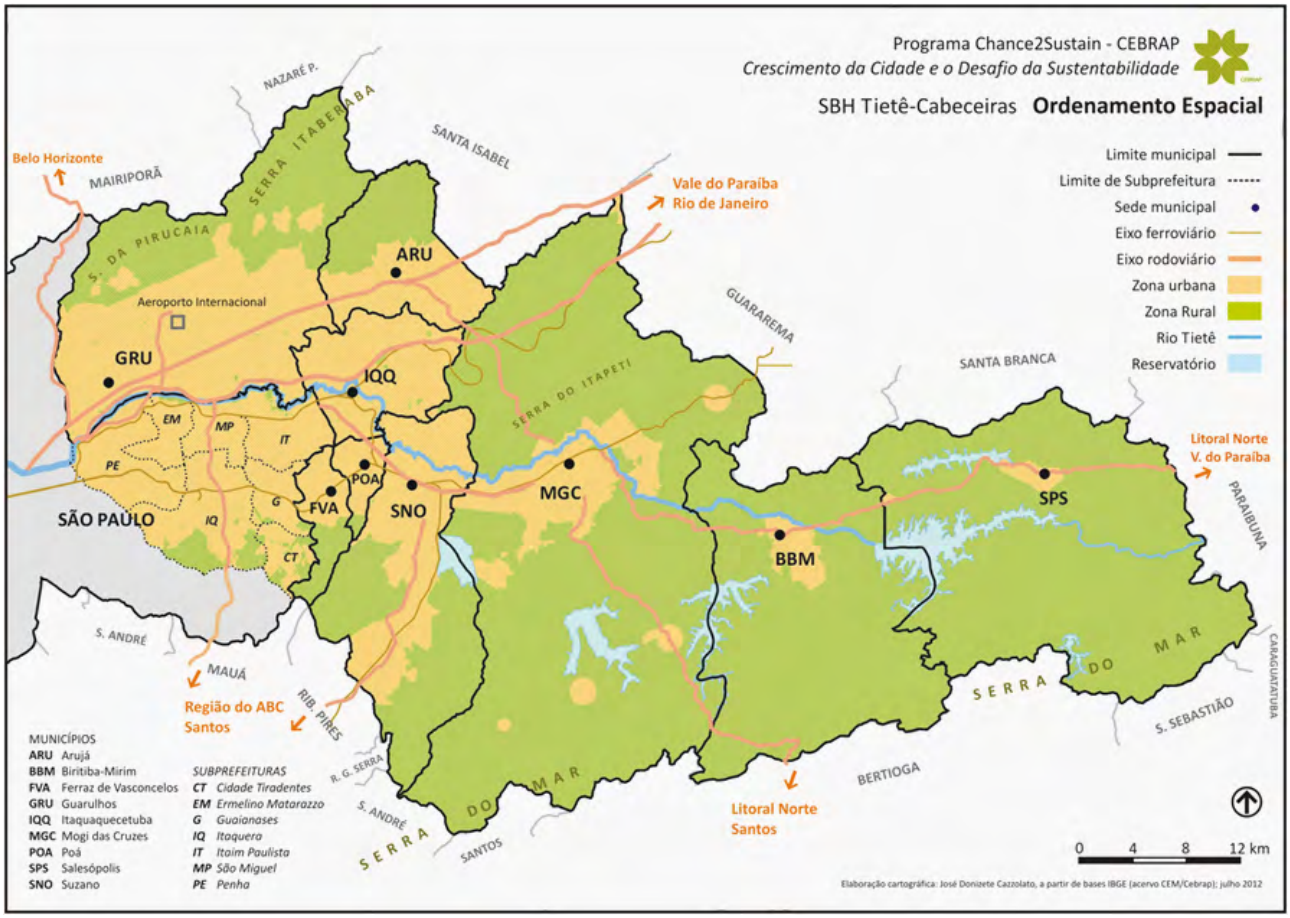
Source: FUSP. 2012.

addressing water and natural resource issues. The subdivision of the committee (CBH-AT) into sub-committees reaffirms the intention of decentralizing power and promoting participation. One of the five sub-committees of the CBH-AT is the Tietê-Cabeceiras subcommittee. It corresponds to the sub-basin and oversees nine municipalities in addition to the municipality of São Paulo, which participates in all sub-committees in the Tietê river basin.

The Tietê-Cabeceiras sub-basin extends over an area of 1,694 km^2 and is home to 2.6 million inhabitants (in 2010). It covers the Tietê river spring in the municipality of Salesópolis, followed downstream by the municipalities of Biritiba Mirim, Mogi das Cruzes, Suzano, Poá, Itaquaquecetuba, Arujá and Ferraz de Vasconcelos, up to the borders of the municipality of São Paulo (districts belonging to the eastern area of the municipality) with Guarulhos. Regarding land occupation, a rather diverse picture can be observed. On the one hand, there are municipalities that remain quite rural with considerable forest cover (in spite of being highly populated in their urban areas): the municipalities that follow this pattern are Salesópolis and Biritiba-Miriam, and to a lesser extent, Mogi das Cruzes. On the other hand, there are extremely urbanized municipalities that are almost entirely conurbated: for example the urban spot that extends from Suzano to Guarulhos, including the eastern part of the city of São Paulo.

It should be highlighted that, to a certain extent, the socioeconomic and environmental diversity within the watershed are due to various restrictions imposed by the Law for Spring Protection (state bill 898/75) (Sao Paulo 1975). This law imposes constraints to local development and it is not surprising that a correlation can be found between municipal areas under this law and their levels of urbanization and economic wealth. While 98% of the territory of Salesópolis (64% urbanization rate) is regulated by the Law for Spring Protection, Guarulhos, at the other extreme, has 100% urban population, with only 30% of its territory subjected to the Law for Spring Protection. Other municipalities within the sub-basin are spread along the range defined by these two cases. This reality, along with the level of economic development of the municipalities (The GDP of Salesópolis is ranked 328th and that of Guarulhos - second in the state), clearly reflect the development models in place, and the weak incentives for

Figure 5: Sub-basin Tietê-Cabeceiras, municipalities and urban area



Source: IBGE. Demographic Census 2000 and 2010.

areas to provide environmental services. With regard to water services, the sub-basin is almost entirely covered by public water networks (most municipalities above 90% and some approaching 100%). However, regular daily access to water has been an issue for neighborhoods in the periphery of several cities. For the entire sub-basin, the major problem and challenge is sewage treatment, which has major impact on water pollution and disease control.

2.4. The Municipality of Guarulhos

With a GDP of US$ 16.24 billion (in 2009), Guarulhos is the municipality with the largest economy in the sub-basin and the second-largest in the state. It occupies the second position in the state also in terms of population size (1.22 million in 2010). The demographic density is 3,838 inhabitants/km² and the urbanization rate is 100% within its 318 km² territory. In Guarulhos, the 30% of territory protected by the Law of Springs is mostly concentrated in the northern part of the municipality, integrating the Cantareira System, which is a very important source of water for the RMSP (20% of fresh water). Guarulhos plays an important role in the state and national economy due to its strategic location and its transportation network. It is cut by two federal highways: the Rodovia Dutra, connecting São Paulo and Rio de Janeiro, and Fernão Dias, which links São Paulo to the state of Minas Gerais. It is also crossed by one state highway (Ayrton Senna), serving as an alternative route between São Paulo and São José dos Campos, also served by the Dutra highway. Moreover, the International Airport of Cumbica is located in Guarulhos, the largest airport in Brazil with a high turnover of passengers and cargo. The location of industries is highly influenced by the expansion of the transportation network in addition to logistics enterprises, and dates back to the decade of the 1910s. Its proximity with the city of São Paulo and the passageways to other states and cities in the state of São Paulo works to its advantage.

The economic dynamism over the last few decades was accompanied by significant demographic growth. Due to planning deficiency serious problems occurred. Just like

in other urban centers, the construction of new condos and sets of buildings has had an impact on the quality of the water basins located in the municipality, aggravating the deficit of environmental and sanitation services. Among those problems are those of water supply and sewage collection/treatment and problems related to urban drainage.

In 2010, 97.5% of households were supplied with water. However, according to the Plan for Water Supply and Sanitary Sewage of the Municipality of Guarulhos (2010), the water availability of the municipality is low and its springs are insufficient to meet the demand. Roughly 88% of the water that supplies the municipality is acquired from the State Water Company (Companhia de Saneamento do Estado de São Paulo, SABESP) (SAEE Guarulhos 2008). SABESP is in charge of water services in more than 350 municipalities in the state of São Paulo and has more than 27 million clients. It is the largest company in this sector in Brazil and among the five largest sanitation companies worldwide.

95.4% of the population is covered by sewage collection (2010). However, until 2009 Guarulhos did not offer any type of treatment for collected sewage. In 2010, only 3% of the sewage was treated (SNSA 2011). The sewage was discharged into the waterways that supply the water basins of Baquirivu–Guaçu and Cabuçu de Cima rivers, which cut through the city of Guarulhos, and the Tietê river. This issue only started to be addressed when the Term of Procedural Adjustment (Termo de Ajustamento de Conduta - TAC) was signed by the municipality and the state Public Ministry. According to this TAC, the municipal government will undertake the treatment of at least 80% of the sanitation sewage generated by the municipality until the end of 2017. One of the biggest municipal infrastructure projects is the construction of five wastewater treatment plants. Two of them are already operating and treat 35% of the collected sewage (SAEE Guarulhos 2008; SAEE Guarulhos 2012).

Finally, landslides and flooding are also the result of unregulated land occupation. They significantly affect the population that resides in illegal occupation and precarious settlement, also including, in most cases, deforestation and inappropriate discharge of solid waste. Many of these problems are found in conservation areas protected by law, which should not be occupied, such as high declivity slopes, hill tops, floodplain areas, and trails along the waterways and springs (SAEE Guarulhos 2008). Among these areas protected by law, two important Conservation Units (UC) stand out: the Núcleo Cabuçu, located inside the Cantareira State Park north of Guarulhos, and strips of the Tietê Floodplains Area for Environmental Protection (APA do Tietê) in the south of Guarulhos. These UC's are supposed to comply with conservation regulations and serve as areas for regulating inundations and minimizing temporary flooding in urbanized areas near the Tietê river between Guarulhos and the Municipality of São Paulo.

These areas includes the regions of Pimentas and Itaim with districts that have been heavily affected by flooding. The most extreme case occurred during the rainy season of 2009-2010 (December-January) in the districts of Jardim Izildinha, in Guarulhos, and Jardim Romano, in São Paulo. The latter was flooded for almost a month. After the catastrophe, the state government signed a cooperation contract with the Department for Water and Electric Energy (DAEE) and eight municipalities located at the Tietê river margins. This contract includes the Tietê Linear Lowland Park project (Parque Linear Várzeas do Tietê), which will be implemented over a 75 km land stretch of the Tietê river, from Salesópolis to Guarulhos. The aim of this project is to recover and preserve the river margins, serving to regulate floods and to provide recreation facilities in the form of a leisure area for the more than 3 million people living in the region.

Vila Any began to be occupied through land invasions over three decades ago and Jardim Guaracy followed a decade later. The area is locked in-between a major highway (Dutra) and the Tietê river, creating obstacles for mobility of residents and accessibility to other areas and work opportunities. The river is highly polluted and subject to flooding, making its surroundings less suitable for living. The majority of the area has been urbanized to some extent, but land tenure remains a problem for areas in Jardim Guaracy. Basic services are lacking and there are only few local economic activities. Both neighborhoods have faced problems concerning safety issues, drug trafficking, healthcare, and access to education. Although these neighborhoods still lack good infrastructure and public facilities, residents report that conditions have improved since they have arrived (Van den Brandeler 2012).

Since a severe drought problem a few years ago, the water network in these two neighborhoods has provided water only every other day. Social movements do not seem to be very present in the area and interviewed residents are not formally organized. Residents of Jardim Guaracy living within 50 meters from the river will be evicted, but information about this process has not been disclosed. Such uncertainties are stressful and could affect social cohesion. All these factors contribute to the vulnerability of residents, including water-related risks and challenges to building resilience in the face of daily threats (Van den Brandeler 2012).

3 Water Governance and the State Policy on Water

3.1. Water Governance and Actors

The notion of governance is based on "the concept of social power which mediates the relations between the state and civil society, as a locus for construing alliances and cooperation, but also permeated by conflicts which derive from the impact of the social asymmetries and their effects upon the environment and the forms of resistance, organization and participation of the actors involved in the process. Therefore, this notion transcends a more technical-institutional approach and is embedded on power relations, strengthening of social control, and building of participative public actors…." (Jacobi, Günther et al. 2012:335).

In the case of water resources, governance was initially established according to a technical-institutional approach that prioritizes a disciplinary framework (hydrology, sanitary engineering) based on scientific and normative knowledge. Despite the fact that this concept is still predominant, it gained magnitude and complexity by incorporating power relations into discourse and practice. This switch allowed for water governance to be treated in a more interactive and collaborative way, incorporating different actors (stakeholders, experts, and public officials) and types and forms of knowledge, such as tacit (practical, experimental), contextual (technical, community-based, managerial, administrative), and codified (scientific, analytical, regulatory). This process raised the curtain on different views on how to search for more integrated and participative models for water resource management. In the Brazilian case, this course of action derives mainly from the democratization process, in which social movements gained relevance on several fronts. Water basin committees turned into an especially advantageous locus for building these novel participatory management models.

The building of governance implies putting in place a system of rules, norms and procedures that expresses the values and worldviews of different stakeholders, whether they are individuals or established groups. In addition to this formal system, Craps (2003) emphasizes the importance of considering informal inter-organizational relationships, which is especially important in the Brazilian context.

Institutions and government play a key role in water management, however responsibility should be shared with different sectors of society. The relationships between actors facilitate arrangements and create governance structures for establishing and implementing policies with the potential to identify issues and build shared views. Within this model, widespread social participation is seen as an effective process of integrated governance, which also allows for the safeguarding of legislation, public organizations, and stakeholders during the decision-making process and the implementation phase.

When dealing with the planning and management of water basins, Orr, Colvin and King (2007) identify four types of stakeholders: co-deliverers, professional organizations, local organizations, and members of the public. These categories are not rigid and may overlap. This categorization is based on attributes such as legal mandate, statutory assignments, formal organizational and common interests concerning water resources. Some examples of these categories are: water enterprises and environmental agencies (co-deliverers), association of industries and labor unions (professional organizations), environmental NGOs and neighborhood associations (local organization), and owners and citizens with various concerns (members of the public).

Besides identifying actors, Pahl-Wostl (2005) stresses that it is important to perform an institutional analysis of those actors differentiating them according to key dimensions such as: scale of action (national, regional, local), tier (planning, operation), function (policy, regulatory, operational services), aggregation (individual, collective), and networks (thematic and policy). In addition to those dimensions, we could add the level of interest and power and the type of knowledge which informs the decision-making and the action of actors.

3.2. São Paulo State Policy on Watersheds

The São Paulo State Policy for Water Resources recognizes water as a natural resource essential to life, economic development, and social wellbeing. Consequently, its aim is ensuring satisfactory water quality standards and making sure water resources are used and controlled for the purpose of serving current users and future generations in the state. In order to reach this goal, this policy is based on four basic principles:

1. Recognition of water as a public asset of economic value;
2. Adoption of the water basin as the physical territorial planning unit;
3. Integrated, decentralized, and participatory management; and
4. Integration of water resource management with environmental protection and sustainable development.

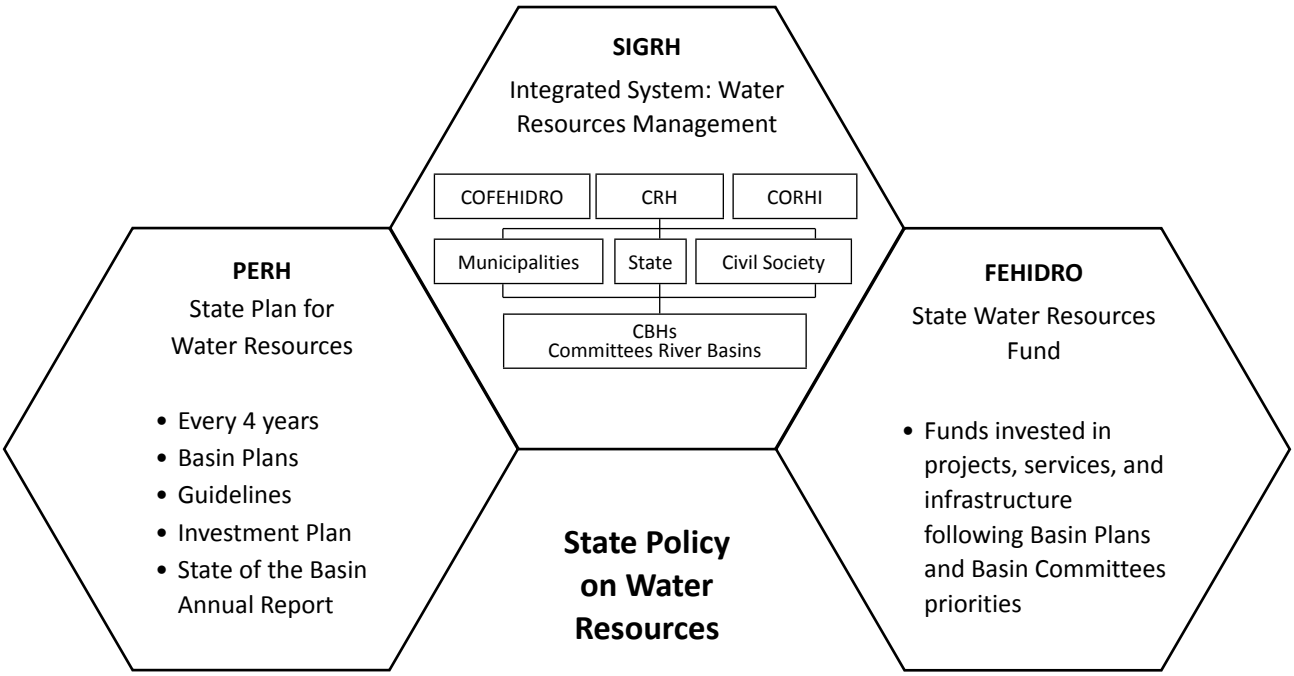
Based on these principles, three main mechanisms for structuring and implementing the policy have been developed and should operate in an integrated mode. These mechanisms entail management, planning, and financing of actions. Figure 6 illustrates these three mechanisms, which are described below.

Management is achieved by the Integrated System of Water Resource Management (SIRH), composed of three spheres. The most complex one is the decision-making and consulting commission, of which the highest body is the Council for Water Resources. This council is a consulting and decision-making entity, which has 33 members who uphold the right to vote and represent the state, municipalities within the different basins, and civil society at large. Each of these levels holds one-third of the votes. Government representatives within the committee rule over the following areas: environment, sanitation, energy, planning, agriculture, housing, and civil defense. Municipal representatives are the mayors of municipalities within the 22 state water basins. Civil society representatives include water users for different purposes and sectors (industry, agriculture, energy, domestic supply), entities such as labor unions and professional associations linked to water resources, and social movements (in general environmentalists), and non-governmental organizations such as the ones that advocate for consumer defense. A selected group of public academic institutions, professional entities, and governmental agencies participate as observers as they do not vote and only a few of them are allowed to voice their opinions.

The Basin Committees (CBH) reproduce the tripartite representation of the council (state, municipalities, and civil society) focusing on the local basin or sub-basin, which also applies in the case of the Alto Tietê. In theory, the committees extend participation of stakeholders and integration of actions to the local management level, serving as communication channels between decision-makers at various levels.

The other two spheres reporting directly to the council are: 1) the Coordinating Commission for the State Plan of

Figure 6: Water Resources State Policy – Major spheres and mechanisms



Source: SirRH Sao Paulo 2012
(http://www.sigrh.sp.gov.br/cgi-bin/sigrh_carrega.exe?f=/index/informe_files/informe32-sigrh.html)

Water Resources (CORHI), which detains administrative and planning power and 2) the Council for Guidance of the State Fund for Water Resources (COFEHIDRO) that deals with financial issues.

The second central mechanism of the water resource policy is planning. CORHI plays a main and decisive role concerning technical aspects. CORHI is responsible for the State Plan for Water Resources (PERH), which is updated every four years. PERH establishes the state guidelines and defines the corresponding investment plan. The basin plans carried out by the committees (21 for the state) and the "state of the watershed" annual reports are important and mandatory instruments for developing a state plan. These "state of the watershed" annual reports present a current picture of the basin, including biophysical and socioeconomic dimensions, main problems, threats, and foreseen improvements.

The third and last central mechanism of the water resource policy is financing, and the COFEDHIDRO is in charge of it. Financial resources of the fund are supposed to support projects, services, and infrastructure projects included in the basin plans and considered a priority by the basin committees. Within the category of projects, academic-technical surveys can be envisioned to obtain data on the status of rivers and streams. This is the case concerning a project presented by the Municipalities of Arujá and Guarulhos in partnership with a local university and FEHIDRO. This project will identify water quality and main polluting sources of the Baquirivu river that cuts through both municipalities. Collected data will support an implementation plan for clean up or minimizing major pollution sources into the river. The main financial source of FEHIDRO is 70% of the total compensation provided by the federal government to the state due to flooding and loss of productive areas with reservoirs for energy supply (dams) and royalties paid by the Itaipu Binacional, which owns and operates one of the largest water dams in the world on the border of Brazil and Paraguay (Paraná river). In 2004, the FEHIDRO budget was R$ 32.6 million (US$ 19.2 million) (FEHIDRO 2005).

The national policy on water resources and its organizational and institutional structure are very similar to the one described for the state of São Paulo. The National System of Management for Water Resources (SINGREH) was established in 1997, after the one in São Paulo had been put in place (1991), and has a normative and decision-making character. Alongside ministries and federal departments, the National Agency for Water (ANA) holds a leading role in many areas.

3.3. Main Actors in the Tietê-Cabeceiras Sub-basin

As discussed above, the organizational and institutional structure in water governance systems in São Paulo is quite complex. This creates additional challenges in identifying actors, and even more, in assessing their positionality. The category systems proposed by Orr et al. (2007) and Pahl-Wostl (2005) can be integrated as a means to develop a better understanding of the array of actors, arenas, and issues at stake in the Tietê-Cabeceiras sub-basin. This exercise is used with two aims: 1) identify major actors and their main characteristics; and 2) assess the appropriateness of this framework for the specific case under analysis.

In our initial assessment (see below), we did not include all categories proposed by the authors. The array of actors we included in our list are the ones who formally participate in the sub-basin committee and others considered key for water-related issues in the watershed.

Among co-deliverers there are three major categories: 1) State water regulators/providers; 2) State secretaries and 3) Municipalities. All actors in this category except for SABESP (sanitation and water company with open capital) are public institutions and collective bodies (organizations and not individuals). With the exception of municipalities, which operate at the local level (municipal boundaries), all actors operate at the state level with more focused action at the sub-basin area.

State water regulators/providers, the first category of co-deliverers, include three major players in addition to the state environmental agency CETESB. In spite of the importance and power of CETESB (it is in charge of environmental regulation and enforcement in general - water, air, land, pollution), its actions regarding the sub-basin are somewhat more diffused and less involved with ordinary matters. The Secretary of Sanitation and Water Resources (SSRH) is in charge of the overall policy on water-related issues for the state, overseeing all aspects from regulation to operational services. While it has great power and is directly involved in decision-making processes with high levels of interest and disputes, its action is statewide and not necessarily felt directly and immediately at the sub-basin level. An agency under SSRH with great impact on watersheds is the Department for Water and Electric Energy (DAEE). DAEE is the regulatory state agency in charge of giving companies and municipalities water concession use rights and regulating the entire water system (levels of reservoirs, water withdrawal quotas, etc), with major impact on water supply and flood control. The current president of the sub-basin committee is a technician from DAEE's permanent staff. Finally, the last major state water/

regulator is the Sanitation Company of the State of São Paulo (SABESP). It is a private firm, the state being its major shareholder. SABESP supplies water and collects/treats sewage in more than 350 municipalities in the state and is a major player in the sector within the metropolitan region. It has vested interest in the whole water system. It is very powerful as it operates at various levels, dealing with state authorities as well as individual customers, including mediation with municipalities that have contracted its services. Table 3 (see Appendix 1) provides a synthesis of these stakeholders (and others in the category of co-deliverers) and their major characteristics.

The second group of stakeholders in the broad category of co-deliverers is formed by several state secretaries/departments. A major difference compared to the first group is that their level of power and influence is lower than that of the four major players described above. However, their interests and mandate are substantial, as they deal with the environment, regional development, agriculture, housing, and civil defense. The most present and active state departments in the sub-committee are related to environmental and housing/civil defense issues, the latter including displacements, relocation, and flood related emergencies. This second group of stakeholders also includes more technical agencies such as the Agricultural Extension Service (CATI) and the Institute for Technological Research (IPT), which are very active in risk assessment (geology, hydrology). The Departments of Health and Education also have a seat on the committee, although their role is not quite as straightforward.

The third category of co-deliverers encompasses the ten municipalities in the sub-basin, including the Municipality of the city of São Paulo. While São Paulo has four representatives in the sub-basin committee covering environment, housing, district management, and public network, other municipalities have only one seat. This illustrates the level of power of the municipalities; while most have limited power, Guarulhos is placed in the middle, and São Paulo at the top. Municipalities operate in several sectors, resembling very much the state structure represented in the committee such as environment, development, urban infrastructure, housing, and civil defense. For municipalities, suppliers also include the local water company. This is also the case in Guarulhos, even though a significant portion of its water is provided (or sold to the municipality) by SABESP.

Following the categories proposed by Orr et al. (2007), professional organizations include an array of representatives with various interests, and all are groups rather than individuals (collective). There are groups representing industrial and agricultural users (the two major categories of water consumers), professionals associations (environmental consultants, bar association, SABESP engineers), and cultural and academic teaching/research centers (see table 4 in Appendix 2). While most of them are private organizations, there are also a few aligned with the NGO sector. Interests within this group range from specific (such as fees and water prices) to more diffused and related to sustainability. Power and direct influence on the decision-making process depend very much on the issues under scrutiny, and internal alignment of interest groups may vary significantly. In general terms, groups of users have more issues at stake and therefore are more likely to put systematic pressure on committee members and state authorities. Academic groups serve more as advisors for technical matters, although they can push for agendas not necessarily backed by industry and agribusiness.

The list of local organizations with a seat on the sub-basin committee is short, including only one NGO that performs cultural, social, and educational work in the metro area (see table 4 in Appendix 2). Other local organizations, as well as individual citizens, may participate in meetings as they are open to the general public. Depending on the meeting's agenda, neighborhood associations, local environmental groups or concerned scholars might attend as well, to express their concern and opinion on specific matters. In general, these types of participation and outside collaboration are very rare.

4 Major Issues, Internal Dynamics, Conflicts and Complementarities

The RMSP has a significant economy with a GDP of US$ 306.5 million (GDP per capita US$ 15,500, 2009) and incorporates the main and most complex industrial center of the country, which accounts for 20% of Brazil's industrial production (IPEA, IBGE et al. 2002). Moreover, it harbors large companies of diverse sectors, including the transnational financial sector. However, the problems and challenges the metro region faces pertaining to water resources, including their governance, are also substantial. So, as in the metropolitan areas of most emerging countries, environmental problems in the RMSP result from the rapid urbanization, lack of planning and spatial regulation, and too little focus on socio-environmental sustainability. These issues are intrinsically related to various dimensions of poverty and the exposure to degradation and environmental risks, such as the limited access to environmental sanitation and problems deriving from flooding and landslides. Issues involving the quality and quantity of available water for the supply of the RMSP have been pointed at as the major conflict to be addressed and solved in the coming years.

The State Plan for Water Resources 2012-2015 (DEPRN Sao Paulo and DUSM 2012) highlights that water supply for urban populations is one of the major demands. Studies show that water scarcity in this region is associated with low water availability as it cannot meet water demands. In 2007-2008 water demand in the Alto Tietê basin (AT) was estimated at 158% to 176% of its capacity (SMA/CPLA São Paulo 2011). This excessive demand is further aggravated by the low water quality in the basin that is already compromised by high levels of water pollution. Another impact factor for water is irregular occupation of springs that, adding to water pollution due to the discharge of sewage and solid residues, also worsens risks of siltation at river margins, floods, and landslides.

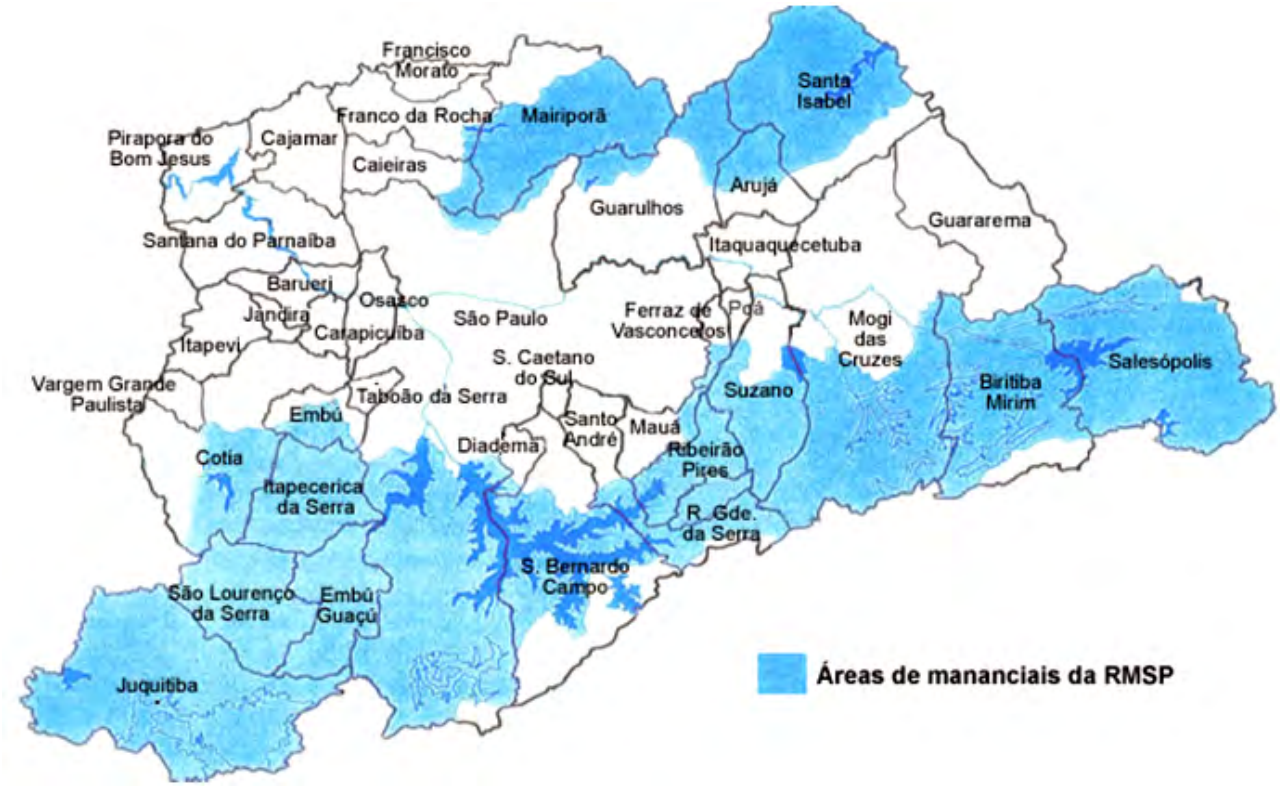
Given this situation, the RMSP is "importing" water from other basins, especially from the Piracicaba-Capivari-Jundiaí basin (PCJ), a neighboring basin in a region which is also industrialized and has a significant population concentration. This situation required official agreements between the basin committees, which led to charging water extracted from the PCJ basin and transferred to the AT Basin through the Cantareira water system. In this case, the importance of discussions concerning the renewal arrangement granted to SABESP to extract water from the Cantareira System in 2004 should be highlighted. These discussions started within the technical chambers and meetings of the PCJ Committee, involving later the AT Committee, the DAEE, and federal water agencies. Besides renewing the conferral of the Cantareira system, these discussions and negotiations conducted by the PCJ Basin Committee also influenced the creation of a specific bill (state bill nº. 12,183 (Sao Paulo 2005)) which defines a fee for water use under state domain and related legal instruments such as the term of commitment for allocation (termo de compromisso de outorga) (CBH-PCJ, 2006).

This term includes, among other actions, the commitment by SABESP to identify other water supplies for the RMSP, in order to reduce its dependence on the Cantareira System, in addition to providing for urban sewage treatment. SABESP is making significant investments to reach what it has coined as the 300% project (100% water supply, 100% sewage collection, and 100% sewage treatment). This plan is already a reality for 140 municipalities served by SABESP in the state. For the RMSP, the aim is to reach this level and quality of services by 2020 (SABESP 2012).

One of the ways to solve or at least minimize water-related problems is to create green areas with the explicit purpose of protecting and preserving the springs. In the RMSP, 64% of the territory comprises areas of springs, and some municipalities are part of the City of São Paulo Green Belt Biosphere Reserve (Subcomitê da Bacia do Alto Tietê-Cabeceiras, 2010). Out of the 36 municipalities within the AT basin, 22 are located in Spring Protection Areas (APM) and are subject to specific legislation for spring protection (Lei de Proteção dos Mananciais (state bill 898/75) (Sao Paulo 1975). Nine out of the ten municipalities (including the city of São Paulo) that constitute the Tietê-Cabeceiras Basin possess APMs. These APMs can be proportionately quite small - for example, in Poá it covers 6% of the municipality - medium-sized like Guarulhos (30%) and Mogi das Cruzes (49%), or spread over almost the whole municipality, like Salesópolis (98%) (see figure 7).

The Spring Protection Bill influences directly land occupation and land use, zoning of economic activities, and future development in these areas. It establishes regulations and enforcement and monitoring acts to protect springs, streams, reservoirs, and other water resources of interest in the RMSP. Therefore, protected areas, urban infrastructure projects, and economic activities related to agriculture, industry, and services need to be screened and approved by

Figure 7: Spring protection areas, São Paulo Metropolitan Region



Source: DPRNDUSM, 2012 (www.fundacaofia.com.br/gdusm/apm.htm)

state departments and the state environmental agency CETESB. Restrictions imposed by this bill aim to ensure adequate water quality and quantity at the Alto-Tietê Sub-basin, an area that has attracted attention and has been a source of friction between state government and municipal administrations within the RMSP. In this area, there are the Alto-Tietê and Rio Claro Systems, which jointly provide 20% of the fresh water of the metropolitan region.

Because of the processes discussed above, the positive impact of creating conservation units like the APMs is not universal or straightforward.. Objections to APMs have been raised because these protection areas impose heavy restrictions on local development while providing little, if anything, in exchange. An important question whic is attracting attention and which will have to be faced by the public sector and society at large, is how to create the right incentives and benefits for the provision of environmental services like the ones offered by conservation units. Although pricing these services can be controversial, there is no way to avoid it, since socio-environmental impacts are not equally distributed in terms of space and social groups.

Climate change water-related vulnerabilities are unevenly spread in the RMSP and phenomena which characterize urban meso climate zones can be seen in smaller areas within the metropolitan region including heat islands, localized thermal inversion, and uneven wind and rain and drought patterns. These micro climate regimes have significantly different impacts on the territory and its population. As headline news has increasingly shown, extreme events such as intense heavy rainfalls have become a growing problem in the RMSP. Problems such as flooding and landslides are expected to worsen in the coming decades due to the increase in temperatures and the effects of global climate change. Estimates show that the majority of problems related to climate change in the RMSP directly affect 30% of the population, including almost three million people living in substandard settlements. (Nobre, Young et al. 2010). The population that is vulnerable to water-related risks is also exposed to other threats, turning it into the most vulnerable group in general.

As a general rule, there are limited (at best) orchestrated adaptation policies in place considering water-related vulnerabilities, and policies specifically addressing climate change. In 2009, the city of São Paulo approved its law establishing its policy on climate change (municipal bill 14.933). Despite high expectations for change at the time, but so far, it remains a plan, and important issues such as urban mobility and transportation policy were removed from it in order to secure approval by the municipal house

of representatives. No other municipality in the metropolitan area has a similar bill and to a large extent, water-related vulnerabilities and climate change adaptation are not included in city-level vision and planning in a substantial manner.

The RMSP has often lacked overall planning, trend forecasting, constraints, and opportunities on several fronts, and water resources are not an exception. The interaction between water availability scenarios (in particular climate affected at river basin level of analysis) has become a concern, however, in a reactive manner. Land use planning and actions on the ground have proved inadequate in anticipating problems. In most cases, they are prompted by mounting problems and constraints due to irregular land occupation, inefficient allocation of resources or the inability to design policy and projects within an integrated framework (multi-sector and multi-temporal and -spatial scales). City strategies developed for managing water-related climate change risks remain largely restricted to emergency responses to extreme events and disasters. The few exceptional cases to this general scenario only highlight the complexity and seriousness of the situation in the RMSP.

There is no doubt that the new structure for water governance in Brazil, centered on the water basin as spatial and political unit with its committee, has represented significant progress on previous arrangements. There is strong evidence that this governance structure has been successful in expanding democratic forums and bringing a variety of water-related issues to the table. Having said that, scholars have identified several issues that need to be addressed in order to fully take advantage of this structure and maximize societal benefits for water governance.

The integration proposed by the new water governance policy is still under construction and in many ways its planning, management, and monitoring remains fragmented. The integrated approach has been very welcome and supported by technical staff and academics, but remains to be fully incorporated by politicians and stakeholders. Devolution, and the associated transferring of responsibility to locally-based committees and the adaptation of a spatially-explicit reference (watershed), has not been entirely implemented. This transition process still lacks deliberative power to fulfill expectations and potential for effective governance (Campos and Fracalanza 2010). In addition, Brazilian public administration is known to be very bureaucratic, which slows the process, and on many occasions opportunities are missed or decisions come very late.

Water basin committees have not been very successful in promoting social inclusion and effectively influencing decision-making processes at state level. While socioeconomic and racial differences do not restrict opportunities for free speech, technical matters and difference in access to information and command of specific knowledge bodies have been reported as a barrier for more inclusive and participatory discussions. The committees have been more successful in voicing opinions and building agreements on public issues, than in strengthening state enforcement and controlling private interest groups (Abers, Formiga-Yohnsson et al. 2009).

Due to technical, political, cultural, and organizational factors, discussions and deliberations within basin committees are a complex process. These processes are further complicated as a result of the value placed on expert and technical knowledge in contrast to tacit and experiential forms of knowledge. This is a true barrier, not only for individuals but also for smaller municipalities, which have limited staff and often lack professionals with specific disciplinary backgrounds. In many cases, discussions are cut short and the easiest path is to follow directions provided by other representatives or bigger players. Turnover of committee members is also a barrier to building more solid structures, as local officials might not be in office after four years and systematic participation puts a burden on many stakeholders who participate on a voluntary basis.

Several of the challenges discussed above are at play in the Alto Tietê-Cabeceiras sub-committee. Asymmetric access to information, diversity among municipalities, power issues, limited deliberative power, poor communication, and slowness, to mention but a few, have been reported. The process of preparing the specific water bill for the sub-basin started in 2009 and only in mid-2012 its final draft was sent to the Alto Tietê Committee for approval. After its approval, it will be sent to the State Assembly for final deliberation and vote by representatives. Important measures related to land use regulation, charging environmental services, and investment in infrastructure are on hold, which has compromised the development of more effective water governance processes.

This decentralized structure cannot prevent committees from being used to legitimize specific interests that contrast with their mandate. However, networks formed by committee members have served as important instruments for cooperation, promoting horizontal dialogue and local capacity (Jacobi 2006). Also, considering social participation as a political issue has the potential to call attention to the complexity of water governance systems, including conflicts over water use, unequal access, and challenges and opportunities to build integrated, participatory, and more democratic decision-making spheres.

5 Some Conclusions - The Tietê Linear Lowland Park

In this report, we started by providing a general context of water issues in Brazil and then focused on the state of São Paulo. Particular emphasis was put on the AltoTietê water basin and the AltoTietê-Cabeceiras sub-basin, including its diversity of municipalities and local development realities. The discussion on water governance and how it is plays out within the Watershed Committees and subcommittees offered a glimpse of how complex and challenging it can be to implement participatory structures for water governance. This is especially true when various stakeholders representing the state and society at large are involved. Providing a summary of main points based on the discussions above, would be repetitive and is not very helpful. Therefore, we conclude our paper by referring to the Tietê Linear Lowland Park (Parque Linear Várzeas do Tietê) project. We opt for this, because the project can be considered a vignette which synthesizes some of the many and significant problems related to water resources in the metropolitan area in general, and in the city of Guarulhos in particular. We describe this project below while making some comments alongside the presentation of the case.

Projected to become the greatest linear park worldwide and with investments of roughly US$ 850 million, the Tietê Linear Lowland Park will extend for 75 km covering an area of 107 km^2 and benefitting directly 3 million people in the eastern region of the capital, and indirectly the entire population of the metropolitan area. The decision to construct the park was announced in July 2010, after severe flooding occurred in late 2009 and early 2010 which submerged settlements on the border between Guarulhos and São Paulo.

The Tietê Linear Lowland Park is a mega project supported by the state government, together with the Department for Water and Electric Energy (DAEE) and in partnership with the Municipalities of São Paulo, Guarulhos, Itaquaquecetuba, Poá, Suzano, Mogi das Cruzes, Biritiba Mirim, and Salesópolis. The park will be built on the Tietê river stretch, located in the Alto Tietê-Cabeceiras sub-basin, extending from the Tietê Ecological Park (Parque Ecológico Tietê, Penha dam in São Paulo) to the Tietê Spring Park (Parque Nascentes do Tietê), located in the municipality of Salesópolis.

The main purpose of the project is to recover and protect the functioning of the river lowlands. Furthermore, the project aims at ensuring flood control downstream (maximum flow 498m^3/s at the Penha dam), creating options for leisure, culture, tourism, and education for the population in the East zone of RMSP, and ensuring access to decent housing for a population to be evicted and resettled (DAEE 2012).

According to the plan, as presented in 2010, the park will be constructed in three phases. The first step is to construct a park that will extend for 25 km along the Tietê river margins, from the Penha dam to the border of the municipality of Itaquaquecetuba, covering the municipalities of São Paulo and Guarulhos (see figure 8). In line with the project presented by the governor of the state of São Paulo, this step will be concluded in 2012 and will cost US$ 200 million, including 42% invested by the State of São Paulo and 58% to be financed by the Inter-American Development Bank (IDB) (DAEE, 2012). This step will be the most complicated one because it involves densely populated areas and requires the eviction of residents of substandard irregular settlements on the riverbanks in the east zone of the municipality of São Paulo and its border with the municipality of Guarulhos. In this region, the construction of the park attempts to solve the problems of recurrent floods that affect residents in Guarulhos (Jardim Izildinha) and São Paulo (Jardim Romano).

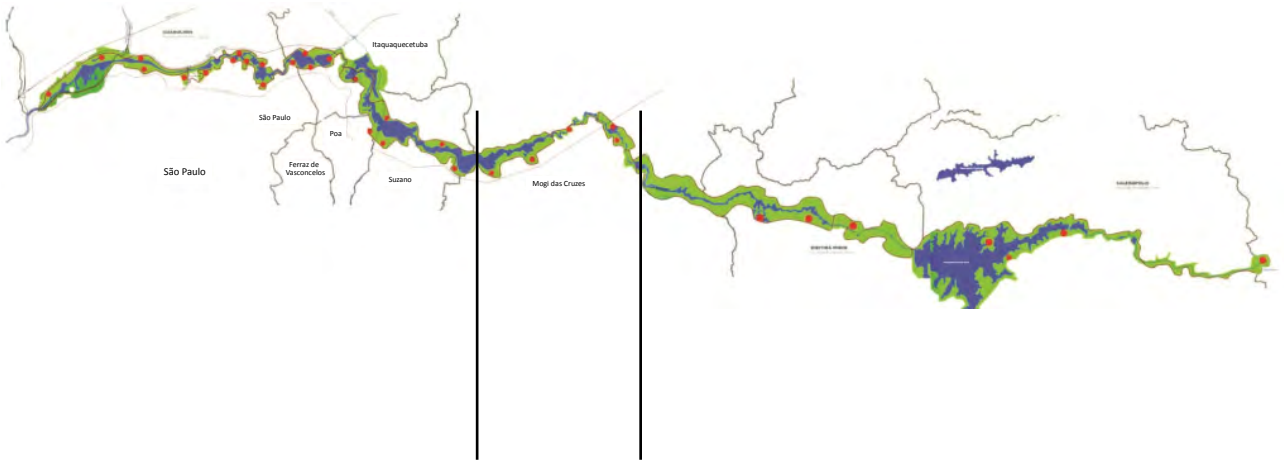
The second step will extend over 11.3 km and will cover river lowlands in Itaquaquecetuba, Poá, and Suzano. This phase is supposed to be completed in 2018. The final stretch (third step) will extend over an area of 38.7 km, which spreads from Suzano to the Tietê river spring, in Salesópolis, including the municipalities of Mogi das Cruzes and Biritiba Mirim, and shall be completed by 2020.

The park will not provide a solution to flooding in the region, but it will contribute to alleviating the issue, insofar as it will enhance the planning of land occupation and its use in the area of the Alto Tietê-Cabeceiras sub-basin, reducing water pollution and avoiding floods more effectively than what could be expected or anticipated (César 2009).

Taking into consideration that the project of the park covers part of the municipalities of the Alto Tietê-Cabeceiras sub-basin, and that among them there are important municipalities that play a role in the socioeconomic dynamism of the RMSP, such as the municipality of Guarulhos, it was expected that this project and its

implementation would result in discussions, agreements and joint actions between the State, the DAEE, participating Municipalities, and stakeholders represented by the sub-committee of the Alto Tietê-Cabeceiras basin. However, the preliminary interviews we carried out with sub-basin committee representatives from the Municipalities of Guarulhos, Suzano, and Arujá, and state agencies who are quite active, show that so far there has been no information and even less informed debate at the sub-committee level on the proposed project and implementation of the park. Interestingly, the same void of information concerning the project and its current status was emphasized by other interviewees, including officials in the Urban Development, Environment, Housing, and Civil Defense departments in Guarulhos, the municipality in which the first step of the park will be implemented. In less than two months, the heart of the rainy season, the most critical time of the year for flooding, will be underway. This period will be a good opportunity to observe if the debate around the park is going to take off or will be completely washed out, like many of the poor households' houses affected by severe floods and landslides on the border between Guarulhos and São Paulo.

Figure 8: Development phases - Tietê Lowlands Linear Park, 2011-2020



Source: DAEE (2012) adapted by authors.

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7 Appendices

Appendix 1

Table 3: Major Stakeholders – Co-Deliverers

Type of Stakeholder Co-delivers	**Scale of Action** (national/ regional/ state/ river basin/ local)	**Function** (policy/ regulatory/ operational services)	**Thematic Network**	**Power Level in Decision Making Process (Sub-basin)**
DAEE – Department for Water and Electric Energy	– State level – Basin; sub-basin	– policy – regulatory – operational serv.	– water syst. regulation	Very high
SABESP – São Paulo Sanitation and Water Company	– State level, local – Basin; sub-basin	– operational serv.	– basic sanitation services (water suppliers; sanitary sewage)	Very high
SSRH - Secretary for Sanitation and Hydro Resources	– State level – Basin; sub-basin	– policy – regulatory – operational serv.	– planning and implementation of state policy of basic sanitation (water supply, sanitary sewage) throughout the state	Very high
CETESB – São Paulo Environmental Company	– State level, local – Basin; sub-basin	– regulatory – operational serv.	– environmental regulation	High
SMA – Secretary for the Environment	– State level, – Basin; sub-basin	– policy – regulatory	– environmental regulation	Medium
SEHAB - Secretary for Housing	– State level – Basin; sub-basin	– operational serv.	– housing in floodplains areas or urban drainage problems	Low
Civil Defense	– State level – Basin; sub-basin	– operational serv.	– prevention, mitigation, response and recovery (floods and landslides)	Low
Other secretaries (Agric.; Planning, Education, Health)	– State level – Basin; sub-basin	– operational serv.	– basic services and social equipment for various ectors	Low
Municipalities Arujá, Biritiba Mirim, Ferraz de Vasconcelos, Guarulhos, Itaquaquecetuba, Mogi das Cruzes, Poá, Salesópolis, Suzano; São Paulo	– Local – Basin; sub-basin	– policy – regulatory – operational serv.	– basic services: (water and sewage) – less degree: drainage, flooding, flooding and landslides	Low for most Medium GRU High – São Paulo

Appendix 2

Table 4: Major Stakeholders – Professional and Local Organizations

Type of Stakeholder **Professional and Local Organizations**	**Scale of Action** (national/ regional/ state/ river basin/ local)	**Function** (policy/ regulatory/ operational services)	**Thematic Network**	**Power Level in Decision Making Process (Sub-basin)**
CIESP – Center for Industry in São Paulo (Guarulhos and Mogi das Cruzes branches)	– State level/ Local – Basin; sub-basin	– policy; – operational serv.	– industry; – management plan and water charges	High
AFESP – Rural Agribusiness & Entrepreneurs	– State level/ Local – Basin; sub-basin	– policy; – operational serv.	– agribusiness; – management plans and water charges	High
Rural Labor Union in Mogi das Cruzes	– Local level, – Basin; sub-basin	– policy; – operational serv.	– labor rights; – local development	Medium
Professional Associations (engineers, lawyers, envtal consultants)	– State/ Local level; – Basin; sub-basin	– policy; – operational serv.	– advisory role, proposes measures and actions relevant to environmental defense and protection	Medium
Cultural, Educational and Social Organizations	– Local level; – Basin; sub-basin	– operational serv.	– extension & educational activities; environmental conservation, sustainable practices, and social welfare	Medium
Local Universities	– Local level, – Basin, sub-basin	– policy; – operational serv.	– advisory role; studies on environmental impacts on water resources and development	Medium

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