Actors' Capacities to Address Water Vulnerabilities in Metropolitan Cities Facing Climate Change

Exploring Actor Network Configurations,
Discourse Coalitions, Power Relations and
Scenario Building Processes as Social
Constructions of Knowledge for Multi-scalar
Water Governance

By Liliana Miranda Sara, Michaela Hordijk and Shabana Khan



Chance 2 Sustain Work Package 4 Thematic Report

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with inputs from Catherine Sutherland, John Sydrenstricker-Neto, Francine van den Brandeler, Eva Filippi, Shazade Jameson and Eduardo Neira

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Introduction

Water is 'spring and origin of existence, it precedes every form and supports every creation' (Eliade 1959 :130). water governance approach in their city, and to what extent do they take the expected consequences of climate change into account?

The 'urban water challenge' is Janus-faced: it is as much about how to provide water (and sanitary) services to increasing urban populations as it is about how to respond to the growing risks and uncertainties of climate change, often in a context of scarce and unfair distribution of financial and human resources. The burden of failing water governance is borne mostly by the urban poor: they often receive lower quantities and qualities of water, often for higher prices, and tend to be the most exposed to water related climate change risks.

As the recently published 5th Assessment report notes 'much of key and emerging global climate risks are concentrated in urban areas. Rapid urbanization and rapid growth of large cities in low- and middle-income countries have been accompanied by the rapid growth of highly vulnerable urban communities living in informal settlements, many of which are on land at high risk from extreme weather [...]. These risks are amplified for those who live in informal settlements and in hazardous areas and either lack essential infrastructure and services or where there is inadequate provision for adaptation' (Revi, D.E. Satterthwaite et al. 2014).

Global warming is expected to increase the frequency and exacerbate the intensity of weather events, such as increased and more intense rainfall, heat waves and storm surges, but also drought and increased aridity, resulting in water scarcity. Cities in low elevation coastal areas are, in addition, at risk of sea-level rise. The urban water sector will thus deliver many of the impacts of climate change through increased floods, heavy rainfall events, or the contrary, droughts (Danilenko, Dicskon et al. 2010).

Given that it has been acknowledged that 'the current water crisis is first and foremost a governance crisis' (UNESCO 2006; Castro 2007; Bakker 2010), work package 4 of the Chance2Sustain projects investigates the following overarching question:

To what extent are the city's key actors (individuals), actor networks and/or coalitions—capable of reaching socially supported agreements generating changes in the

This research departs from the premise that actors, actor networks or actor coalitions use their powers to influence water governance structures, decisions and outcomes in their cities and beyond the city boundaries. To do so they need certain capacities. We have particularly focused on actors' discourses, knowledges and the participatory processes that foster or undermine the social construction of knowledge on water vulnerabilities and climate change The underlying assumption is that the social construction of knowledge (implying data gathering, analysing and exchanging in a participatory manner) can foster the move from sectorial to more integrated planning. The multi-scalar dimension of governance is of particular importance to water governance, given that cities depend on water sources well beyond their city boundaries, sometimes even coming from riparian states. The policy making process in cities is also shaped by legislation and policies at higher levels of government. This work package has addressed the question to what extent actors in water governance take this multiscalar dimension into account, as well as whether, and how, spatializing knowledge can improve the understanding of the territorial dimension of water governance. The knowledge built up has served to support inclusive scenario building processes to envisage the plausible consequences of climate change on the identified water vulnerabilities.

"Urban water governance" is as much a biophysical process, as it is a socio-economic and political one (Bakker 2010:7). The conceptualization of water as a chemical compound (by Lavoissier in 1783), and the following scientific inquiries into the bio-physical properties of water resulted in an 'objectification' of water (Linton 2010:76-78), which in turn enabled its conceptualization as a "natural resource", and even natural capital, at humankind's service. The influence of mankind on the biophysical world is so profound that political ecologists argue the "socio" and the "nature" can no longer be disentangled¹. When applied to

¹ Swyngedouw 2004 even argued: "once the separation became hegemonic it turned from a dominant epistemology into a dominant ontology....the strong belief that the world was ontologically split into things natural and things social" Swyngedouw, E. (2004). Social power and the urbanization of water: flows of power. Oxford, Oxford University Press.

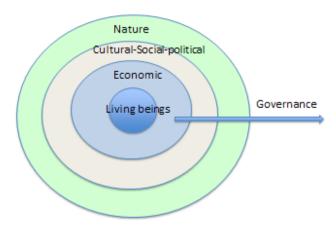
urban water provision: water is a quintessential and essential element of the natural world. Yet, when this water reaches the tap, it has undergone a transformation process of abstraction, treatment, distribution and storage through a complex infrastructural system and it is impossible to determine where in this route water has lost its quintessential natural characteristic to become a naturesocio hybrid. Infrastructure also transforms the natural world, as water passes through aqueducts, dams and reservoirs that alter water cycles. For example, the infrastructure that transports water from the Amazonian side of the Andean mountains to the coastal city of Lima leaves the peasants along the routes without water, and destroys local ecosystems. It is characteristic for the socionature approach, with its roots in urban political ecology, to focus on the material flows that move through the city, the different governance processes, power relations (and the associated knowledges and discourses) as much as on the infrastructures through which these processes are mediated (Bakker 2010:7). By enacting certain discourses (such as 'water scarcity', 'water crisis', or 'integrated water resource management') certain societal projects are furthered (such as escalating investments in water infrastructures to support certain development trajectories), which in turn benefit certain groups over others. These discourses are constructed based on specific sets of knowledge, and their prioritization over others reproduces power dynamics and exclusion.

The inseparability of the natural and the social world is also the key in a variety of alternatives to development approaches strongly promoted in Latin America and in more radical perspectives that have been developed in South Africa. What these alternatives have in common is a profound criticism of (western) modernity and the hegemonic development model; a strong call for a locally rooted diversity (of knowledges, practices etc), the call for a cultural and/or political re-appropriation of nature (Escobar 2007). The more recent ascendance of 'buen vivir' is the result of more than two decades of 'alternatives to development thinking' based on alternative knowledges (Escobar 2007, Chavez & Miranda Sara, 2013). The gist of 'buen vivir' is that 'living well' or 'the good life' is only possible in the community, in which community is understood as encompassing both humans and nature. Buen vivir is thus well-being based on cohabitation of humans and nature, as in the Andean concept 'ayllu', where wellbeing encompasses humans, cattle, crops and the rest of nature. Nature in turn should be understood as both its material and its spiritual component (Gudynas 2011: 44). 'Sustainable development' from this perspective places human wellbeing as being embedded in economic processes, which in turn should be embedded in social-political and cultural processes. Economic processes that are embedded in cultural and social political processes cannot become the dominant force or interest. All this in turn is embedded in nature, and cannot exceed nature's limits.

Buen vivir offers a platform for discussions on alternatives to development, embraces a plurality of knowledges and conceptions, and has also become part of political projects. The new constitution of Bolivia (approved in 2009) and Ecuador (approved in 2008) incorporated the concept, the latter enshrining 'the right of nature'. In WP4 this principle was considered by reflecting on the extent to which nature's right to water was considered by actors.

Figure 1: A holistic vision of sustainability

A more embedded vision of sustainability (WP4)



Source: Adapted from Miranda Sara & Hordijk (2006)

a. Case-study cities

This research has been carried out in six cities of different order: Lima and Arequipa in Peru, Guarulhos in Brazil, Chennai and Dwarka (Delhi) in India and Durban in South Africa. The case study cities differ considerably in some of their basic characteristics. Lima is a capital city, Arequipa, Chennai and Durban are regional hubs, Guarulhos is a fringe city within the Sao Paulo Metropolitan region, and Dwarka is a sub-city within the National Capital Territory of Delhi.

As a capital city **Lima** is home to a third of the Peruvian population (8,5 million inhabitants) and a clear example of a primate city. Its governance structure is highly centralized, yet its *water governance* structure is very fragmented, covering three river basins, 3 regional governments, 4 provincial governments and 44 district governments. Given its location in a desert area with 9 mm rainfall per year, water scarcity is a major concern. Water has to be transported from the other side of the Andean mountains to ensure an adequate supply in Lima. Peru is one of the most vulnerable countries to climate change. Reaching socially supported agreements (or *concertación*) as it is called in Spanish, is essential to Peruvian state-society interaction (see for more details Lima city report).

Arequipa (850.000 inhabitants) is a major regional hub in Southern Peru, situated in the dry Andean highlands at 2300 meters above sea level. Multisectoral and multi-actor water resource management has taken place in Arequipa on an informal basis since the mid-1980s (Filippi 2014), therefore the Chili river basin, from which Arequipa gets its water, was selected as a pilot study for a river basin management committee. Both the previous informal and the current formal multi-actor management bodies are dominated by private users such as a mining company and agriculture. The local mining company has gradually expanded its stake in water resource management, financing projects in water treatment and drinking water provision. Arequipa's water vulnerabilities include both droughts and flooding, which will be aggravated by climate change (see for more details Arequipa city report).

Guarulhos (1,2 million inhabitants) is a city 'at the service of Sao Paulo'. It is home to the international airport, it is a dormitory city for Sao Paulo and has many industries providing Sao Paulo. It has strategically used this position, and is now among the top 10 cities in terms of GDP in the country, despite its small size. Brazil has a progressive water governance institutionality, enabling participation of a wide array of actors in water basin councils. Yet neither Guarulhos municipality nor other local stakeholders were involved in the planning of a large linear park along the municipality's major river, the river Tiete, inter alia meant to reduce flood

risks. The city has to face water scarcity, water pollution and flooding and landslides.

Dwarka (1 million inhabitants) is not an independent municipality, but a sub-city of Delhi (16,7 million inhabitants). The city has been planned and developed by Delhi Development Authority to accommodate the rapidly rising population of Delhi, yet this planning did not encompass a full provision of water and sanitation to match with its speed of development. Consequently water scarcity is a major problem for Dwarka's inhabitants. Water governance in Delhi is highly complex, fragmented and characterized by overlapping responsibilities. For Dwarka this results in an inadequate, insufficient and highly fragmented provision of drinking water, where many inhabitants have to turn to individual (private) solutions.

Chennai is the fourth largest metropolis in India with a population of almost 8 million people. The physical geography of Chennai in Southern India makes for a contradictory relationship with water. Lying in the coastal rain shadow of the Western Ghats mountain range, Chennai suffers both from heavy monsoon rains and droughts, despite a higher than average annual rainfall. As a flat, low elevation coastal zone, there is little natural gradient to encourage runoff, causing urban flooding from rain as well as risks from storm surges. There are multiple and overlapping types of water-related vulnerabilities in Chennai. The challenged felt most immediately by residents is water scarcity, both from the limited water resources in the physical geography but also in irresponsible extraction and distribution. Water demands are five times more than supply (Janakarajan et al. 2007), not to mention highly unequally distributed (Anand 2001). The increasing irregularity of rainfall means drought. In the crisis drought of 2004, the piped water system was shut down for almost a year.

Durban is home to 3.6 million people and it is a regional hub within the Province of KwaZulu-Natal. Durban is administered by the eThekwini Municipality. It is a water scarce city even though it has a high annual rainfall and a significant number of medium to large rivers. The challenge in Durban is to capture the water that falls in the uMngeni Catchment and to move it through the formal water system to meet the 'increasing' demand for water. Many of the rivers within the eThekwini Municipality are highly polluted, which limits the capacity of these rivers to meet the water needs of the urban poor. The Municipality is currently exploring the option of recycling grey water for water provision, given the scarcity of water. A large new dam, the Spring Grove Dam will be completed in 2014, but current demands already take up all the water that will be provided by the dam. In **Durban** a 'spatially differentiated service provision' model has been developed to ensure that all 3,6 million inhabitants have

Table 1: Key features of the case-study cities

Cities & Countries	Inhabitants mill.	Growth rate	Water connections %	Sewerage con- nections %	l/person/day
LIMA PERU	8.5 ¹	1.32	73.5% connected + than million without connection ³ 1 million with rationing	84%4	430 to 30 l unequal distribution ⁵
AREQUIPA PERU	0,85	1.3 ⁶	Truck water Public taps 90% connections	95%7	160 I/day/person (average) ⁸
ETHEKWINI, DURBAN SOUTH AFRIKA	3.59	2.310	93% have access to state provided water within 200 m of the household 9 kl of free basic water to poor households per month 65% of households are connected to water supply in their homes ¹¹	56 %12	200 l/person/day average for those connected to water borne 60 l/person /day for those receiving free basic water ¹³
GUARULHOS, SÃO PAULO BRASIL	1.2 ¹⁴ 19.7 (Sao Paulo Metro Area)	1.33 ¹⁵ 0.97	98% (2011) ¹⁶ (Guarulhos)	82% connections and 29% treatment (2011) ¹⁷	135 l/day/pers ¹⁸
DWARKA, NEW DELHI INDIA	1.0 in Dwarka (DDA, n.d) ¹⁹ 16.7	Exponential annual growth rate for Delhi is 1.92% between 2001-2011	81.3% households have tap water supply, out of which 75.2% receive water from treated sources ²⁰ In Dwarka there are multiple sources of water supply. Tap water is available in few housing types and rest depend on formal and informal sources of water supply.	59.3% for Delhi ²¹	Domestic norms for Delhi- 80 gpcd or 172 lpcd Water received is highly variable across different housing types ²²
CHENNAI, INDIA	8.7 ²³	2.11 ²⁴	n.d., though multiple sources of legal and illegal private provision ²⁵	n.d. ²⁶ but over 1.6 lakh illegal connection ²⁷	Average 108 lpcd ²⁸ ; highly unequal range from 11 lpcd – 235 lpcd ²⁹

Elaborated by Miranda, Liliana; Fernandez, Isabel; Hordijk, Michaela; Shabana Khan; Jameson, Shazade; Sutherland Catherine and John Sydrenstricker-Neto

See Annex 1 for references Table 1

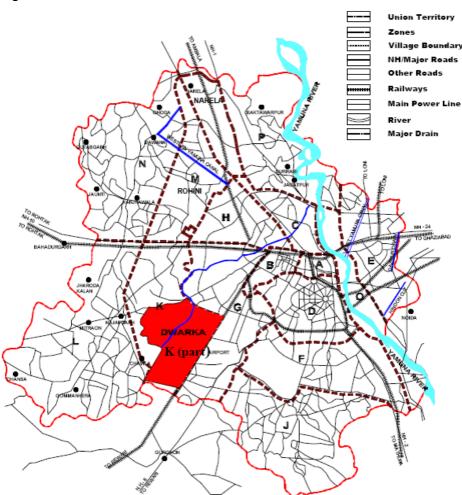


Figure 2: Location of Dwarka in Delhi

Source: DDA, 2006

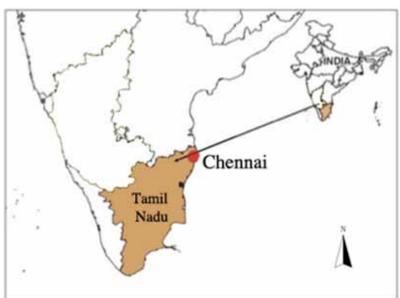


Figure 3: Chennai city and case-study location

access to at least a basic water supply, with the poorest segments of the population receiving free basic water, given the large backlogs in water and sanitation provision as a result of the apartheid legacy. Driven by both economic and environmental concerns, the Ethekwini Water and Sanitation Unit has chosen to use alternative forms of service provision beyond the so called 'urban development line', which marks the boundary between the urban core and the rural periphery of the city. Decisions in water provision in Durban are supported by a well-developed GIS-database, which integrates information from various departments. Durban is considered a leader in both water provision and climate change adaptation, although the differentiated service provision is also criticized by some civil society organizations, who believe that it reinforces inequality.

b. Reflections on Methodology

Water governance processes in the case study cities have been assessed by using a territorial perspective (macroregion, river basin, metropolis, neighborhood), analyzing multi-level governance processes (national, sub-national and local), as well as the role of the multiple actors engaged. Water vulnerability perceptions of the residents and key actors, actor networks and discourse coalitions have been understood by applying the concept of 'configurations' as developed in the Chance2sustain analytical framework paper (Peyroux et.al 2014). In basis of the framework, configurations in water governance have been defined for WP4 work package, which include:

- 1. Discourses, discourse coalitions and dominant ones,
- 2. Key actors, actor network configurations and their power relations
- 3. Vulnerability perceptions and multi scalar analysis,
- 4. Scenario building as social construction of knowledge, and
- 5. Changes in processes, power relations and outcomes in terms of hydric justice.

Once the analysis of the discourses and knowledges of the different actors had been completed, inclusive scenario building workshops were held in four cities (Lima, Guarulhos, Dwarka and Durban). These workshops further contributed to the understanding of the dominant discourses, types of knowledge brought forward by actors (codified, expert, contextual embedded, see WP5 final report), and discourse-coalitions that emerged during the workshops. The objectives of the scenario building workshops included:

- a. To develop plausible scenarios for water governance vis-à-vis climate change for case study cities;
- To understand knowledge needs, possible role and potential contribution of key actors to knowledge generation in water governance; and
- c. To develop a methodological guide for inclusive scenario building on water and water related energy issues in the case study areas in relation to climate change risks (published separately on the Chance2sustain website).

Research in this work-package has been undertaken by drawing on a common conceptual framework and shared guidelines for data-collection, such as semi-structured questionnaires, interview guidelines and a preliminary methodological guide for inclusive scenario building (although the scenario building processes played out differently in the four case study cities given their different contexts and the way in which the research could be embedded in the 'work' of each 'local state'). Interviews were conducted with key-actors at different government levels (including basin-level), which enabled the mapping of key-actors' water vulnerability perceptions; while primary surveys including both interviews and questionnaires were carried out among residents of the selected case study neighborhoods which facilitated mapping of water vulnerability perceptions among residents. Besides, focus group discussions, the analysis of secondary data (including the analysis of spatial knowledge developed and used by different actors) and the inclusive scenario building workshops helped to fulfil the information gaps collected from different methods (see Annexe on Methodolgy for further explanation). Each local research team has applied these instruments informed by their own positionality and the local research context.

In **Lima**, where the work package leader was located, the research had most breadth and depth and could build on an existing network organization (Cities for Life Foro) bringing together multiple actors (municipalities, universities, NGOs) striving for 'cities for life'. Since the *raison d'être* of this network is the social construction of knowledge and capacity building for urban environmental management, the team could draw on an extensive existing network, various complementing research projects² and a tradition of participatory action research. Results of the

² LiWa project, Adaptation Strategy of Lima with Municipality of Lima sponsored by Avina, Master field work on Sustainable Development from international students of DPU, UCL, UK and from the University of Amsterdam in Lima (2013, 2014) and the Phd research study from the first author of this report.

Chance2sustain research in Lima (including spatial knowledge produced as part of the project) fed directly into policy processes, including into the development of Lima's Climate Change Adaptation Strategy³. The research furthermore benefited from the existing culture of 'concertación', bringing actors together to debate issues, agree on solutions and develop proposals for action.

In Arequipa the research was undertaken by staff of a local NGO in coordination with the Municipality, which are also a member of the Cities for Life Forum, well embedded locally and with a similar potential to call together local stakeholders as in Lima. The local NGO, however, could not draw on complementing projects as the team in Lima could. A second complicating factor was that in the years the research was implemented Arequipa faced two major events of heavy rains and the subsequent floods (2012 and 2013). Although these events provided evidence for the importance of the research on water governance and climate change, this also demanded direct actions from the local actors, which resulted into discontinuation of the planned scenario building workshops. Consequently the vulnerability maps produced during the research could not be debated and validated in these workshops.

In **Guarulhos** research has been undertaken by a team from the research institute CEBRAP, based in Sao Paulo. Several staff members of CEBRAP could draw on existing relations in Guarulhos, yet the research tradition at CEBRAP is more geared towards informing policy making processes than engaging in policy making processes. Given the importance of river basin councils in Brazilian water governance, special attention has been paid to the functioning of these councils. One scenario-building workshop was held with members of the river basin councils. The participatory phase of the research process had to be discontinued because of local elections in 2013. When research was resumed in June 2013 many participants were new in their jobs.

EThekwini Municipality (**Durban**) has developed strong links with research institutes. The local research team, based at the University of KwaZulu-Natal, had been involved in many research projects carried out for, or in cooperation with the municipality, and therefore could not only draw on existing relations, but also on a culture of social construction of knowledge. This social construction of knowledge is strong in Durban, however, at a broad level the Municipality does not have a strong culture of participation. The focus of the scenario-building process was determined in collaboration with senior municipal officials. A community based mapping process in one of the

case study communities, revealed the location of water vulnerabilities in the settlement. This mapping exercise was also used to develop a community census, as a result of the imminent relocation of the informal community. Detailed surveys and interviews were conducted with communities in four different sub-standard settlements and this data provides insight in to community responses to water and sanitation issues. This data is triangulated with the data collected through interviews with politicians, officials, NGOs and civil society organizations to produce the understanding of water governance in eThekwini Municipality that has been presented in the Chance 2 Sustain project.

The local research team in **Delhi** was based at the School of Planning and Architecture (SPA), which also has a long tradition of working with and for government, yet as in Guarulhos, more in a policy informing manner than in terms of engaging in policy processes. Bringing actors of different levels of government, and from different levels of the hierarchy together in participatory workshops is less common in Delhi than it is in the other case-study cities. For many residents coming to the scenario building workshops it was the first time to engage with government officials on issues of water scarcity.

In **Chennai** research was carried out by researchers from SPA, the French partner CNRS and the Dutch partner University of Amsterdam. As indicated in the Fieldwork report, conducting scenario building processes requires long term engagement in local processes. Since we could not build on such processes in Chennai, no scenario process was conducted in this city.

Given these very different positionalities of the research teams, which also have an influence on the research outcomes, the research results can only be compared in a relational sense (Ward, 2008, 2010; Parnell and Robinson, 2012; Scott 2013, Peyroux et.al 2014),. Yet the sequencing of research methods enabled us to analyze the capacities of actors to 'perceive' their reality, their capacity for mutual understanding, and if this enabled their capacity to negotiate, to reach socially supported agreements (or concertar) to construct consensus, and their capacity to take decisions and address their reality. Throughout the research process the team has asked the question 'how can the very different perceptions of reality be integrated or harmonized? How can the capacities to reach agreements, to modify existing practices and to deal with the uncertainties of the future climate change scenarios be strengthened? In theory both deliberation in river basin councils (Molle 2009) as well as inclusive scenario building processes (Miranda Sara & Baud 2014) enhance these capacities, and therewith strengthen adaptive capacities as

³ See for more details Miranda & Baud (2014)

outlined in Chance2sustain final analytical framework (Peyroux et.al. 2014).

The report is divided into five sections. Section 1, the introduction, is followed by section 2 which presents the water governance configurations in the case-study cities, paying particular attention to framings and discourse coalitions, (spatial) knowledge and power relations. Section 3 discusses water vulnerability perceptions from an environmental justice perspective, including the rights of

nature in this analysis. Section 4 focuses on a scenario building process as a method of knowledge construction. It discusses to what extent and how the actor-coalitions identified in section 2 showed capacities to understand and address the water vulnerabilities identified in section 3 and what scenarios they developed. The concluding section reflects on the findings that may be applied for building adaptive capacities (Peyroux et.al. 2014) in water governance in the case-study cities.



Water Institutionality, Actor Network Configurations and Discourse Coalitions

a. Global discourse⁴ evolution: sustainable development, water, climate change and cities

The visions of "sustainable development" have evolved over time. Initially, only two meanings dominated: the macro-economic growth and the conservation of nature and national resources with a pre-eminence of the role of national governments. Although the 28th chapter on the role of local governments includes promoting local Agenda 21, the emphasis was given to transfer mandates but not resources. More recently and especially after the Rio+20, sustainable development has increasingly been linked to cities, human settlements and houses ("The Future we Want" RIO+20, UNEP, ONU). In 2012, in the final document of Rio+20, in its chapter about "sustainable cities and human settlements", it has been recognized that cities that are well planned, managed and constructed, which function in an integrated manner, can promote sustainable societies economically, socially and environmentally. Similarly, there has been an attempt to introduce the concept of green economy, but no consensus has been reached and the implementation has been left open to every country.

On the other hand, UN Habitat, focuses on integrating sustainable development and environmental challenges in

the urban agenda posed by the Brundlandt Commission (WCED, 1987) by incorporating Agenda 21 and the agreements of Rio de Janeiro (1992), Rio+10 (Johannesburg) and Rio+20 in the Agenda Habitat (Istanbul 1996, New York 2001 and Vancouver 2006) as well as the declarations of the World Urban Fora (from 2002 to 2014). Recently it has also incorporated agreements of the United Nations Climate Change Conferences (UNCCC). It promotes an integrated, cross-sectorial approach to the planning, management and sustainable construction of human settlements and cities, supporting local authorities, raising awareness amongst the population and increasing the participation of citizens, including the poorest, in decision-making process.

Several reports have been published that consider access to water and sanitation as a human right. This 'right' was ratified on 28th of July 2010 as part of Resolution 64/292 by the General Assembly of the United Nations. The Millennium Development Goals have set as a target to reduce by half the number of persons without access to services of water and sanitation by 2015. Although the governance of water and the processes of local governments or institutions of the city around water management were not highlighted, the goals have formed a core focus in debates around water governance.

After more than 20 years of discussions and negotiations, civil society and scientists globally have reported that we are far from having realized sustainable development. Social gaps, ecological problems, climate change challenges and urban inequalities are increasing globally and are reaching dramatic levels.

Discourse and narrative analysis even it is not a a unified body of work is an approach that has gained increasing legitimacy over the last decade or so and produced a strong body of literature to understand how societies are governed (see Fox and Miller, 1995; Hajer and Wagenaar (eds), 2003).

From the climate debate perspective, there is also a slow but clear shift from a global debate about carbon control to a more spatialized logic that attempts to develop carbon targets and quotas at urban and regional levels. The COP 20 of 2014 which is scheduled to be held in Lima, for the first time has prioritized "Sustainable cities" as one of its five emblematic themes under discussion, where local and sub-national governments are invited to be part of the negotiations as key actors on mitigating carbon emissions as well as adapting to the climate of the futures. The rescaling of the state (see WP 2 Thematic Report) is confirmed in this sense. There is a clear recognition of the important role of cities-with their production and consumption patterns – as they are responsible for between 40 to 70 per cent of carbon emissions depending upon the method of calculation (eg. including or not transport). Local Governments globally are actively organizing (ICCLEI, C40, Asian resilient Cities Network and others) and developing different type of initiatives for implementing these agendas.

The IPCC⁵ fifth assessment report confirmed the anthropogenic causes and the irreversibility of climate change and that its impacts have extended across all continents and oceans. The fifth report stated that "the warming in the climate system is unambiguous and, since the 1950 decade, many observed changes did not have precedents in the last decades or millennia. The atmosphere and the ocean have warmed up, the amounts of snow and ice have decreased, the sea levels have risen and the concentrations of greenhouse gases have increased". To achieve the cutting down of global warming to 2 to 2.4 degrees Celsius, greenhouse gas emissions have to be reduced by 50 to 85% for which industrialized countries have to commit to a higher quota based on their historical and accumulated responsibility.

The IPCC fifth assessment report argues that in relation to the water cycle "the changes which have occurred in the global water cycle, in response to the warming in the 21st century, are not uniform. The difference in rainfall between wet and dry regions and between wet and dry seasons is stressed, although there can be regional exceptions". The IPCC also points out in the same report that there is a high level of confidence that the El Niño/Southern Oscillation (ENSO) phenomena will remain the dominant mode of yearly variability in the tropical Pacific, which will have a global effect in the 21st century. Given the existing humidity, it is likely that at regional scales the variability of rainfall will increase, in relation to El Niño. The natural variations in amplitude and pattern of this phenomenon are huge. Because of this, a low level of confidence exists in any projected change for the 21st century. On the other hand,

direct human impacts, such as changes in the use of soil, pollution and use of water resources, will continue to dominate global threats with the greater threats being to the majority of continental water systems (high confidence) and earth systems (medium confidence) during the next three decades.

Adams et al. (2009:5) and GTR (2009:40) confirm these water risks by stating that by 2030, under a scenario of medium economic growth with no improvement in efficiency, the global needs for water will increase by 4500 million square meters to 6900 million square meters. This is 40 percent on top of the current supply (including the return flows and taking into account that a big part of the supply is reserved for ecosystems and other species). This global percentage is the sum of a huge number of local lakes, of which some are in a bad state: a third of the population, concentrated in developing countries, lives in basins where the shortage will be more than 50%.

Global discourses about the city

The discourse of the "competitive city" within the context of the discourse of the "global city" builds on strategic instead of integrated planning. It has moved from an urban, metropolitan or territorial scale of planning, which manages the city in an integrated manner, towards a focus on 'megaprojects', generally leaving big parts of the cities without investment increasing inequality, segregation and fragmentation (Burguess and Jenks, The Compact City, 2010). Although it has been abandoned for a great part by its promoters (Borja, Jordi, FUM 7, 2014 from Barcelona Strategic Plan), the corporate sector as well as national governments and municipal associations continue to support this discourse, which has a strong focus on privatization. This push for privatization became less strong after a number of failures (for instance in Buenos Aires, Paris, Cochabamba on the issue of water). The dominant modality nowadays are the public private partnerships (PPP, see Thematic Report WP 2). These PPPs usually are established for developing large scale infrastructure projects and megaprojects, identified via strategic planning and prioritizing regenerative projects as "urban enclaves", which can entail re-locations of the most vulnerable, and connecting these privileged places with best equipment, best quality of urban living and, consequently, better location, by super roads and high-tech infrastructure (see Thematic Report WP 2 and WP 3), also called "acupuncture" projects (Lerner, Curitiba). The core of this discourse can be found in the paradigm of growth ("modernization and efficiency"), which has almost been converted into a cult (population growth, GNP growth, investment growth). This is a discourse, which is clearly hegemonic at a global level and virtually indisputable.

⁵ Intergovernmental Panel for Climate Change

This development discourse can go in parallel with the discourse of the "compact city", when it is implemented through the concept of city "densification". The "compact City", so often associated with ecological benefits, can also be used to direct investments towards zones with high construction density, but with low population density. In Lima we observed that legitimized by this discourse investments favored high income areas (Opportunities for Lima's sustainability?, Miranda et al, 2014), resulting, for instance, in more m2 of construction and green areas per person, providing higher quality of urban life. In the low income areas in the periphery in contrast, we find low construction density, high population density and a low to very low quality of life. Hence, the 'compact city' can become a "double" discourses when it is implemented in a way that enhances cities inequalities and fragmentation.

Growth or de-growth? Rapid or slow urbanization?

Both from the literature as well as global social movements, an alternative discourse is developed as a counter discourse of the paradigm of growth (from Meadows, 1973⁶, Schumacher 1973⁷ to a world movement of

Degrowth⁸, Escobar and others) particularly aimed at the overdeveloped countries. For example, the table attached demonstrates how the growth rate of the world population has decreased since 1950, contrary to the increase of the world population, which is unequally distributed in space. The majority of the new population is concentrated in urban zones and underdeveloped areas; particularly in Asia. This has resulted in a significant increase of population density, which exists as a contrast to the decrease of population density in the most developed countries. The contrast is further increasing. "In 1900, 10 percent of the world's population lived in cities, which 100 years later had risen to 50 percent of the world's 6 billion inhabitants and by 2050 it is projected that nearly 70 per cent, of a global 10 billion population will live in cities" (United Nations Population Fund (UNFPA, 2007). The rapid urbanization process has come slowly to an end in Europe and North America, however Asia and Africa continue to urbanize at a rapid rate with the greatest amount of growth occurring in small to medium sized cities.

In fact, what this growth argument stresses is the idea of an increasing, and permanently growing demand of natural resources consumption (such as water, energy, flora, fauna, etc.), the need of and endless increase of

Table 2: Demographic Dynamics, 1950 - 2050

Period	Average grow rate of the world population	Increase of millions of individuals of the earth population	World population density at the end of the period (population per km²)	Density of the most developed regions	Density of the less developed regions
1950 - 1955	1,78	47,1	20	16	23
1970 - 1975	1,94	75,4	30	20	37
1990 - 1995	1,54	84,8	42	22	55
2005 - 2010	1,17	78,3	51	23	68
2020 - 2025	0,88	66,6	59	24	81
2040 - 2045	0,45	40,4	66	24	94
2045 - 2050	0,36	33,06	68	23	96

Source: Population Division of the Department of Economics and Social Affairs of the United Nations Secretariat, World Population

Prospects: The 206 Revision and World Urbanisation Prospects; the 2005 Revision, http://esa.un.org/unpp

⁶ The Limits to Growth, 1972, Meadow et al

⁷ Small Is Beautiful: A Study of Economics As If People Mattered, 1973, W. F. Schumacher's

⁸ International Conferences on Economic Degrowth for Ecological Sustainability and Social Equity (since 2008 till now)

number of houses, land, water and energy associated to the construction of those houses. In sum, economic growth, GDP growth which underpins the paradigm of growth solves the city challenges. Then, from there, those defending this argument make it possible to connect the "growth paradigm" with the need for infrastructural investments growth. It can be stated that, in the majority of the cases, the sectorial, pro-infrastructural and pragmatic discourse goes hand in hand with the growth paradigm.

This "pro growth" discourse is dominant in the four countries and cities studied, where for some it is strongly evident, such as in Peru, South Africa and India, while for others it appears in a more populistic ("soft") way, but is still dominant, such as in Brazil. In South Africa the progrowth discourse is tempered by the pro-poor development discourse as a result of the country's history and the ANC's commitment at a policy level to redistribution. In all countries studied, the pro-life/green development discourse is not a dominant one and even in the case of India it is still only emerging. This research has identified the coalitions and configurations supporting and reproducing these discourses, which will be shown in the following sections.

Development, cities and water discourses connections

From the sustainability concept, there are several variations, like eco cities, bio cities, cities for life, some of them emphasizing the need to include nature with its own right as well as non-human actors, and finally those understanding cities as 'smart', 'intelligent' and necessarily, efficient. The correlation of the 'development', 'city' and 'water' discourses as shown in Table 3 is based on the assumption that in the territory and city, discourses which have been identified, can be grouped as "world class" cities, "global" cities, as well as the one which conceptualizes the city as "inclusive", "popular" and "equitable".

As can be seen, these discourses have been coupled with the development approaches and discourses with a: "progrowth", "pro-poor", "pro-life/green" and "buen vivir" — as well as the "sectorial / pragmatic (mainly pro-large infrastructure investments)", being the first and the last one generally associated to the so called public-private-partnerships (PPPs). And finally, it shows the correlation with the water discourses, which will be further elaborated later, such as those which define water as an "economic good", as a "human right", as "all living beings' right or a socio ecological good" and water as a "sector". From these arguments and statement discourse analysis and the discourse coalitions which support the hegemony of some of these discourses have been developed in the following sections.

b. Water institutionality and actor network multi-scalar configurations

Institutions determine, inter alia, the processes of information exchange, coordination and decision-making procedures and the allocation of responsibilities and resources (Ostrom, 1990).

According to UNESCO (2006), the major cause of the current and future water crisis is not the shortage or lack of supply of water and technology, nor the problems in water governance, but more precisely, also according to Swyngedouw (2012) is the problem of democracy and water unequal distribution. In addition to this, in the context of climate change and the increased pressure on hydrologic resources – including their contamination – the need to address the nexus between poverty reduction, inequality and ecosystems and water management has been recognized (Batchelor 2007). For this, the challenges

 Table 3: Discourses on development, cities and water: their inter relations

Development	Pro growth	Pro poor	Pro life/green, « Buen vivir »	Pro infrastructure/ sectoral
Cities	Global/Competitive « World class »	Inclusive, equitable	Green/Sustainable Ecocities, Biocities	Smart/ Intelligent Efficient
Water	As an economic good A commodity	As a human right	As a living being's right	As a sector, mainly associated with infrastructural options

Elaborated by Liliana Miranda

of the rate of increase, population density and water consumption per person have been generated for cities viability (and even competiveness).

It is noted that because of water scarcity, permanent tensions and conflict exist particularly between the residential, industrial, commercial and infrastructural (energy and others) sector, along with the mining sector in some cases (Lima and Arequipa). The competition of who has the best quality and more quantity of water supply is ongoing, although in all cities and areas studied in this research, it has been difficult to identify due to the limited transparency in the management of this information. In addition, the information has been diverse, variable, uncertain, diffuse and confidential. The sectoralization, fragmentation and lack of capacity of water management are important factors in this situation of imprecise data and information that makes analysis and understanding of the complete hydrological cycle of water for the larger area, river basins, metropolis and city difficult. This opens spaces in which only the better informed – and better prepared - achieve the best conditions in the distribution of water rights, where generally the poorest and the most vulnerable populations, alike nature, organisms and ecosystems are the losers.

In addition to what has been mentioned, corruption, lack of integrity and unethical and dishonest behaviors — created by the private or public sector or the community because of failed water governance — are also contributing factors to the conflict, tension and lack of confidence. This also results in the loss of great amounts of finance intended for the sector. The empirical evidence demonstrates that the conflicts occur as a result of the lack of satisfaction of major groups in a society—generally the most vulnerable—on how decisions are taken in favor of the few at the expense of others and ecosystems. Some of these conflicts are outlined extensively in the studied cases. Others are latent conflicts waiting for how the climate scenarios or other critical conditions will unfold. They are in a temporal stage of remission.

In all the cities studied, despite being confronted with different levels of hydrologic stress, including the cases which are the most acute (like Lima and Dwarka) and with climate scenarios which are clearly unfavorable and uncertain in relation to the situation of water and the potential water related disasters, the key actors — except for some residents — do not prioritize the implementation of measures of adaptation to climate change. Although in case of Durban and Lima strategies for adaptation to climate change have been outlined, they face different types of barriers in implementing them and gaining their formal approval (Lima).

The conflicts of water governance

The conflicts and rights about water (in dispute) are intrinsically related. They relate to the questions of what, how and who decides about hydrological resources. It depends on the social and political organization of property rights about water (for example: who approves the water laws and codes, who is in power, which authorities demand what and which powers are associated with the water rights for each water user).

The questions of rights and resources are intertwined with the different approaches of the principles of governing, governance and regimes of water. There can be distinguished between regimes of public property, private property, common property and situations of open access (Musetta, 2010). Institutionalizing the management of the supply and distribution of water is principally a responsibility of the state. It assumes that the situation of open access includes the provision of water for other organisms and their ecosystems for which a solid body exists in the literature associated with conservative and ecological groups. However, they are generally included in a weaker form in the dominant discourses around water.

In the general debate about governance, the different well-known models or institutional frameworks are the public/technical/institutional model, the hierarchical model, the cooperative model and the market model. They mask the fact that this is inherently a political and conflicting process, in which the power structures play an important role. Included in the multi-actor approach — or the actor and network approach — is the recognition that the actors have different interests, which are not always in balance. It often presents an idealized version of symmetric and triangular interaction between the state, civil society and the market, rather than emphasizing that, the power differences between them play a role in who access water, in which quantity, quality, for which price and with which frequency.

The conflicts on water are not scarce and they have been documented extensively, both in history and now (Merlinsky 2009). In reality, the well-known phrase "water flows in the direction of power" has been the prevailing situation (Boelens, Dávila et al. 1998:447). In the southern cities, water does not only polarize public opinion, it also fragments urban spaces in areas with and without water. Moreover, the urban space is fragmented by a tendency of discrimination and socio-environmental conflicts, which strongly connect, to water access (Fernández-Maldonado 2007, Ioris, 2012).

Gudynas statement that the governance and cooperation about water is not about dialogue and

consensus but also about dealing with uncertainty, conflict and corruption has been confirmed by this research (Gudynas 1992: 106). In contexts where a large history exists of over-exploitation of natural resources going hand in hand with exploitation of human beings – like is the case in many developing countries and countries rich in natural resources – a conjunction can be found between social and environmental problems and conflicts.

In addition, conflicts over water are not only socioenvironmental, but also economical, political, cultural and spatial or territorial. Therefore, in problems of water governance these different dimensions come into play (Merlinsky 2009: 7-9). Why, how, and who takes the decisions about hydrological resources? On which geographical scale and for the benefit of whom? Which property regime authorizes – and maintains – these decisions?

These questions of the rights and resources are interrelated with different approaches or discourses about water governance. Is the provision of water a mainly responsibility of the state or should be based on market principles, or even should it be administrated by the community based on the principles of the common good? Do they include the rights of the nature?.

In the literature review of WP4 there is little treatment of either the role that actors play in leading processes of change and development or in how to identify and analyze their capacities and rights. On the other hand, this investigation has shown the importance of considering the leadership capacities (Sutherland, C. 2014, Opinion Paper c2s and Salazar, L and Lopez, J., 2002) of the actors and their networks in the processes of water governance and particularly their capacity to generate change. It is found that persons, institutions and/or networks of actors defined or represented the discursive coalitions with greater clarity. This research also investigated whether these actors constructed, increased or lost influencing capacities and power, which was one of the criteria for the identification of participants in the scenario workshop as well as the interviewed institutions or citizens, for providing a representation as close as possible for every case or city.

Water institutional arrangements

As it can be seen in Table 4 below, despite discourses on decentralization, participation and integrated water management, in all the cases, with the exception of Brazil, central government still makes the major decisions concerning water, starting with the water rights. In Peru, there is the National Water Authority attached to the Ministry of Agriculture; in Brazil there is the National Water

Authority attached to the Ministry of Environment; in India, there is the Ministry on Drinking Water and Sanitation and Ministry of Water Resources; and in South Africa, there is the Ministry of Water Affairs.

At the level of the rivers basins, there are no institutions with a clear mandate to take charge of the management of the ecosystem. In Perú, a multi actor and intergovernmental council leaded by three Regional Governments manages three river basins (Rimac, Lurin y Chillón) that provide water to Lima City but without including the Mantaro River Basin, in the Andeans, from which almost quarter of the water sources come from. In Brazil, a council constituted by the representatives of the State of Sao Paulo, local municipalities, users, private companies and civil society organizations manages the river basins of the Tieté and Sorocaba rivers that provide water to Sao Paulo City and Guarulhos. In India, the Yamuna River Basin Council starting to be formed and yet poorly implemented for regulated over extraction of water by peri urban farmers. In India, the Council of Yamuna River Basin recently formed and still poorly implemented, attempts to manage the over water extractions by periurban farmers. In South Africa, Catchment Management Agencies were supposed to be established at the catchment level but these are still not in place. The national department DWA is responsible for water resource management in all South Africa's catchments.

At the level of metropolitan areas, companies of different nature manage water. In Lima, SEDAPAL is a public company attached to the Ministry of Economics and ruled by the Housing Ministry. In Guarulhos, the public water company SAEE depends on bulk water supply from the state level public-private company SABESP. SABESP is considered one of the largest water and sanitation companies in the world in terms of the population served. In India, Chennai Metropolitan Water Supply and Sewerage Board (Metro Water) is a public enterprise who serves only the inner city of Chennai and in Durban, EWS is a public department within the municipality with the mandate and responsibility to provide water and sanitation to the city.

In contrast to the principles of the global discourse on Integrated Water Resources Management, in all the case studies, management of river basins is not under the control of one multi-sectoral entity that manages the production and distribution of water to all users, as well as to the cities. This means that there is no unit in the management of the entire water cycle. There are many water users from industry, mining, agriculture, hydroelectricity and others beyond the control of urban water service management. Furthermore, in all cases there is a strong approach to the issue of water from the limited perspective of sanitary engineers and infrastructure

Table 4: Key features of the case-study cities

Country (and city) / Levels	Perú (Lima)	Brasil (Guarulhos)	India (Dwarka and Chennai)	South África (Durban)
National	Agriculture Ministry ANA (National Water Authority) ANA defines the water rights	Environmental Ministry and SINGRE ANA (National Water Authority)	Ministry of Water Resources & Ministry of Drinking Water & Sanitation	Department of Water affairs (DWA), they define the water rights and the South Africa Constitution
Macro Regional / River Basin and water rights mandates	Rimac, Chillón and Lurín inter river Basin Council to be approved leaded by Regional Govern- ments of Lima, Municipality of Lima and Callao without community participa- tion	Alto Tieté Watershed Basin Council is a descentralized multiac- tor council with a tri- partite representation of Municipalities and civic society (including residents) existing and functioning Water rights defined by State level	Upper Yamuna River Board regulates the water distribution in the adjoining states including Uttar Pradesh, Haryana, Rajasthan, Himachal Pradesh, Rajasthab and NCT of Delhi. Tamil Nadu Groundwater Act (2003) first recognition of need for regulating over-extraction of periurban farmers' wellfields & inner city aquifer; yet poorly implemented	Umgeni Water Umgeni Water's current customers include the eThekwini Metropolitan Municipality and other municipalities
Metropolitan City	Sedapal - Water public Company (Owned by Fonafe from Economy Minstry)	SABESP provides water services in more than 350 municipalities Water public Company (Owned by the Federal Government of Sao Paulo within a Corporate Government and under the stock market	Delhi Jal Board is an autonomous body which is responsible for production and distribution of water in the National Capital Territory of Delhi. It is headed by the Chief Minister of Delhi. Delhi Jal Board is a responsible organization at the city level which provides water throughout the city. Chennai Metropolitan Water Supply and Sewerage Board (Metro Water) elected by entire federal state but serves only the inner city of Chennai.	EThekwini Municipality Water and Sanitation Unit (EWS) reports directly to the Department of Water Affairs
City and water distribution	Sedapal Water distribution between 430 to 50 liters per person per day	SAEE Guarulhos (Autoctono Service Water and Sewer) Water public Company Owned by local authority of Guarulhos , provides average 220 liters per person per day	Multiple water suppliers add to the complexity of water governance at the local level in Dwarka. The distribution of water is 80 liters per person per day average Chennai's water scarcity crisis results in complex multiplicity of actors; On top of MetroWater's piped system, there is also extensive privatization through water tankers and packaged water, domestic wells & rainwater harvesting.	Water Distribution by Municipality EWS commits to pro- viding basic water supply and sanitation service 200 lts/person/day average for those connected to water borne sanitation sys- tem
Not connected households	26.5 % Not Connected 1 million with rationing Provided by water Tankers and small scale community and private companies	2 % not connected	In Dwarka: 50% Not Connected with multiple providers In Chennai: 40% of population with connection (including shared taps)	93% of residents have access to water, levels of service vary from water veing provided 200 metres from household to full pressure systems within households. 60 lts/person /day for those receiving free basic water

Elaborated by Miranda, Liliana; Hordijk, Michaela; Shabana Khan; Jameson, Shazade; Sutherland Catherine and John Sydrenstricker-Neto.

development. The social, environmental, production and other aspects are not usually considered.

In this sense, water management prioritizes the idea of extending the water connections to the whole population by expansion of the distribution network. Reducing water consumption and recycling is not considered in the management scheme-with the only exception being Durban, which is starting to raise water scarcity as a critical issue-because it does not contribute to the logic of commercial business development and public works. In accordance with the foregoing, there are no sources to record all information concerning water management. In some cases, the information is scattered among various actors and, in other cases, it does not exist or is inaccessible. Finally, one aspect that characterizes the local water management systems is the lack of transparency. Overcharges to poorest, commissions to carry out infrastructure works, fees to favour certain users, are some of the forms of corruption.

Water institutionality in Lima, Peru

Peru is a highly centralized country, and Lima, as its capital and biggest city, hosts one third of the national population, more than two thirds of industries, finance, services, trade and others. Water consumed in Lima and its suburbs comes from four basins formed by the rivers Rimac, Chillon and Lurin, which have their origin in the highlands of the Andean mountains, dropping 5,000 meters from the mountain to the coastal desert and finally the Pacific Ocean, forming three broad valleys in which the city of Lima is located. The fourth basin of the Mantaro River flows across the Andean highlands and leads in to the Amazon River and the Atlantic Ocean. Part of its water is transferred to the Lima basins, on the other side of the highland, to increase the supply of the city via a large-scale infrastructure projects. Moreover, considering the slope through which water flows, there are seven hydropower plants contributing to the generation of 60% of the country's electricity. We also must state that it never rains in Lima. The annual average rainfall is 7 mm, the lowest average of any metropolitan area in the world. Rain in Lima is considered to be a strange phenomenon for most of the population. Therefore, water comes entirely from the rivers that originate in the Andes.

Water management in this macro region is divided into several authorities with overlapping responsibilities. On one side, there is SEDAPAL, a public enterprise belonging to the Ministry of Economy, that monopolizes the provision of water and sanitation for the metropolitan city, but it is regulated by the Ministry of Housing and Sanitation, and as it has been said, the Municipality of Lima is not involved in

its management. On the other side, there is EDEGEL, a private company that operates hydropower plants; and thirdly, there is the National Water Authority (ANA) under the Ministry of Agriculture and responsible for national water management policy. The ANA works through local administrative units in coordination with the River Basin Councils⁹ under Regional Governments, and multiple actors as public and private entities, water users, academia, professional associations, and Municipalities, which is still in the process of formal approval to begin its functions. Civil society organizations and environmentalists' movements have been providing support to the formation to such a council, but they are not formally members of it by law.

People not connected to the water distribution system (about 1 million inhabitants) are organized in a movement without water, but without participation in any deliberative council. They must purchase water from tanker trucks that sell water on a small scale. The system is not equitable, nor just. People that are not connected, which have the lowest ratio of water consumption in the city, are paying about 12 soles per m3 (via truck providers), meanwhile mining companies pay ("retribute" to ANA¹⁰, in legal terms) 0,009 to 0.26 soles per m3. Therefore, in Lima the water governance system is fragmented and dispersed, with institutions overlapping, actors not coordinating their actions, and additionally, there is a lack of integrated information systems, information is neither reliable, nor transparent and the complexity is its main characteristic. As Kaiser says (Kaiser, Jean Paul, 2013) "the institutional disarticulation, the deprioritization of climate change, the lack of information, and the dispersion of actors, make a difficult situation to build resilience and adaptive capacity to climate change." All this creates a hard barrier for the land and territorial planning at district, metropolitan and regional macro scale.

In this disjointed and confusing scenario, water management tends to be dominated by a sectorial approach and controlled by sanitary engineers and builders of infrastructure, whose main expectations are to generate higher revenue for the company and its contractors. This situation results in cases of inefficiency, as significant loss of water in leaky pipes (34%, SEDAPAL 2013), lack of treatment facilities and water recycling, corruption, lack of transparency, labor problems, among others.

⁹ In 2010, the new Water Act resulted in the creation of the River Basin Hydric Resource Councils (CRHC in Spanish) under the leadership of the regional governments, with the aim of promoting the participation of local actors in the management of resources water.

¹⁰ National Water Authority, under authority of the Agriculture Ministry

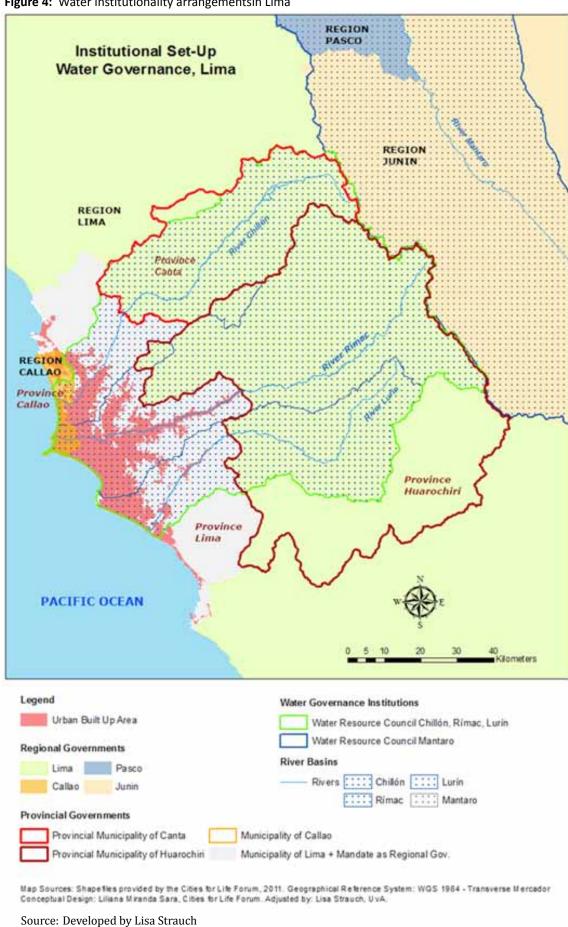


Figure 4: Water institutionality arrangements in Lima

Water institutionality in Arequipa, Peru

Arequipa is the second largest city in Peru after Lima. Located in the south of the country (2,300 meters high), water comes from the Chili River, in whose basin Arequipa settles. The network and service of drinking water and sewage in the metropolitan area of Arequipa is conducted by SEDAPAR, a private company ruled by public mandates established in 1961. Its Shareholders are 33 municipalities of the region headed by the Municipality of Arequipa. The water supply is fed by seven sources with an output of 4,293,833 m3 per month. In the city, 83% of the population has access to drinking water, this means 143,856 household connections with an allocation of 153 liters / person / day (average), and 17,010 connections for industrial and agricultural use with an amount budget of 42 liters / person / day.

Since the 1990s, environmental and civil society organizations have pressed local authorities to promote Agenda 21, stop industrial and mining pollution of the Chili River, and improve the public transport system. In early 2000, 24 new regional governments were established in the country, replacing the previous administrative structure based on Departments. In Arequipa, the new regional government promoted the creation of multi-sectoral and multi- actor river basin council with public, private and civil society actors, in order to take decisions about several services, including drinking water. Thus, the Council of the Chili River Basin was created with the participation of SEDAPAR, the regional government, municipalities, private companies and civil society organizations. In fact, Cerro Verde, one of the biggest cooper mines in the world, is located on the edge of the city having a strong influence on the decisions taken by the Council. Therefore, what should be a space for democratic participation in decisions concerning water and the environment ends up being a functional space for the most powerful, and it is dominated by expert engineers in sanitation and infrastructure networks. Meanwhile, the population has no information about the shortage and mis-distribution of water affecting the city nor the level of contamination of the water consumed nor about the need to change and reduce their consumption patterns.

The CRHC of the Quilca—Chili river basin in Arequipa was created in 2012, and it is one of the four existing throughout the country so far. This is an interesting change in the institutional framework for regional environmental management "from a predominantly public, hierarchical and centralized water governance system to a more mixed, marked-led and decentralized network governance model" (Filippi et al. 2013:3). Unfortunately, the consolidation of the CRHC of the Quilca — Chili river basin is currently paralyzed (Huamonte, 2000).

Water governance is undermined by environmental supply problems such water scarcity, pressures and conflicts related to hydric resources like ground waters. There are many limitations to an adequate river basin management such as the regression of the decentralization process; inefficient sanitation infrastructure; non-applicable priorities of use; the disjuncture between water conservation, water quality, water supervision and control activities; insufficient human and logistical resources for supervising water quality.

The Regional Government of 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. With regard to climate change, the Regional Government of Arequipa has approved a regulation that gives priority to the development of a Regional Strategy on Climate Change. Despite this, little has been done with regard to policy and legislation at the city level; neither have there been efforts to change attitudes and practices towards more sustainable water use.

Water institutionality in Guarulhos, Brazil

With 1.2 million inhabitants (IBGE 2010) and a US\$ 16.2 billion (2010) gross domestic product (GDP), Guarulhos is the second largest city in the state of Sao Paulo. It is located in the Northeast section of the Metropolitan Region of São Paulo (19.7 million inhabitants and a GDP of US\$ 305 billion), and is spread over two large river basins: the Alto-Tietê Basin and the Paraíba do Sul Basin. The majority of the municipality falls into the first river basin. Due to its strategic location and transportation network, Guarulhos has a high ranking within the state and national economy. It hosts the country's largest airport and the main roads connecting Sao Paulo City with other regions cross it.

In Brazil, the water basin is the main geographic unit for water management and governance, and municipalities are allowed to have their own company or hire water and sanitation services from another sources (public or private). The SAAE Guarulhos was created in 1967 to provide water and sewerage services to the city. As municipalities, states and the nation have entities (organizations and institutions) for water governance, so the picture becomes quite complex. There are several overlaps, making it very difficult to clearly define mandates and responsibilities. Guarulhos does not have enough water to supply the entire population, therefore it buys 87% of its water consumed. Yet even with this additional supply, it cannot provide water to all citizens with a 24 hour / 7 day supply, and thus uses a rotational

system of water provision in large parts of the city, particularly during dry periods (SAAE 2010). This situation is made worse by the population's alleged limited awareness of the water scarcity situation and the worst prolonged drought seen in the last decades.

The water scarcity in the Alto-Tietê Basin can also be considered a quality issue, as many water bodies have become too polluted for public consumption. Lack of sewage treatment is considered the main source of contamination. Nevertheless, since 2008 the SAAE has invested heavily in sewage treatment and plants. In 2011, 82% of the population had access to the system of sewage collection, while the municipal plant treated 35% of this collected sewage. By 2017, it aims to treat 80% of sewage (SAAE 2013). These new goals, and recent progress in terms of sewage treatment, show a shift towards a more comprehensive approach to water, that includes notions of water as a social and socio-ecological good. Moreover, the Municipality is entitled to make decisions on land use, which indirectly influence water quantity and quality. They are also responsible for the micro-basins and areas of springs within their territory. Urban drainage and local environmental issues also fall under Municipality jurisdiction, but are shared with the Sao Paulo State government.

The Environmental Department of Guarulhos develops the Municipal Environmental Policy together with the other municipal departments, and with the participation of organized civil society through public hearings and consultations. It also promotes environmental education activities, raises funds for environmental projects, contributes to the municipal master economic plan bringing an ecological perspective. It is also involved in the municipality's protection of areas of springs. It approaches water as a socio-ecological good. A number of other municipal departments are relevant for water governance, such as the Departments of Urban Development and Housing, because of the high levels of urbanization of Guarulhos, the lack of adequate housing and the large proportion of the population living in areas at risk. Moreover, Municipalities do not allow water and sanitation companies to connect houses in irregular settlements to the public network. Therefore, to a certain extent, housing policies determine service provision in poor peripheral neighborhoods.

In cases of floods or other disasters, the Civil Defense of Guarulhos is in charge of basic provisions and safety measures by coordinating and supervising civil defense, maintaining and updating information, elaborating and implementing programs and projects, providing budgets for assistance actions, conducting trainings, arranging the

distribution of supplies and proposing the enactment of emergency and public calamity situations.

In addition to the municipal institutions of water management and sanitation, there are other state actors involved in these matters. The DAEE (Department of Water and Hydropower) is the state body for water management and implements the State water resources policy. The DAEE addresses water resources —both surface and ground water— in terms of quantity and it grants water use permits. The DAEE also undertakes studies, projects and work related to macro-drainage and flood control. It is responsible for the governance of the Tietê River and carries out projects such as the dredging of the river and the Tietê Linear Park. The DAEE approaches water as an economic good.

The CETESB (São Paulo State Environmental Agency), created in 1968, controls, supervises, monitors and licenses activities that could cause pollution. It also develops environmental education projects with the objective of increasing participation and awareness among citizens. In addition, CETESB conducts licensing activities involving the cutting of vegetation and interventions in areas of environmental protection. The CETESB works with municipalities as this cooperation facilitates licensing and pollution control. It approaches water as a socio-ecological good, describing its agenda as one of environmental management from the point of view of sustainability (Brandeler van den 2013; 2014).

SABESP (Company of Basic Sanitation of the State of São Paulo) is a government-sponsored, publicly-traded water and sanitation company (51% owned by the State and 49% owned by stockholders), bound to the SSRH, that provides services to 363 of the 645 municipalities in the state of São Paulo (SABESP n.d.). It is the largest in South America, serving around 25 million consumers (Johnson and Kemper 2005: 23). Its services cover most of the MRSP21. The company aims to universalize basic sanitation services by 2018 within the areas it operates in. It is funded through water fees and since 2002 is listed on the stock exchanges of São Paulo and New York.

There is a certain amount of redundancy between actors at this level. For instance, in terms of water quality, the CETESB is responsible for pollution monitoring, largely focused on industrial pollution, while the SABESP monitors water quality in the dams that it uses for water supply. The Office of the Public Prosecutor of the State of São Paulo also monitors polluting activities through specialized departments and it is currently suing SABESP for its lack of investments in sewage treatment.

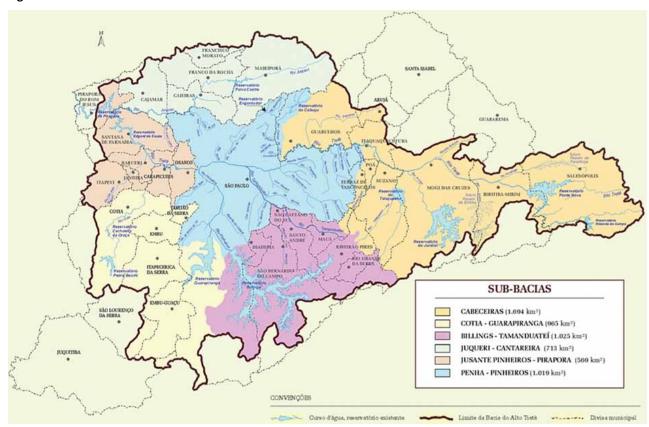


Figure 5: Alto Tiete watershed and its sub-watersheds

Source: 2002 Alto do Tiete Watershed Master Plan

As the production of electric energy for the metropolitan region's 20 million inhabitants represents an important use of the basin's water, the EMAE (Metropolitan Company for Water and Hydropower) is also an important actor. The EMAE is a hydropower generation concessionary in the MRSP linked to the State of São Paulo. It operates a number of hydroelectric plants through dams located south of the city of São Paulo.

States have also established basin committees that are responsible for water resources management within their territory. These deliberative bodies are based on the principles of decentralization, participation and integration. The Alto-Tietê Basin Committee was stablished in 1994 and occupies a central role in water governance as it involves many key actors at different scale levels. The committee is composed of 18 State representatives, 18 Municipal representatives and 18 organized civil society representatives. The DAEE seems to dominate river basin committees.

The Alto-Tietê River Basin is further divided into subbasins with sub-committees that also have a tripartite composition. They have the same attributions as the main committee in terms of water resources management, as well as the responsibility for the regulation and implementation of headwater conservation, protection and recuperation policies at the local and regional level. Guarulhos is located within the Tietê-Cabeceiras subbasin. Although the Water Act defines a unified vision for water governance, the multitude of different actors creates tension between the principles that the basin committees are based on and the principles of their members. In theory, however, when integrating deliberative and participatory bodies, members adopt the approach of these bodies.

Water institutionality in Durban, South Africa

In South Africa the regulation and management of water resources is the responsibility of the national state, while the provision of water and sanitation services has been delegated to water services authorities (WSA's), which in most cases are local municipalities. The eThekwini Municipality is the administrative entity that governs and manages the city of Durban. The eThekwini Water and Sanitation Unit (EWS) within the Municipality is responsible

for water and sanitation service provision. The municipality receives water from Umgeni Water, which is an entity that was established by the national government during the apartheid era to provide bulk water supplies within a commercialized framework. At the same time, Umgeni Water relies on eThekwini Municipality as its major client, with the Municipality taking up 85% of its bulk water custom. These two entities are therefore mutually dependent. According to Loftus (2006), this relationship places pressure on the human rights discourse for water provision, as bulk water has been commoditized and brought into the circuits of capital as an accumulation strategy for Umgeni Water.

In 2002, the National Municipal Demarcation process in South Africa led to the reconfiguration of municipal administrative boundaries. This process was part of postapartheid spatial restructuring which created wall-to-wall municipalities that were designed to reduce socio-economic inequalities by spatially integrating underdeveloped and poor rural hinterlands with better-resourced cities and towns, allowing for cross-subsidization. This process led to the formation of the administrative area of the eThekwini Municipality, adding 67% more land to the city, most of which was underdeveloped rural and peri-urban areas under Traditional Authority (see Figure 6). This has added 75 000 rural households, 60 000 of which did not have access to basic services to the city.

The division between the urban core and rural hinterland of the Municipality is encapsulated in the concept of the Urban Development Line (UDL), which is spatially represented in maps that inform policy making and development in the Municipality, such as the Spatial Development Framework for eThekwini. The UDL defines the urban and rural development zones of the Municipality (see Figure 18). The purpose of this concept is to promote a more compact, efficient and sustainable urban form, as it demarcates the spatial limit of development according to infrastructure availability, and it protects agricultural resources and environmental services in the rural periphery upon which many households rely. Water and sanitation provision in the Municipality is provided using a spatially differentiated service provision model where those living in the rural periphery receive a different level of services to those in the urban core as a result of the history of underdevelopment, the lack of bulk infrastructure, the high cost of service provision, lower densities and the steep topography in the periphery.

The unequal provision of services has been "rendered technical" and can be defended using the spatial logic that has been presented above. This discourse of 'spatially differentiated service delivery' is well established in the

Municipality and has become institutionalized, even though it is contested by some civil society organizations and community based organizations, as well as other municipal sectors. It has therefore become embedded in the development of the city and, hence, is a discourse not only about service delivery but about broader development as well.

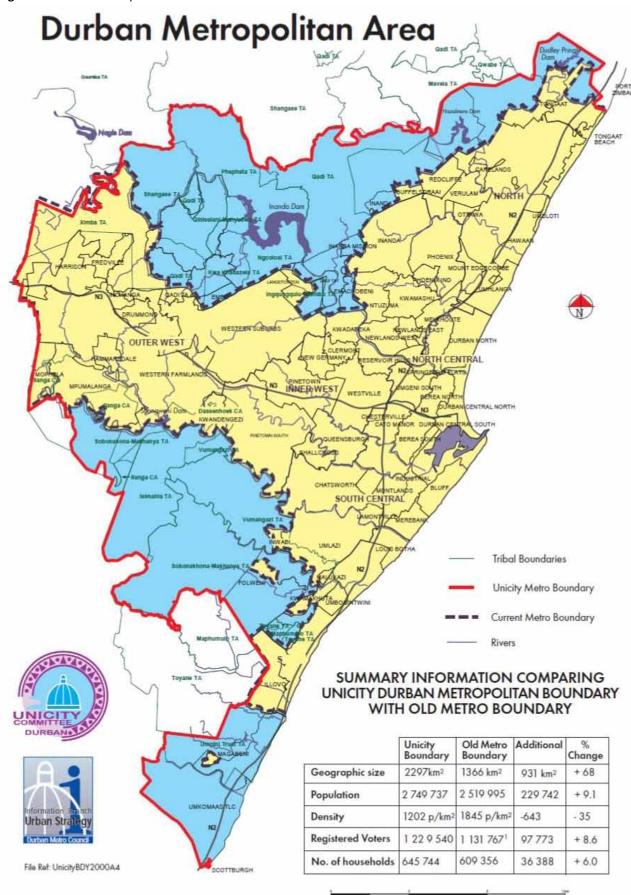
Recently a new discourse has emerged namely the discourse of 'experimental governance and incremental learning'. EWS, under the leadership of its Head, Neil Macleod, purposefully adopted a flexible policy framework to ensure adaptability in service provision and the room to maneuver. Consequently, water governance in eThekwini Municipality is flexible and adaptive in terms of both process and practice. The organizational culture of EWS has developed around an openness towards learning, support for experimentation and a lack of fear for being innovative and learning from mistakes. This type of organizational culture is important as it develops confidence amongst EWS officials at all levels to open up the space to discuss, amongst different actors, critical water and sanitation challenges.

Water institutionality in Dwarka

Dwarka not only reflects a number of challenges relating to institutional water management faced by the state city of Delhi but also the disadvantages associated with being a new sub-city. Water in Delhi is managed by several agencies at different levels, which are responsible for the supply and availability of water throughout the city. Delhi Jal Board was created in April, 1998 through an Act of the Delhi Legislative Assembly integrating the Delhi Water Supply and Sewage Disposal Undertaking under one body. Besides being responsible for the treatment and distribution of drinking water from surface water (Yamuna River, Bhakra Dam, Ganges Water) and groundwater, the Delhi Jal Board is also in charge of sewage treatment and disposal of waste water. Chief Minister of Delhi is the chairman of the Delhi Jal Board. Equipped with the powers of the capital city, the Delhi Government through the Delhi Jal Board, has been able to shape the discourse around Delhi's water crisis in such a way that Delhi's water crisis is predominantly understood as a demand-supply gap, and hence main emphasis is frequently laid on creating new sources of water and building new dams and related infrastructure.

Even though, the Delhi government has taken initiative to involve Resident Welfare Associations for local participation for water management under the Bhagidari scheme with Delhi Jal Board, it has yet to bring fruitful result at the local level. Most of the rainwater harvesting

Figure 6: Durban Metropolitan Area



Source: Durban Metropolitan Council (2000)

systems either do not work or people are unaware of such things. While Delhi Jal Board (DJB) is the sole government agency responsible for meeting water demands of the city, numerous other agencies deal with water for different purposes at various scales. DJB supply treated water in bulk to the New Delhi Municipal Corporation (NDMC), Delhi Cantonment Board (DCB), and Delhi Development Authority (DDA) which are responsible for the distribution of water within their own territories. The provision of water in the areas under three Municipal Corporations of Delhi (North, south and east) is the responsibility of DJB. In Dwarka water is supplied by DDA, DJB and many other pirate actors including private tanks and packaged drinking water suppliers. The reason behind highly fragmented provision of water supply in the sub-city is associated with lack of accountability and inadequate capacity of DJB to supply water to the sub city. Since a larger part of Delhi fall under water demand area (map a), there is less hope for Dwarka to be a priority area at the city scale. Map B clearly shows that the plan to increase underground reservoir area in Delhi from 2011 to 2021 affects less to Dwarka then its peripheral areas. A significant population in Dwarka also depends on ground water, the matter relating to which are mainly addressed by the Central Ground Water Authority (CGWA) and Central Ground Water Board (CGWB). Other institutions that have a say in water related policy and implementation in the city include Delhi High Court, Delhi Disaster Management Authority and Central Public Works Department (CPWD). Diverse priorities among these organizations and lack of common action plan affects the delivery of services and management of various issues relating to infrastructure and hazards. Apart from the government, various nongovernment organisations and private sector are also engaged in the provision, development and maintenance of water supply in Delhi and thus in Dwarka, some of which are shown in the following figure 7.

Water institutionality in Chennai, India

The physical geography of Chennai in Southern India makes for a contradictory relationship with water. Lying in the coastal rain shadow of the Western Ghats mountain range, Chennai suffers both from heavy monsoon rains and droughts, despite a higher than average annual rainfall. As a flat, low elevation coastal zone, there is little natural gradient to encourage runoff, causing urban flooding from rain as well as risks from storm surges. How the different urban configurations are positioned in relation to these material realities, shape the discourses and institutional arrangements around water governance issues, primarily regarding water scarcity, flooding, or the combination of both.

Whilst the scarcity of water is undeniable, the overwhelmingly hegemonic discourse is about increasing supply to meet the demand as opposed to reducing consumption or redistribution of endowments. The Chennai Metropolitan Water Supply and Sewerage Board, the main parastal water company (hereafter referred to as Metro Water), turns to large infrastructure projects: Chennai has two large desalination plants, with two more in the planning stages (Lakshmi 2014), as well as a large transboundary pipeline bringing water from the Krishna River basin over 250km away in Andhra Pradesh. Whilst increasing water availability, these solutions attempt to address the problem from a purely technologicalmanagement perspective, remaining costly and relatively inefficient, without addressing wasteful consumption patterns, leakages and unjust distribution.

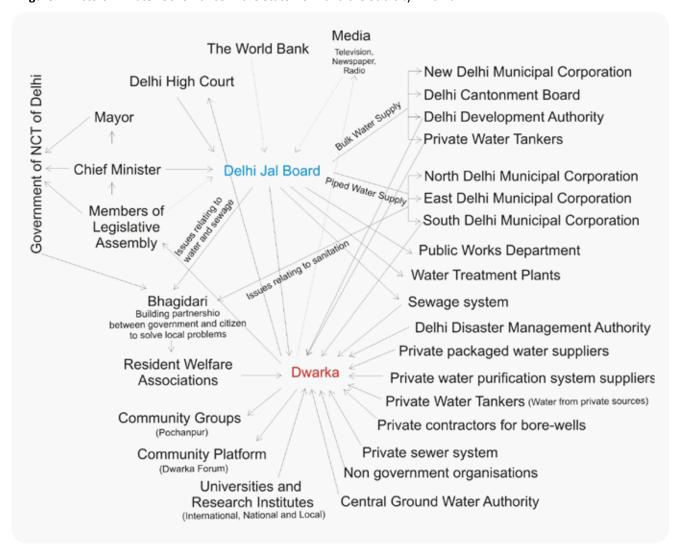
The discourse of increasing supply also manifests in skewed distributions of water by private water tanks bringing in water from peri-urban well fields. The drought of 2004 meant the private packaged water market boomed, but the Ground Water Act meant to preserve water sources is not enforced, resulting in an unregulated market and a downward spiral of over extraction as urban residents becoming increasingly more dependent on private water sources (Roumeau 2012). This distributional injustice skewed in favour of urban residents, marginalizing rural farmers who no longer have enough water into their fields.

Increasing water supply is a politically sensitive issue and thus the action is double-pronged; since 2004, the state government instituted a Rainwater Harvesting (RWH) Lawmaking RWH mandatory for all houses. The responsibility for set up and maintenance lies with the individual homeowners, and the only enforcement is when municipal services need maintenance.

Metro Water has created an enormous advertising campaign to save water. It certainly has increased awareness exponentially and groundwater sources marginally, the maintenance is limited and does not address the systemic issues of consumption. Having RWH structures are often only performative for compliance with the law, though the personal benefit of adequate RWH is not always internalized nor the efficiency maximized. In this sense, the RWH law shifts responsibility to the people under the guise of participation of 'a people's movement'.

The main vehicle for this people's movement is the coalition with the main RWH NGO in Chennai, the Rain Centre, functioning as a RWH education centre and hub for networks; funded by Metro Water, all RWH articles in the newspaper direct individuals with questions to the Rain

Figure 7: Actors in Water Governance in the State Delhi and the Sub-city Dwarka



Centre, not Metro Water. It functions as the office for the main frontman for RWH in Chennai, who other activists can connect to on a personal level.

The distinction between scales is pronounced; RWH is mandatory for personal homes, but nothing is said of the streets. Though storm water drains have RWH structures before the opening, these are often blocked with debris or overlain when repaving the roads, and do not take into account spatial differentiations of geology (which would determine the depth of the pits). At the macro scale, the water megaprojects are constructed as simple solutions and the realm of contractors, whilst RWH is relegated to the micro individual scale.

The distinction echoes divisions in sources of knowledge; in the IT hub that is Chennai, the reliance on technological

megaprojects and private contractors (Kennedy and et. al 2014) is at odds with the traditional, simple technologies of holistic water management. At the individual scale, the Rain Centre and activist individuals advocates for a return to traditional dug wells and grey water segregation for a holistic and efficient self-reliance through decentralized water management (Ragade 2005).

However, macro level RWH traditionally manifests as a dual RWH and flood control mechanism of an extensive network of connected seasonal water tanks called erys built in the 13th century (Mukundan 2005). These tanks' primary purpose is irrigation, with flood control as secondary, accentuating natural depressions in the flat landscape to store and recharge water. With the decreased relevance of agriculture in an incredibly dense city, the dry lake and tank beds in summer are high temptation for

encroachment as 'free land'. The tanks were also actively pushed to be filled in with concrete by the World Bank in the 70s as land for development.

Today, the urban flooding as a result of heavy rainfall is unequivocally 'naturalised' as being the result of 'naturally low-lying areas'; whilst true, it ignores the causes of filling in traditional water tanks and their interconnections which would ultimately lead out to sea. The urban development authority, the CMDA, does recommend the refurbishing of macro tanks in their Master Plan, yet the job is relegated to the Public Works Department (PWD) whose main mandate is drainage and water provision as opposed to the interconnected causes of flooding (Jameson 2014). Particularly, the lasting influence of the faulty British land use classification system which overlooked seasonal land uses fails to respect urban tanks and natural flood sinks (Vencatesan 2006), resulting in rampant encroachment of all water bodies and unclear responsibilities within Metropolitan governance coalitions as to how to stop, prevent and deal with the issue (Jameson 2014).

The dominant discourse is of techno-scientific, civil engineering solutions. Flooding is to be solved by efficient storm water drains. The Corporation of Chennai deals with micro level drains and the PWD deal with the three main macro drains. Together with their private contractors and zonal administrators, these engineers are the primary government coalition around flood management (Jameson 2014). Yet working solely by gravity in a flat coastal plain, they are self-limiting, as well as echoing Metro Water in overlooking socioeconomic vulnerabilities by measuring 'city coverage' as opposed to 'connections'.

The macro water canals, the two rivers and what use to be a navigation channel, but is now a flood buffer and sewer, are the material node assembling different discourse coalitions. Particularly as lower economic groups set up substandard settlements on the banks of the larger rivers in the inner city, upgrading storm water drainage overlaps with the modernization project of 'slum free cities' (Coelho and Raman 2013). In renovating 'their canal', the PWD collaborates with the slum authority to evict encroachers and renormalize them by taking their biometric details. The urban development authority then paves the banks for traffic flow, beautification and prevention of the return of settlers, demonstrating the entanglement of hegemonic discourses.

There are a few voices contesting dominant framings by emphasizing circular water metabolisms and distributional justice, such as NGOs contesting storm water drains and promoting the revival of traditional RWH because storm water drains are polluted and covered in concrete (preventing groundwater recharge), or the independent Centre for Water Resources conducting excellent critical participatory academic research. However, in general these are few, relatively dispersed, and marginalized as being social activists in the realm of technological civil engineering.

Trying to circumvent these discursive blockages, the academic activists recourse to cultivating social capital with individual bureaucrats, grabbing the attention of the media, or through international academic arenas for recognition and spreading their message (Jameson 2014). Still, the uptake of holistic conceptions of water is patchy with few feedback loops, and there is nobody within the private water sector capitalizing on interdependencies between different water providers to strategically improve the system (Roumeau 2012). Meanwhile, demand for water continues to skyrocket, and climate change will only increase the extremity and irregularity of rainfall.

c. Dimensions of water, approaches and discourses

The modern discourse on water has developed over centuries. A significant part of the twentieth century it has been dominated by discourses reflecting an utilitarian perspective, with a strong push of expanding large scale water infrastructure (in particular dams), and a gradual development of the 'modern infrastructural ideal' implying a municipal authority or parastatal providing drinking water and sanitary services through piped networks. Since the 1980s, the construction of dams became more and more contested because of their detrimental environmental and social consequences. In the same decade, a strong push for privatization and increased cost recovery to replace inefficient public service providers was part and parcel of structural adjustment programmes imposed on many Southern countries. From the 1990s onwards the rights based approach to development was given increasing attention, and the 'water as a human right' gained importance. That these different approaches to water can be intertwined is evidenced by the Dublin principles, which define water as a public good (but not yet a right!) with an economic value, and as a finite resource.

In this research it has been proven that every actor and/ or actor network configurations uses different approaches to water, governance, and governance of water. This section revises the literature review of WP 4 document «Water Governance Key Approaches, an Analytical Framework", in which definitions and an analytical framework was presented about water and its governance, the conflicts around them and the perceptions of the actors involved. It developed four approaches around water and its governance, which have been shown to contribute to a better understanding and analysis of the discourses, arguments, mayor preoccupations and interests in every city that has been analyzed.

It is assumed that identifying and understanding these approaches and underlying values contributes to the management of conflicts, leading to consensus being reached for the reconfiguration of water governance, as well as for increasing the capacity of preparation and to address the plausible effects of the scenarios of climate change in the future.

This type of analysis could be accompanied by the theory of mental models, which argues that «mental models act as filters determining which information is actually perceived and how it is interpreted and valued» (Eisenack and Stecker, 2012; Moser and Ekstrom, 2010).

This research has identified and evaluated the opportunities to reconcile different water discourses as well as to evaluate how far they interconnect with cities and development approaches which in turn determine the capacities to build up agreements which may contribute to the reconfiguration of water governance.

Discourse analysis

According to Hall (1997, p44) discourse, for Foucault means: "...a group of statements which provide a language for talking about—a way of representing the knowledge about—a particular topic at a particular historical moment... Discourse is about the production of knowledge through language". A discourse is also defined as "an ensemble of ideas, concepts, and categories through which meaning is given to phenomena. Discourses frame certain problems; that is to say, they distinguish some aspects of a situation rather than others" (Hajer, 1993). Scholars applying discourse analysis deal with the intersection of diverse disciplines. During this research it has been partly used a sociolinguist method (Brown & Yule 2003), "language is recognized as a medium, a system of signification through which actors not simply describe but create the world" (Hajer, 1993) but understanding that "discourses through which policies, associated texts and rhetoric's are articulated, mean much more than language", so, following Atkinson's a particular emphasis has been given to a "second generation" of discourse analysis methodologies that, in part, is unified by a focus on power (Atkinson, et al working document¹¹):

"There are at least three streams of discourse theory that should not be confused. One, deriving from Habermas, is based on the analysis of language structures that mediate social practices. In simplistic terms this approach is based on Habermas' normative project that argues power must be eliminated in order to realise an ideal of 'communicative reason'. In contrast, discourse theory derived from the work of Foucault seeks to understand how institutions condition discursive rules of formation, truth, knowledge and power. From this position power and discourse cannot be separated as discourse is shaped by power and power shapes discourse. In a third stream of discourse theory, Laclau and Mouffe (1985) follow Foucault but problematise his notion of institutions that somehow sit outside of discourse, therefore all social practices, institutions, etc, are products of discourse. They argue that there is no distinction between the discursive and the nondiscursive. In terms of power, all social relations are power relations".

The analysis of discourse was conducted through the interviews undertaken and the social interactions during the scenario workshops which helped to clarify the story lines related to the city and its water related context meanwhile identifying the drivers of changeAdditionally, the analysis of transcribed spoken sample data during interviews and scenario workshops, in some of our cases, contributed to the development of an argumentative analysis for understanding the scenarios, dialogues, interactions and debates. As Michael Billig wrote "to understand the meaning of a sentence or whole discourse in an argumentative context one should not examine merely the words within that discourse or the images in the speaker's mind at the moment of utterance. One should also consider the positions which are being criticized, or against which a justification is being mounted. Without knowing these counter-positions, the argumentative meaning will be lost."

So, this research used an interpretative methodology, from a socio constructivist perspective adopting Hajers's concepts and methodology (Hajer 1993, 1995, 2005) whom indicated that "whether or not a situation is perceived as a political problem depends on the narrative in which it is

¹¹ Theories of Discourse and Narrative: what do they mean for governance and policy?, Rob Atkinson, Gerhard Held and Stephen Jeffares taken from http://eprints.uwe.ac.uk/11394/2/Chapter_6_-_Final.docx

discussed". "In this respect there are many possible realities....a changing perception of the role of language in political life". What Hajer explains is that the political problems are socially constructed". So, discourse production of reality was analyzed, combined with the analysis of the city and key actor's practices from which the social constructs and political problems emerge from where those actors based their statements. As it will be shown, it is not always coherent with their reality.

Additionally the process of discourse structuration¹² and institutionalization has been used as a way to facilitate the reproduction of a given discourse. As it has been experienced, actors who have been socialized to work within the frame of such an institutionalized discourse use their positions to persuade or force others to interpret and approach reality according to their institutionalized insights and convictions.

Hajer's criteria have been used to determine if a discourse dominates:

- Because it dominates the discursive space; that is, central actors are persuaded by or forced to accept, the rhetorical power of a new discourse (condition of discourse structuration); and
- (2) This is reflected in the institutional practices of that political domain; that is, the actual policy process is conducted according to the ideas of a given discourse (condition of discourse institutionalization).

So far, it can be stated that more and in-depth academic research on discourse analysis is needed in the field of action learning-opportunities for contributing to social construction of knowledge as well as learning from social practices and as part of action research methodologies within its connection to policy development.

Water as an economic, social or ecological good or as a sector discourse

As has been confirmed in the revision document on the literature, the identified approach about how water is governed and administrated is influenced strongly by how

12 Discourse structuration occurs when a discourse starts to dominate the way a society conceptualizes the world. If a discourse is successful-that is to say, if many people use it to conceptualize the world-it will solidify into an institution, sometimes as organizational practices, sometimes as traditional ways of reasoning. This process is called discourse institutionalization.

every actor perceives water¹³, within its own right. In the scientific literature and among the involved actors in water governance at least the following four nodal concepts can be outlined:

- Water as an economic good or commodity (water for different types of users: generally mining or electric industry and later households and agriculture) dominating the integrated approach of water resource management¹⁴ with a 'linear' focus on the water trajectory (taking water from sources, using, recycling and disposing it)
- Water as a human right and a social good (prioritizing water and sanitation for domestic use) which can be complemented by other approaches (e.g. the integrated or the socio-ecological approach).
- 3. Water as a socio-ecological good (water, drainage, ecological sanitation¹⁵), incorporating the approach of water as human right with of all living organisms and ecosystems right. A member of this group would emphasize that water (not only fresh water) is a non-renewable and vulnerable resource (and not open for economic compensation), would argue for a holistic and profound ecological vision¹⁶, observing the hydrological cycle as a whole (eg. the metabolism of water).
- 4. Water seen as a sector (water and not always sanitation). It often goes in hand with an approach of water being an economic good and a renewable resource within a technological, pragmatic and infrastructural vision.
- 13 Or only seen as a resource in function from his point of view
- 14 The term water generally refers to the natural element, whereas the term 'hydrological resources' refers to water as an economic good, able to be used by anyone. Like water is not necessarily a source of water if the extent of use is not always economically viable (Braga et al. 2006:1).
- The ecological sanitation is a non-conventional approach about the way of thinking and acting about human waste. It is an approach about the « closed cycle », both about zero-discharges, maintaining the sweet water bodies, and water free of pathogens and nutrients. First of all the ecological sanitation has an approach on ecosystems in which it considers valuable urine and faeces as necessary resources to restore the fertility of the soil and increase the production of food following this human rights approach. Residual water can be of great value for water and the quality of the soil, improving the food security and as a contribution to the ecological transformation of the city (Based on Esrey, Steven, Andersson, Ingvar, Hillers, Astrid, Sawyer, Ron. Closing the Loop, Ecological Sanitation for Food Security (2000)).
- This includes the realization in which water ecosystems have natural limits in which we need to stay.

Furthermore, three different groups are distinguished in relation of the spatial "position", from where do the actors and/or leaders "observe" the water:

- 1. From outside of the city (from a macro- or regional perspective or from a territorial, basin or rural area perspective)
- From within the city (often from the ward level and from there seeing the city as a whole with the rural zones nearby)
- From a multi-scalar perspective (global, macro, regional, territorial, basins, city, ward and vice versa).
 Often in combination with a holistic or eco-systematic approach, within a multi-level governance perspective (central, sub-national, local or community)

Table 5 presents an updated version of the similar Table presented in the WP4 Analytical framework (Miranda et al, 2012) literature review document with the characteristics of these discourses based on their target, main actors, main democracy approach, governance approach, key actor's interaction strategy, management model mainly applied, the territory, river basin, city and/or neighborhood scale or perspective, their technology approach, rationality, professionals' rationality, disciplines, personal attitudes and values and economic valuation.

For the analysis of the discursive practices in the cities studied for Chance2Sustain, their major challenges, central arguments, actors and networks in which they participate in the construction of their respective discourses have been identified. Also, in particular in the construction phase of the scenarios and through interviews, their discursive practices (metaphors, analogies, historical references, etc.) have been identified. Thanks to this, the discurse coalitions¹⁷ which have been formed were identified (Allen, 2013).

This has allowed the research to—with different levels of depth—identify discourses, counter-discourses, themes included and excluded — particularly those referring to climate change -, levels of hegemony of certain discourses and their temporality as well as the position of actors in relation to each other. To finally, although only in a few cases (Lima and Arequipa) also identify the power relations and configurations which emerge based on these interactions.

Thus, according to those who give major importance to any of these discourses, they have classified them within one of the other 'discourses, although in practice every actor – consciously or unconsciously – also used the words and language of the dominant discourses, even though they did not match with their main focus. In the human rights discourse for example, there are cases in which also the vision of water as commodity can be found. In other cases, although to a smaller extent, the rights of other organisms are recognized. Therefore, it is not a 'closed' classification but a synergetic and dynamic one. As Hajer said, "consequently, the political arguments of actors typically rest on more than one discourse at a time" (Hajer 1993).

In this research it has been proven that actors define their capacities to observe and perceive their reality, understanding it and explaining it based on these discourses. This, in turn, influences the capacity of mutual understanding as well as the capacity and level of interaction and networking, reaching agreements and, consequently, acting upon reality in a (non) collaborative form.

Thus, for example, when a sociological expert in social housing, during a meeting in Lima, stated that "there is no problem of water in Lima: look at this photo. There, next to the coastal side are the people who die from asthma or tuberculosis. Those are the problems" (the hills of Lima have been naturally affected by the generation of coastal sides or "lomas" as a result of the humidity of the fog which is present during certain periods in the year). He immediately received a comment of another participant (an environmentalist architect), who stated that: "it is a result of the humidity, which is part of the hydrological cycle of water. The diseases mentioned are respiratory diseases, thus the cause of the problem, isn't it the water?". Thus, actors 'observe' the reality, based on their discourses, disciplinary approaches and mental models. Therefore, where water is perceived as a human right, a right of all living organisms or when these discourses are included in the multi-scalar observation framework in the territory (or just from a neighborhood perspective), linked or not – with the surrounding natural areas, their level of understanding of reality is predetermined.

Additionaly, several actors assume that water is provided "magically" through the taps and is drained without major connections to the origin or final destination. Others are able to observe the hydrological cycle of water as a whole and analyze its interactions and linkages in a holistic form, rather than sectorial only, and include the relation with other organisms and ecosystems.

Thus, although water does not flow only through pipes and infrastructure, a good part of the actors that were contacted through this research, generally engineers and a number of urban residents do perceive it this way. These

¹⁷ A discourse coalition is basically a group of actors who share a social construct (Hajer, 1993)

 Table 5:
 Water governance discourses and main arguments: An analytical framework

Nodal concepts	Brown Agenda	Brown Agenda	Green Agenda	Blue/Brown Agenda
Main concern	Market	Human Beings	Environment, Human and other beings	Sector Mixed
Main Approach	Commodity Economic Good	Human Right Social Good	Human and Ecosystems Right Socio Ecological Good	Sector «pro infrastructure»
Target	Clients Providers Consumers	Users Communities Basic human need	Holistic Ecosystems based	Rural areas, cities and towns Biodiversity
Main actors	Corporate Companies Governments Inter sectorial actors	Local and Sub-national Governments Communities	All beings (human and non-human), peasants, indigenous peoples as well as environmentalists Cross sectorial actors	Users and providers Water Sectors coordination Governments
Main democracy approach	Representative Authoritarian	Deliberative Democracy (DD)	DD including the voice of nature and minorities (eg. peasants, indigenous)	Mainly representative Hierarchical
Main governance approach	Elitist, Monopoly New Public Management (NPM)	Democratic, Participative Mixed, competitive	Inclusive, "concerted" Network, Reflexive Mixed, competitive	New Public Management Corporate Social Responsibility Monopoly
Main strategy	Negotiation Corruption, control Crisis, Conflict management	Dialogue, Deliberation "Concertation" Conflict resolution	Dialogue, Deliberation "Concertation" Consensus Building Transparency	Negotiation, Collaboration Cooperation Regulation, some transparency Win-win strategy
Management Model (mainly)	Integrated Water Resource Management Private Water Boards Public Private Partnerships (PPP)	Public Water Boards Public-Private Partnerships (PPP) Multi stakeholder partnerships	Water Ecosystem Management (inter related with) Public Water Boards Multi Stakeholder Arrangements (MSA)	Integrated Water Resource Management Basin Management MSAs, (but weakly connected with) Public or Private Water Boards
Territory and City (scale	Region, Inter river Basins, City, Neighborhoods and (household)	City and Neighborhoods	Region, multiple basins (urban and rural, cities and towns) coastal and marine areas	Basin, urban and rural, cities companies and towns
Main technology approach	Large scale infrastructure projects	Large to small scale infrastructure	Ecological sanitation Medium/Small to no infrastructure	Large to small scale infrastructure Ecological sanitation (partial)
Main rationality	Prosperity Growth Free markets	Social justice Pro poor water policies	Environmental justice Integrated Ecosystems Development	Pragmatic, any of the rest
Professionals' rationality	Business Management Resilience	Develop capacities Reduce vulnerabilities	Strengthen transformative capacities	Capacity Building of multiple stakeholders

Nodal concepts	Brown Agenda	Brown Agenda	Green Agenda	Blue/Brown Agenda
Disciplines	"Neutral" Scientists Lawyers, Economists and Engineers	Social Scientists, Engineers, Architects, Urban Communities	Pan disciplinary Ecologists and Environmentalists, Urban, Social Scientists	From hydrologists, Engineers to Social Scientists and communities Lawyers and Economists
Personal attitudes and values	Technocrats Bureaucrats	Bureaucrats Commit to change	Advocacy groups Commitment to change	Bureaucrats Technocrats
Economic valuation	Market price Tariffs regulation Polluters pay principle	Tariff Subsidy Polluters pay principle	Non compensable (water has no economic value) Externalities control Payment for environmental services	Tariff Payment for environmental services

Elaborated by Liliana Miranda Sara, Cities for Life Foro

perceptions determines the form in which water is seen and the form of how the actors interact, decide and invest (or not) about the water issue.

Table 6 summarizes the discourses identified into the cases as well as their level of hegemony. Particular attention has been given to the legal status of the 'water as human right' discourse. These discourse dynamics are being analyzed in the next section city per city.

Discourse analysis: the different case study cities

In Lima, in general, central government actors keep applying a dominant "pro-growth" and/or "pro-sector/infrastructural" development discourse (quite consciously). Private sector, construction and real state companies also express in the territory the "pro growht" discourse (city visions) as well as using the "scarcity" nodal concept to justify the "water offer" approach for more large scale infrastructure projects on water to fulfill the "growing" demand. This is a discourse which is being used in policy development in terms of water and land use and occupation (formal and informal) so far in the city.

The Lima Municipality has undergone changes to balance the social differences within a "pro poor" and even "pro life/green" discourse but without undermining the "pro growth" dominance. Their nodal concept focuses on the "water demand" side, advocating for the reduction of water consumption patterns and the more comprehensive understanding of the whole hydrological cycle including the change of water technologies paradigm involving recycling, reuse and even rainwater harvesting.

But, it is not getting enough influence into the water management decision making process.

The SEDAPAL Water Company of the central Government acts as a water monopoly with the preeminence of the Public Private Partnerships but keeping around 1 million inhabitants without water connections and another million with water being rationed, these inhabitants are not getting more than 50 liters per person a day. The unequal distribution of water along the city is justified due to an economic reasoning to be able to subsidize those inhabitants. The sectoral and pro infrastructural approach is dominant within the company staff and directors.

The Rimac, Chillón and Lurin Inter River Basin council is still in the process of formal approval. It has not been able to counterbalance the dominant water approach yet and even has not been able to build up a shared clear water discourse. Yet, the inter river basin council is the only entity advocating for a multiscalar, multisectoral and integrated hydric management approach thanks to the Hydric Resources Law.

Civil society organizations have been advocating both for the water as a human right as well as water as all living beings' right discourse, but those groups have not being able to build up agreements nor a shared agenda to work together and counterbalance the dominant discourse.

The social sectors discourses remain at a partial level or micro scale demands, even the emergence of (still weak) city wide movements: The homeless and the waterless from Lima remain as a pressure group demanding (land) water as a human right, but within an asymmetric

Table 6: Dominant water discourses in Lima Arequipa, Guarulhos, Durban, Dwarka and Chennai

	Approaches and discourses on Water	Water as a Human Right legal status
LIMA PERU	A dominant approach of water as an economic good as well as sectorial Presence of human right discourse and weak presence of the socio ecological one	Water Law No. 29338, 2009 acknowledges water as a human right but no at constitutional level
AREQUIPA PERU	Predominance of water as economic good Presence of human right discourse as well as the socio ecological one	President proposed a Law to introduce it at Constitutional level (2012) not approved yet
GUARULHOS SÃO PAULO BRASIL	Dominance of water as an economic good, sectorial approach, social good and emerging socio-ecological good	National Law on Hydric Resources N° 9433 (1997) acknowledges water as a human right
DURBAN SOUTH AFRICA	Predominance of water as a human right as well as an economic good Emerging water as a socio-ecological good, protecting ecosystems and all living beings	Constitution (1997) provides the right to access to sufficient water for all
DWARKA, NEW DELHI INDIA	Water is increasingly treated as an economic good Increasing influence and growth of private companies	No formal commitment to water as a human right
CHENNAI	Dominance of water as an economic good and a sectorial Weak, but present, water as a socio ecological good	

Elaborated by Liliana Miranda, Michaela Hordijk, Shabana Khan, Catherine Sutherland, John Sydrenstricker-Neto and Isabel Fernandez

interaction with the dominant discourse. There is still a weak participation of the residents in the water debate.

Arequipa has a Municipal Water Company, SEDAPAR acting as a water monopoly with unequal water distribution in the city. It finances the city's waste water infrastructure in a partnership with a mining company (see WP 2 Arequipa case report) to simultaneously also provide water to the mine. This reveals a dominant discourse coalition of water as an economic good in parallel with a discourse of water as a sector. Concerns of residents, citizens and agricultural users were not taken in to account, as they were not informed about and who were excluded from the negotiation process. The discourses of water as human right was therefore neglected in the decision making process. As a result, the mine got the city to pay for their water provision, while almost 44,000 inhabitants do not have a water connection at home.

The Chili River Basin Council, which is functioning but is not yet formally approved by the National Authority of Water, advocates for a discourse of water as a socioecological good. However, this discourse is not able to counterbalance the hegemonic discourse of water as an economic good, which is supported by industrial users and other members of the council.

Civil society and environmental movements, who are not entitled to participate in the council, have the benefit of having the support of the Regional Government. They used to be strong, yet have weakened over the past decade. They have formed a discourse coalition with small scale agricultural users, supporting the water as a socioecological good discourse. The coalition of the dominant 'water as an economic good' discourse has proven incapable of coping with the water challenges in the city, nor with its environmental problems. Yet the coalition promoting the counter discourse has not been able to change the present hegemony.

Concerns about corruption and the fear of water scarcity and its impact on agriculture areas as a result of the public

private partnership between the Municipal Water Company and the Mining Company are de-legitimizing the dominant discourse, which undermines its power, reducing its influence on policy development in the city. Consumer associations from Arequipa are contesting the agreement between the mine and the water company. They legally denounced it and sent it to trial with the argument that the contract is not in favour of city interests and that the negotiations were not transparent. They argue that through the PPP developing the waste water treatment plant the city is paying for the water provision to the mine, with the argument of treating the city waste water (see wp2 case in Arequipa). The mine is getting water pumped up from the city and then, after using it, is sending it back to the river to be used by farmers, being committed to sending it back with a proper water quality. The water company argument is that the negotiations were in the best interest of the city.

Guarulhos: Federal and state laws on water issues define water mainly as a social good but also as a socioenvironmental good. Water as an economic good per se is not incorporated into the law. However, in practical terms the economic good discourse is present, including the sectoral approach which is very much engaged in heavy investments in infrastructure and framing water and sanitation as another consumption product and not as a basic need and universal basic service.

In Guarulhos, these discourses get intertwined and it is very difficult to identify them as operating alone. Due to the left-wing orientation of the municipal administration, even at SAAE the social/human rights discourse is present. SAAE has a specific department and programs dealing with water and sanitation issues in substandard/illegal settlements. At the basin/sub-basin level, the socioenvironmental good has a stronger presence very much due to the scale of operation (large areas) and a more prominent presence of public officials from environmental departments and independent environmental groups (NGOs, academia).

Durban: The eThekwini Municipality is mandated by national government to provide water and sanitation services through EWS. EWS shows innovation through good leadership, has instrumental participation through a system of managerial governance, engages with a wide range of actors including research organisations and NGOs. Two well established discourses, 'the human rights' discourse and 'the water as an economic good' discourse are evident in the municipality, as state officials attempt to address the inequalities of service provision from the past, and supply water and sanitation services to meet the demands of a fast growing city, while remaining financially responsible and sustainable. EWS has shown its commitment to 'the human

rights' discourse by significantly addressing backlogs in water provision post 1994; leading the decision to provide free basic water and by supporting participatory approaches to water governance in the city, albeit using a managerial and instrumental approach. What is interesting in Durban in comparison to the other cities is that water and sanitation provision is not privatized, as it is a state function and that state takes full responsibility for the provision of services, obtaining water from the para-statal entity, Umgeni Water. Tariffs for water are set by the local state and are guided by national legislation.

A third discourse (which is different to all the other discourses identified by this research) has emerged, namely 'the spatially differentiated service provision' discourse, which provides the rationale for the juxtaposition and entanglement of the 'water as a social good' and 'water as an economic good' discourses. This discourse has emerged as the local state grapples with the challenges of addressing large service backlogs; resource and environmental constraints, low densities of housing in the rural periphery and with providing more environmentally sustainable basic services universally across the city.

The discourse of water as a socio-ecological good is starting to emerge in both Durban and the broader uMngeni Catchment as the concepts of ecological infrastructure and environmental services are now influencing water governance in the region. The new uMngeni Ecological Infrastructure Partnership and the research associated with it will shape water governance in the future in this important catchment.

Dwarka has multiple water suppliers with pre-eminence of the Delhi Jal Board (Government) and it has different levels of participation on water management. The water discourse is increasingly treated as an economic good in Delhi and Dwarka. Increasing growth of private companies in the water sector has resulted in a rise in the cost of purified water available to local residents. Some of the government officials also mentioned water as human right, as it is needed for basic survival and thus also available to those who cannot afford to have a personal or regular supply. Recently (early 2014) water has also been declared a human right by the winning electoral candidate, but as residents are poorly organized, this remains a weak discourse. Ecological aspects of water quantity and quality are also managed through different departments focusing on watershed management and central ground water board and authority. So, the nodal concept of Integrated Water Resource Management (IWRM) is present, but they still provide They provide water bringing it from other river basins using long pipe systems and hence there are concerns about equitable distribution. Yamuna River is

being polluted without proper control and overexploitation of ground water is present. The discourse of water as a socio ecological good or a multi-scalar perspective is almost absent.

Chennai: The discourses of water as an economic good and a sectorial approach are dominant in the form of techno-scientific, civil engineering solutions. The main actor is the state government water company, though to meet demand there is heavy privatization through multiple actor arrangements. There is weak participation, other than large scale rainwater harvesting at the individual level through the discourse of water as socio ecological good, which is present but is weak. It appears as a formal discourse for political publicity of rain water harvesting law, yet there is no formal commitment. There is no formal commitment to water as a human right either.

Whilst the scarcity of water is undeniable, the overwhelmingly hegemonic discourse is about increasing supply to meet demand as opposed to reducing consumption or redistribution of endowments. The Chennai Metropolitan Water Supply and Sewerage Board, the main parastal water company (hereafter referred to as Metro Water), turns to large infrastructure projects: Chennai has two large desalination plants, with two more in the planning stages (Lakshmi 2014), as well as a large transboundary pipeline bringing water from the Krishna River basin over 250km away in Andhra Pradesh. Whilst increasing water availability, these solutions attempt to address the problem from a purely technologicalmanagement perspective, remaining costly and relatively inefficient, without addressing wasteful consumption patterns, leakages and unjust distribution.

The discourse of increasing supply also manifests in skewed distributions of water by private water tanks bringing in water from peri-urban well-fields. The drought of 2004 meant the private packaged water market boomed, but the Ground Water Act meant to preserve water sources is not enforced, resulting in an unregulated market and a downward spiral of over-extraction as urban residents becoming increasingly more dependent on private water sources (Roumeau 2012). This is distributional injustice skewed in favour of urban residents, marginalizing rural farmers who no longer have enough to water their fields. Increasing water supply is a politically sensitive issue and thus the action is double-pronged; since 2004, the state government instituted a Rain Water Harvesting (RWH) Law, making RWH mandatory for all houses. The responsibility for set up and maintenance lies with the individual homeowners, and the only enforcement is when municipal services need maintenance.

Metro Water has created an enormous advertising campaign to save water. It certainly has increased awareness exponentially and groundwater sources have improved marginally. However the maintenance of this programme is limited and it does not address the systemic issues of consumption. Having RWH structures are often only performative for compliance with the law, though the personal benefit of adequate RWH is not always internalized nor the efficiency maximized. In this sense, the RWH law shifts responsibility to the people under the guise of participation of 'a people's movement'. The main vehicle for this people's movement is the coalition with the main RWH NGO in Chennai, the Rain Centre, functioning as a RWH education centre and hub for networks; funded by MetroWater, all RWH articles in the newspaper direct individuals with questions to the Rain Centre, not MetroWater. It functions as the office for the main frontman for RWH in Chennai, who other activists can connect to on a personal level.

Brief comparative analysis of the discourses in the cities

Table 5, which focuses on approaches and discourses, reveals that in all cases, except in Durban, water is considered as a commodity with market value, so only those who can pay can have access to it. In Durban, water is considered as a human right and an economic good, and it is now emerging as a socio-ecological good too, as ecosystems and all living beings are being considered in terms of the role their play in climate adaptation and water supply for the city. A free basic supply of water (9 000 liters per household per month) is distributed to indigent households, which results in 93% coverage of water supply across the Municipality. Furthermore, in all cases there is a strong approach to the issue of water from the limited perspective of sanitary engineers and infrastructure development. The social, environmental, production and other aspects are not usually considered.

In this sense, the idea that is being prioritised is the extension of water connections to the whole population through the expansion of the distribution network. Reducing water consumption and recycling is not considered in the management scheme because it does not contribute to the logic of commercial business development and public works, with again, the only exception being Durban.

Most major infrastructural decisions that matter for water supply are taken at national or even corporate level in Peru, because initiatives from the corporations for public private partnerships (PPP), which has to do with the private initiative (i.e. law that gives the private company the right

to propose an infrastructure in Peru), within the argument that the private sector knows better, it is more efficient, mostly from international companies. In Brazil the same thing happens, with the difference that they have better public control system. Privatization of infrastructure provision is therefore most extreme in Peru and Brazil (see Tiete Park WP 2 case), which is different to India and South Africa. In the case of India (Delhi and Dwarka) it is much more the Delhi or the respective State Government, as the Delhi Jal board which makes decisions and in South Africa it is the national, provincial and local government that drives infrastructure development around water.

This research has found that the four discourses of water governance can co-exist in parallel, or become entangled, based on their interactions and relationships. However, this leads to tension, conflict and even contradiction. Although these discursive logics are not static, once any of these is hegemonic, it can become determinant in making relevant decisions and it can function to show and hide critical issues, such as the deep inequalities in distribution, rates and access to water level, or the level of vulnerability to climate change impacts related to water.

We have also found that the discursive logics are very dynamic, often involving the use of double discourse or counter-discourses, which drives the appearance of discursive coalitions between actors which agree or disagree with each other, and developed in the framework of negotiation, coordination, cooperation and even conflict. In turn, this creates, expands or weakens the legitimacy and the ability of these discourses to influence the legimization of the nodal concepts and arguments to be incorporated into policy development and decision-making.

Actors of water governance have different perspectives of an inclusive water governance system. One aspect that characterizes the local water management systems is the lack of transparency. Overcharges to the poorest, commissions to carry out infrastructure works, fees to favor certain users, are some of the forms of corruption. In accordance with the foregoing, there are no sources to record all information concerning water management. In some cases, the information is scattered among various actors and, in other cases, it does not exist or is inaccessible. The strength of the arguments and the level of information (and understanding) determines the level of support that the actors and their discursive coalitions achieve and / or accumulate.

d. Discourse coalitions¹⁸, actor network configurations and power relations

City actors and networks have a differentiated perception and knowledge on water related vulnerabilities and Climate Change. The discourse coalition approach suggests that once a new discourse is formulated, it produces narratives, story lines, with the use of nodal concepts framing a discourse (e.g. on water). This approach uses story lines as a medium through which actors try to legitimize, to gain influence, or to impose their particular point of view of reality about certain issue upon others, and even to suggest, to defend and/or to influence certain positions and practices, and criticize alternative approaches.

"Furthermore, Hajer (2006) points out that in analyzing political discourse, attention must be paid to power relations, institutions and domination".

According to Hajer, the discourse coalition approach thus has three advantages:

- It analyzes strategic action in the context of specific socio-historical discourses and institutional practices and provides the conceptual tools to analyze controversies over individual issues in their wider political context;
- (2) It takes the explanation beyond mere reference to interests, analyzing how interests are played out in the context of specific discourses and organizational practices; and
- (3) It illuminates how different actors and organizational practices help to reproduce or fight a given bias without necessarily orchestrating or coordinating their actions or without necessarily sharing deep values.

To identify and analyze the discourse coalitions "representatives", we have also identified the institutional and organizational practices and strategic actions in place within in the wider political context of each metropolitan city water governance (see Field Work Report WP 4). This has helped not only to define the dominant discourse, but also the discourse coalitions "representatives" or "champions". They could be

¹⁸ According to Hajer (1995) « a discourse coalition is thus the ensemble of a set of story lines, the actors that utter these story lines, and the practices that conform to these story lines, all organized around a discourse ».

individuals, institutions and/or socio environmental networks. The way they interact, coordinate (or not), include or exclude certain actors and build up their relationships in the water governance arena, we have called the "actor network configurations". These configurations are usually the means for discourse dissemination and legitimization for policy design as well as its further implementation.

The actor-network configurations in each study city the water governance arena been identified are shown in the following Table 7.

However, even though these diagrams only show the river basin to metropolitan city configurations, it should be clarified that there is an element of the national

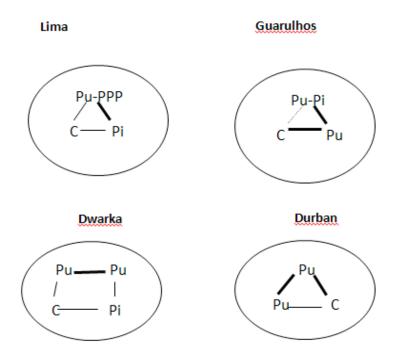
embeddedness of configurations, and the role of private sector at national level. It has being confirmed that the national state does not act alone, as it is shaped by its relation to the global discourses coming via international agencies and private corporations where the private sector influence plays out.

In the cities studied, water configuration models have differences and similarities. In some cases, the water configuration models are entirely controlled by public entities, in others they are under a combination of public and private entities, and at local level, particularly those not connected to the water service, they are held by small private providers in coordination with local communities, with support of civil society organizations and even the academia.

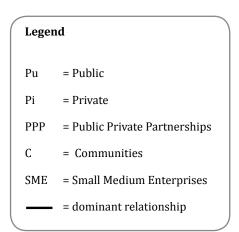
Table 7: Water actor network configurations

City	Configuration per actor type
Lima	Private (PPP) - Public - SME & Communities & Civil Society
Guarulhos	Public-Private (Stock Market)- Public – Communities
Dwarka	Public – Public – Private - Communities & Private
Durban	Public – Public – Communities & Civil Society - Academia

Figure 8: Actor network water configurations diagrams per city: Lima, Guarulhos, Dwarka and Durban



National nor international level of actor network water configurations are not shown on these diagrams, what is shown is the inter-relation within the watersheds or river basin and the cities and neighbourhoods following the water trajectories...





The Geographies of Water and Cities at Risk: Water Vulnerability and Vulnerability to Water Related Climate Change Risks

When we only consider the inequitable distribution of water vulnerabilities as an expression of an unfair allocation of environmental goods and bads, we limit our understanding to the distributional dimension of justice in the liberal, Rawlsian sense (Swyngedouw and Heynen 2003:910; Walker 2012; Schlosberg 2013). Distributive justice reflects the spatial patterns of unequal distribution of water- vulnerabilities within cities, through multi-scalar interactions (certain regions gain at the expense of others), and in the trade-offs between human and ecosystem needs. It is therefore useful in understanding water injustice and the reasons for its particular spatial form. Yet, as Fraser has argued, (1997, 2009) justice is not just about a fair share, the recognitional and representative dimensions are equally important. The recognitional dimension refers to the recognition of (group) differences: some social groups benefit more than others. There are underlying social, institutional, cultural and symbolic conditions determining these differences, and if these underlying conditions that affect the outcome of distributional processes are not understood, we miss out on important sources of injustice. A lack of recognition in turn has a direct effect on peoples' possibilities to meaningful participation. If you are not recognized, you do not participate. Young 1990:23 in Schlosberg (2004: 519) argues that "justice must focus on the political process as a way to address both the inequitable distribution of social goods and the conditions undermining social recognition. Participatory decision-making procedures are then both an element of, and a condition for justice; they simultaneously challenge institutionalised exclusion, a social culture of misrecognition, and current distributional patterns."

The distributive aspect of water justice (or hydric justice (Martinez-Alier, Anguelovski et al. 2014) thus refers to the socio-and spatial distribution of water vulnerabilities and the related risks, the recognitional dimension refers to the extent to which the misdistribution of these water vulnerabilities and the water related risks are the result of underlying social, cultural, institutional or symbolic conditions that affect groups differently. The representative dimension (or "participation" in Schlosberg's terms) refers to the extent to which all people have been able to participate in political and decision making processes that affect the water vulnerabilities and water related risks they are exposed to.

We analyse water vulnerabilities from a hydric justice perspective, encompassing a distributional, a recognitional and representative (or participation) dimension. We have furthermore broadened our analysis to also include injustice inflicted on nature itself. We consequently distinguish:

- Biophysical vulnerabilities, which are linked to characteristics of the natural environment (topography, geology, meteorology) which result in people being exposed to water related risks such as water scarcity and flooding
- Social vulnerabilities are linked to the presence or absence of certain assets (material, financial, human, social, cultural, political), and how these assets are deployed as vehicles for action (Desportes 2013:32)¹⁹. The absence or presence of certain assets results in water vulnerabilities as inadequate housing, lack of or inadequate sewerage and drainage, lack of or inadequate solid waste collection (hence brown agenda issues)
- Vulnerability of nature to what extent is nature itself at risk of water scarcity, the alteration of the hydrological cycle and the consequences thereof for ecosystems (hence green agenda issues).

Vulnerability and risks are socially constructed, and so is the level of risk tolerance of different actors (both residents and actors mandated to address vulnerabilities and risks). What vulnerabilities and risk people identify, and how they weigh a certain water related risk exposure against other

¹⁹ Many definitions of vulnerability focus on the capacity to cope and/or recover Cannon, T. and D. Müller-Mahn "Vulnerability, resilience and development discourses in context of climate change." Natural Hazards: 1-15, Adger, W. N. (2006). "Vulnerability." Global Environmental Change 16(3): 268-281, Füssel, H.-M. (2007). "Vulnerability: A generally applicable conceptual framework for climate change research." Global Environmental Change 17(2): 155-167, Revi, A., D.E. Satterthwaite, et al. (2014). Urban areas. Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. C. B. Field, V.R. Barros, D.J. Dokkenet al. Cambridge and New York, Cambridge University Press. 2.. We would like to add to this the capacities to be pro-active, and to make use of opportunities.

adverse conditions, is affected by knowledge and experience (Slovic 1992; Renn 2008), and by the real choices people have. Another important aspect is at what spatial level people perceive certain vulnerabilities and risks, and to what extent they link these experiences to other levels of scale. In the WP4 case study cities we have mapped both residents and actors perceptions of water related risks and vulnerabilities using various methodologies. In the remainder of this section we will first highlight the major findings on residents and actors perceptions, and then analyse the outcomes from an environmental justice perspective. We furthermore posit that the expected effects of climate change will exacerbate existing water vulnerabilities, but also might create new opportunities because of changing climatic conditions²⁰.

Residents perceptions of vulnerability and risk

Respondents in the neighbourhoods in four out of five²¹ case-study cities identified water vulnerabilities and risks related to biophysical factors, such as heavy rains and the consequent flooding of houses (Arequipa, Guarulhos, Durban), flooding of neighbourhoods because of a combination of topography, risky location and poor drainage systems (Arequipa, Guarulhos, Durban), or water scarcity (Guarulhos, Dwarka and very few respondents in Durban). In Lima residents only referred to social vulnerabilities, namely the pollution of the river (especially through littering), but more important to them, problems stemming from drug addicts and 'criminals' gathering in the dry streambeds, resulting in experiences of insecurity. The risk perceptions recorded in this research were strongly influenced by the choice of the cases. Because the Chance2S ustain project as a whole sought to understand the dynamics and trade-offs between mega-project interventions, social policy and social mobilization and water governance, casestudy neighbourhoods have been selected that were affected by mega-projects. In Lima, Guarulhos and Durban²² this resulted in case-studies neighbourhoods where a number of respondents had to face relocation. This threat of relocation and all the uncertainties with which this was surrounded was much more important to residents than the water vulnerabilities they identified. In Arequipa and Dwarka on the other hand the water vulnerabilities identified were

considered very important overall. Hence: although residents identified similar water vulnerabilities in the case study neighbourhoods, their relative weight is very different: acute in Arequipa and Dwarka and of secondary or even lower importance in the case-study neighbourhoods in Lima, Guarulhos and Durban. Awareness of climate change and plausible impacts on water vulnerabilities also differed considerably: in Lima and Guarulhos residents had little to no awareness, whereas in Arequipa and Durban awareness was relatively high. In Dwarka some residents were aware, others acknowledged they had never heard of it.

a. Residents' Spatial knowledge on water vulnerabilities

Residents provided detailed and fine-grained information on experienced water vulnerabilities at a very low spatial scale. Their knowledge included the precise locationsof risks, and also the secondary and tertiary effects. In Arequipa for instance, the flooding of one of the main roads also implied being disconnected from the city centre, and interruption of the water supply (see textbox 1). The level of spatial literacy differed considerably per case-study area, only in Arequipa residents could locate the risks on a neighbourhood map with relative ease. Hence, that people know in a detailed manner what happens where and with which consequences, does not necessarily mean that they can also point this on a map²³. The exercise turned out to be so difficult for residents in Dwarka that it was even discontinued there. In most cases residents were unable to indicate water vulnerabilities beyond their own neighbourhood, hence they had no understanding of higher levels of scale.

b. Key actors perspectives on water vulnerabilities

Spatial knowledge on water in general and on water vulnerabilities turned out to be dispersed, not shared, and sometimes even difficult to access. First of all issues of lack of access and/or low quality provision of water and sanitation on the one hand, and issues of flooding on the other are dealt with by different entities, and also (surface) water pollution is a mandate of another actor. In some cities official disaster risk or vulnerability maps existed (Arequipa, Lima, Guarulhos and Delhi), though of very

²⁰ Both Durban and Lima are expected to receive more rain in certain scenarios, which might creat new possibilities in these water scarce regions.

²¹ Residents' water vulnerability perceptions have not been researched in Chennai.

²² In Durban various neighbourhoods were researched, also neighbourhoods not affected by megaprojects, to cover the full spectrum of service provision.

²³ In Arequipa we experimented with neighbourhood maps that already had a number of landmarks indicated, this eased the exercise.

Table 8: Most important water vulnerabilities – the residents' perspective

Most important water vulnerabilities – the residents' perspective							
	Lima	Arequipa	Guarulhos	Dwarka	Durban		
Biophysical							
Heavy rains		Х					
Flooding		X	X		Χ		
Drought/water scarcity	Χ			Χ			
Social							
Pollution(X		X	Χ			
Lack of drinking water		X	X	Χ			
Lack of/inadequate drainage			Х	х	x		
Lack of Sewerage		X			XX		
Poor quality drinking water		Х		x			
Cost of water			X	Χ	Χ		
Damage to houses (from rain)					X		
Problems with water infrastructure				Х	Х		
Criminality in river bed	Χ						

Sources: Lewis (2012) on Durban, Brandeler van den (2013) on Guarulhos, Filippi (2012) on Arequipa, Leung (2013) on Lima, fieldwork by Shabana Khan, 2012

differing years, produced by different entities. In none of the case study cities this knowledge was integrated in one map displaying how different water vulnerabilities might overlap spatially. A second problem was that several of these maps were not produced in house, but by consultants (in Lima and Arequipa), hence not 'owned' or 'internalized' by key actors.

Despite this fragmentation the water vulnerabilities experienced by the residents also emerged in key-actors analyses, yet they were perceived in more general terms and at higher levels of scale. Hence key actors recognize water scarcity as a major problem in Lima, Dwarka, Guarulhos, Durban and Arequipa, and also recognize the flooding risks in Arequipa and Guarulhos. Despite this very general convergence between the water problems

identified by both residents and key-actors, there was great variety in the relative importance given to the different problems, the causes identified and the solutions proposed. In many cases this was strongly related to actors' mandates. This became very evident in the case of Arequipa, where many of the actors with city-wide mandates (such as the public water company, municipal actors and employees of civil defence) only mentioned problems at the city level. Only a third of the key-actors interviewed also mentioned problems at the basin level, yet the problems mentioned were directly related to provisioning urban water (sedimentation of dams and reservoirs and inefficient/overuse of water by farmers resulted in less drinking water availability for the city). Actors with a mandate at basin level (such as the water authorities and regional authorities) hardly mentioned

"Water seeks its natural path": Spatially differentiated experiences of water vulnerabilities in neighbourhoods in Guarulhos and Arequipa.

Although situated in a very different climate and topography (respectively in low lying flood plains in a subtropical humid climate and on the other hand Andean mountains in a very dry climate), residents' experiences of and knowledge on water vulnerabilities showed quite some similarities. Both cities had recently experienced significant flooding.

Vila Any and Jardim Guaracy are both located along the river Tietê, yet Vila Any is situated a little more uphill and somewhat further from the river. This difference in location already results in different experiences with and perceptions of water vulnerabilities. In both neighbourhoods residents mentioned water scarcity as a problem, yet uphill residents are significantly more affected by the lack of water as the water in the pipes is too scarce and the pumps not effective enough to bring water to those households. Residents in high locations also pay more for less water as the air in the pipes make their water meters turn.

In both neighbourhoods flood risks are mentioned. The residents of Vila Any (map on the left, border of the neighbourhood in green) mark a larger area as being affected, in more homogeneous terms, and see the heavy rains as the major cause, as well as residents own mistaken decision to settle on the risky banks. It is also clear that they themselves are unaffected. In Jardim Guaracy (on the right, neighbourhood marked in red), residents painted a

more spatially differentiated pattern. Houses along the river are affected, yet even more affected is the low lying central square of the neighbourhood. Here all water gathers in prolonged times of rain, including all run-offs from Vila Any uphill. Consequently, the square floods even faster than the riverbanks. Inhabitants from Jardim Guaracy know that the floods are also caused by inadequate drainage, clogged drains, the opening of the flood gates in

times of heavy rains, and by soil sealing. The latter had even led them to block municipal works to asphalt streets around the main square, which would have aggravated the problem. Residents from Jardim Guaracy furthermore explained that because the sewerage pipes that discharge in the river were placed too low, they experience reflux of sewerage and river water through the pipes and the drains in their houses and in the streets when the river rises. In Jardim Guaracy, residents were also more concerned about the river pollution than in Vila Any.

Knowledge on flood risks did not only mainly come from lived experience – some respondents in Jardim Guaracy reported that their houses had been flooded three times over the last five years - but was also really limited to their direct living environment. This was most marked in Jardim Guaracy. Here there was not only a contrast between those flooded (in the riverbanks and along the main square) and those not, but also between people living in streets

Figure 9: Spatial Perceptions of flood risks in Vila Any (left) and Jardim Guaracy (rigth). The low lying square is marked in red.

Source: Brandeler, van den 2013 : 86

connected by side streets (who could describe what happened in the neighbouring street) and people living in unconnected streets, who did not know what happened in the parallel streets. For respondents living near the low lying square the sewage reflux was by far the most pressing problem. Several respondents in the unconnected streets were aware of the flooding problem in general and mentioned also the clogged drains, but did not consider it a priority problem. We also found that resident's knowledge on climate change is basically absent.

Figure 10: Houses at risk of flooding and sewerage reflux, Jardim Guaracy, Guarulhos, Brazil

Photo: Brandeler, van den



Also the residents in Villa Ecologica demonstrated detailed knowledge on water vulnerabilities. In times of heavy rains the settlement floods because water collects in the stream beds. Residents distinguish between the naturally preserved and artificially filled stream beds. They do not only link the pluvial flooding to a lack of infrastructure, but also blame the neighbourhood leader for consciously covering dry stream bed to be able to sell more plots. This blocked the natural path of water, and thus allowed the litter and trash to be collected and fill the stream-beds. Not all people were aware of the flood risks when they bought their plot. Respondents furthermore emphasised that the recently experienced floods had isolated them from the city when the stream-bed Huarangal (see map) was flooded and could not be crossed. The drinking water provision remained dysfunctional for more than two weeks to a month in some areas, since most public standpipes are located along a main road which is developed on a stream bed. The relevance of their knowledge becomes especially

evident when compared with official (codified) knowledge: Villa Ecologica does not figure among the flood risk areas identified by the Civil Defence of their district.

Contrary to the respondents in Guarulhos, the residents in Arequipa were in general aware of climate change, experienced alterations in the rainy seasons and argued that "the weather was getting crazy".

In both cases residents showed a high level of risk-tolerance vis-a-vis the flooding risks. Despite the discomfort and the acknowledged risk of more serious damage than hitherto suffered, people wanted to stay on the plots they inhabited, basically because they saw it as their only option to acquire a home in the city. They had been living in the area for many years, had invested in their houses, and having this foothold in the city had more weight than the flood risks and their consequences.

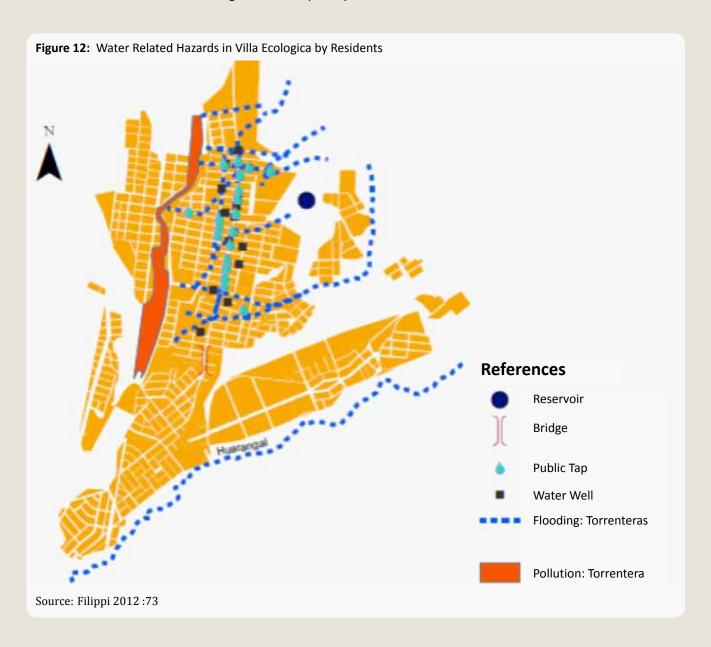


Figure 13: Flood risks in Alto Selva Alegre according to official Risk Map of the municipality Villa Ecologica Source: Filippi 2012: 68

In Chennai on the other hand, in general, there is a complete lack of mapping socioeconomic vulnerabilities. There is no precise mapping of the lack of drinking water connections, only coverage of the city and where households have access, without considering the hours per day that water flows (Roumeau 2012). Flood management is solely relegated to techno-scientific management, based on highly advanced technologies of Airborne Laser Terrain Mapping producing official but highly securitized flood risk maps with a very narrow definition of biophysical hazard based on elevation. The defining of these as risks is the realm of elite knowledges, yet still contestable, as the social and political elements surround the maps within the academics' reports, but get stripped away when shared (Jameson 2014).

There are initiatives for recognizing local knowledges on flood risks and socioeconomic vulnerabilities. One important initiative was the interactive mental mapping exercise of vulnerabilities around the marshland conducted built around the personal relationships between the local NGO CareEarth and the University of Freiburg. They combined PRA methods to visualise community tacit and contextual knowledges about coping with geospatial data. The outcomes followed different strands: freely publishing a flood risk map online (University of Freiburg 2012), releasing an interactive participatory mapping tool online, then publishing an academic paper (Pfeiffer et al. 2008). This particular initiative was taken up by the CMDA and incorporated into the Master Plan of the city as a nodevelopment zone around the marshland, hailed as an enormous success.

Whilst such an instrument is incredibly innovative it is also vulnerable; currently (2014) it is no longer available, for lack of funding, lack of technical capacities in other NGOs, and the individual concerned could no longer take it on board. This reinforces the fact that when the individual champion behind an initiative is for whatever reason no longer then, the initiative falters. Hinging on individuals' initiatives thus depends very strongly on their social networking, and to what extent they have access to decision makers, pointing of the limitations impressed by the potential of transforming dominant narratives.

However, beyond that, to our knowledge there are no other community mapping intiatives nor integrated socioeconomic vulnerability and hazard mappings which can interface between community knowledges and decision—makers. One PhD student calculated economic flood damages and socioeconomic status (Suriya, 2012) and was seen as pioneering and was included in a seminar at the CMDA, yet again the Master Plan recommendations beyond that went unheeded (Jameson 2014).

As a result, the recognition and integration of socioeconomic and biophysical water-related vulnerabilities depends largely on the predisposition of different actor coalitions. Either they recognize the holistic, cyclical nature of water, or they don't; the latter being dominant, reinforced by technical hazard mapping and the increasing multi-scalar privatization of drinking water.

problems at the scale of the city. Only two 'basin actors' mentioned the unequal and insufficient provision of drinking water in the city. City level actors demonstrated a strong sectoral focus, and an orientation on expanding infrastructure as a solution to the demand-supply gap. Although they recognized climate change as a phenomena that would affect water governance, they did not expect it to negatively impact their capacities to provide infrastructural fixes that would allow water imports from neighbouring basins thereby finding a technical solution. Basin actors in turn showed a strong focus on environmental issues such as desertification, deforestation and water pollution. These different approaches also became visible when the actors were asked to locate water vulnerabilities on maps. Respondents from the water company located existing infrastructure, its quality and its deficiencies in the city, whereas basin respondents located environmental concerns at the basin level (see figures 25 and 26 in the annex).

In Lima an interesting knowledge dissonance between water vulnerability and climate change risk perceptions of the key-actors became evident. We contrasted a map developed based on key-stakeholders indications of Lima's water vulnerabilities (Kaiser 2013, see figure 22 in the annex) with a map developed by experts. All actors recognize water governance and climate change as priority issues. However, despite the fact that the majority of the actors interviewed were part of the technical committees on Climate Change of the Municipality of Lima and of the Regional Government of Callao, including the actors that directly participated in the elaboration of the "Plan de Desarrollo Concertado de Lima", and thus are directly implied in the issue, the territorial dimensions at which they perceive the problem are of much smaller dimensions than what is foreseen by external experts. The level of perception, knowledge and acknowledgement of these vulnerabilities is still relatively limited among the key actors. It furthermore varies per discipline, their capacity to perceive the territory of the city, and of course, also varies depending on their experience, their approach to water and development, but most markedly by their interest. Risks for the high income 'green coast' in Lima were systematically underestimated. As in Arequipa, several actors with mandates at local (neighbourhood or district level) in Lima and Callao were not capable of identifying risks at the level of the city or Lima Metropolitan area, they were not capable of observing the city in its totality, and even less of perceiving what happened in the upper levels of the basin. They have no knowledge on where the water from their tap is coming from. There were only very few actors capable of understanding the interactions between various territorial scales and governance levels that are essential in managing water.

Taking the plausible consequences of climate change into account turned out to be even more difficult. The understanding and acceptance that water availability might be reduced because of droughts is not accepted, that water might be overexploited is also not taken up. There is a clear negation and disqualification of the water related climate change risks the city has to face. Those heavy rains might generate serious risks of flooding in the city, or flooding of rivers causing mudslides and flash floods apparently are difficult to understand and accept for many of the actors.

In the other case-study cities similar patterns emerged, with actors responsible for drinking water provision mainly referring to deficiencies and inefficiencies of water infrastructure, and relying on expansion of infrastructure to fix the problem. Actors with a basin level responsibility (such as the Upper Yamuna river board in India) could also see other environmental concerns.

Also in Guarulhos actors with a mandate related to provisioning (such as the municipal water company SAEE, SABESP (bulk water provision and providing water to 363 municipalities in the state of São Paulo) and DAEE responsible for major infrastructure) focus on infrastructure and provision, and perceive vulnerabilities mainly in terms of water scarcity, and the consequences of very serious water pollution for drinking water availability. But as indicated earlier, in Guarulhos the key actors have incorporated elements of other approaches to water over time, and therewith also have a more integrated vision of different water vulnerabilities. Awareness of Climate Change is quite low, even among key-actors. There is a general recognition of the phenomenon, but it is perceived as a distanced risk, with little direct impact, and is not taken into account in daily activities. The only exception is that respondents expect the problem of heat islands to become worse.

Durban/Ethekwini presents a particular case. As mentioned earlier there is no functional governing body at river basin level, which leaves even more room for municipal actors to pursue their policies. There is a strong recognition of the backlog in service provision, and an equally strong recognition of threats to ecological sustainability, and the importance to sustain ecologically fragile ecosystems which can perform a buffer function to cushion the effects of climate change. Water vulnerabilities related to a lack of provision are mainly brought forward by the Ethekwini Water and Sanitation Department EWS, whereas the ecological concerns are strongly voiced by Environmental Planning and Climate Protection Department EPCPD. There is a strong knowledge base underpinning these water vulnerabilities perceptions, in

which spatialized knowledge has become very important. EWS was an early adopter of the Geographic Information Systems (GIS) to guide their infrastructural decisions. It has a strongly developed GIS database, and already in the early 2000s used GIS based surface cost models to determine the costs of infrastructure development in different locations in the municipality. EPCPD used GIS to map Durban's open spaces Durban Metropolitan Open Space System (D'MOSS) and has later calculated the value of the environmental services these open spaces provide (see for a number of maps underpinning the spatially differentiated provision the figures 29, 30 and 31 in the annex. Interesting to note is that as a consequence of the prominence of the municipal GIS data base, almost all maps only represent the municipal territory. It was very difficult to acquire maps of different river basins. This might change with the recent initiative of forming the uMngeni Ecological Infrastructure Partnership (UEIP), which aims to improve environmental quality in the uMngeni catchment.

c. The outcomes of water governance processes assessed along the lines of justice

Distributional Justice

All case study cities confirm the trend that biophysical and socio-economic vulnerabilities are intertwined and are spatially concentrated. In Lima, Guarulhos and Arequipa this is because the most risky areas, unsuitable for urbanization, are inhabited by the poor. The most extreme case in this respect is Guarulhos, where a vast part of the territory is considered unsuitable for urbanization, either because it contains spring areas which are protected, the sites are too steep and suffer heavy rains and mud-slides, or because risks of flooding are too high. These are the sites where the favelas are located (see figure 27 and 28 in the annexes). Spatial distribution of water related vulnerabilities equally match poverty levels in Lima and therewith reflect distributional injustice. In Lima poverty is concentrated in the peripheral districts that are a result of waves of invasions since the 1980s. When the suitable, flat areas had been filled up, people started to invade the steep slopes of the Andean foothills. In these areas water and sanitary services are much more difficult to provide because of steep and rocky terrain, hence in these areas most of the limeños without water connection are to be found. At the same time the hillsides are the most vulnerable to mud-slides. Although these are very rare in Lima because of the very dry climate, it can happen that all of a sudden rain pours for a few hours - as in 1970 - and in case of these extreme events houses at the slopes and in the steep river sides are most at risk. Comparing spatial distribution of risk levels and poverty levels in Lima shows a strong overlap (see figure 24 in the annex). Both in Lima, Arequipa and Dwarka, the residents not connected to the formal water system pay considerably higher prices than those who are connected, confirming a general pattern of water injustice (Budds & McGranahan 2003; Bakker 2010), and likewise as a general trend in all cities poor households consume less water than rich households. This is either because they receive a different service (Durban, Dwarka, Arequipa, Chennai), or because provision is rationed (Lima, Guarulhos, Dwarka) and limited to few hours per day or even per week. It should be noted that both Durban and Lima use a 'social water tariff', basic provision is free (Durban) or cheaper (Lima) than higher levels of consumption. In recent years the scheme of free water provision up to 20 litres is also implemented in Delhi, but Dwarka did not benefit much from it and a larger proportion of households still do not have metered water connection from the Delhi Jal Board. These social tariffs are a typical example of addressing the symptoms, and not the underlying causes of injustice, as they ensure "affordable access to water" but they do not address it causes. And when assessed in relation to prices other uses pay for water, flagrant injustice may come to light. In Peru for instance large scale users as the mining companies are charged between 0,09 and 0,27 cents (Peruvian Sol) per cubic metre, whereas unconnected residents dependent on private providers pay up to 12 soles per cubic metre, up to 130 times more than the mining companies.

In Durban the justice of the spatial distribution of water and sanitation is contested. As indicated earlier in this report the Ethekwini Water and Sanitation (EWS) Unit has developed a spatial discourse on service provision in an attempt to reconcile the discourses of 'water as a social right' and 'water as a commodity'. The essence of this approach is that depending on where people live, they will receive a different kind of service provision. Domestic water connections and flush toilets are provided predominantly within the "Urban Development Line". Outside this line this level of service provision is costly and its implementation is challenging due to low housing densities (which are rapidly densifying) and the steep topography, hence in the rural periphery of the city people are provided with alternatives that do guarantee free basic water supply and ensure access to basic sanitation (water as a human right) but at affordable costs (water as a commodity). The alternative services, such as dry toilets, are also considered an ecologically sustainable model to preserve the vulnerable rural ecosystems, to protect the buffer zone that can absorb the expected effects of climate change. Through this approach of differentiated service provision Ethekwini has

managed to substantially reduce its back logs, and to provide all inhabitants with a basic free water provision.

The spatial differentiation of services however happens to coincide with existing racial and class inequalities. Several sections of the 'urban development line' (see figure 14) coincide with what in the apartheid past was the boundary between the 'white' city of Durban and the homeland of KwaZulu, where the black population lived under the homeland policy. There are many informal settlements along the UDL, now qualifying for communal ablution blocks. The vast majority of the rural population is also black and poor. Critics have therefore coined this policy of differentiated provision 'water apartheid', and they consider it a policy of injustice. Others have raised the question whether the focus of service delivery is on costrecovery or on social and environmental justice. It is clear however, that in Ethekwini Municipality the unequal distribution of water and sanitary service is a conscious policy, resulting from the attempts to provide universal services across the Municipality, rather than higher levels of services to a few (see WP4 Durban Fieldwork Report for more details).

In the planned city of **Dwarka** the water provision landscape is even more fragmented than in Durban. Here the kind of service provision is not linked to spatial location, but linked to the type of housing. As DDA planned Dwarka, it carries the responsibility of water supply to all DDA housing. Subsequently water is available for 24 hours in these societies. The Cooperative Group Housing Societies, which are the largest housing systems in Dwarka are left to manage their own water. Most of the societies depend on private water tankers and packaged drinking water supply and hence pay the highest cost for water. Many of these societies also depend on ground water for

their need, which is illegal and from time to time they get notice from the government to ban its use. Delhi Jal Board water connections are available in resettlement colonies and unauthorized areas. These areas receive minimum amount of water as compared to other housing types. They go through much hardship when there is infrequent water supply because in such a situation they need to pay the cost to buy water or stand in long queues for water outside DJB ground water tanks located in the area. DJB also supplies water to urban villages through weekly water tankers but only for drinking purposes. For other uses, villagers depend on ground water, which is highly saline and unfit for consumption. In plotted developments, which represent individual housing societies, people depend entirely on ground water for their basic needs. As many of these areas have been recently built or are still under the process of construction, the quality of water is relatively better than other urban villages where ground water has gone below the normal or required depth to maintain its quality and hence it contains a very high level of total dissolved solutes (TDS). It is important to note that whereas in Durban/Ethekwini the spatially differentiated service provision is an outcome of a conscious policy, in Dwarka it is the consequence of failed provision. It results in a highly differentiated service provision that spatially illustrates the splintering urbanism thesis at a lower level of spatial scale than its theorists (Graham & Marvin 2001) could have ever imagined.

Hence, from a *distributional* perspective it is evident that in our case study cities the poor lose out. Social vulnerability are spatially concentrated, the poor suffer more from water related vulnerabilities, and are provided less or lower water provision services. These vulnerabilities are however recognised in most case-study cities, and the cities have policies in place to address these vulnerabilities

Table 9: Different levels of service provision across Ethekwini municipality

Area	Standard
Urban service standards for areas within the urban development line (UDL)	Urban Service Standard: Full pressure house connections; Waterborne sanitation; Electricity connection; All weather surface roads
	Communal ablution blocks (toilets and showers) within 200m of served households; Electricity to every dwelling; High mast lights for security; Emergency access roads for waste removal, fire and emergency vehicles
Rural service standards for areas outside of the urban edge	One ground tank per household supplied with 300 litres per day; Urine diversion toilet; Electrification only of densely clustered pockets; All weather surface on all public transport routes and roads within communities with a density of more than 15 persons per Ha

Source: eThekwini Municipality, 2012

ETHEKWINI MUNICIPALITY Urban Development Area Hazelmere. Tongaat lnanda mdloti Kwamashu Umhlanga Rocks Lower Langetontein to Ridge Hillcrest Durban Pinetown Queensburgt Jmbumbulu Isipingo Amanzimtoti Legend Urban Development Line (UDL) Kingsburgh Main Roads (N2 & N3) Waterbodies Main Rivers Umgababa Urban Settlement Formal Urban Settlement Informal Peri-Urban Settlements eThekwini Municipality Umkoma as Coordinate System: WG31 Projection: Transverse Mercator Datum: Hartebeesthoek 1994 Authors: Claudia Meyer and Marco Mazouzi

Figure 14: The different settlement areas and the UDL within the eThekwini Municipality

Source: Meyer 2013

(recognitional justice), although the actual implementation of these policies may lag behind (Lima, Arequipa, Durban), or even does not address the most pressing issues for residents.

In terms of representative justice - defined as participatory decision making processes that address the institutionalised patterns of exclusion – we have to conclude that the most vulnerable are not included in decision making processes regarding the services, the service level or the prices that are set for them, nor are they part of the decision making processes meant to reduce their exposure to water related (climate change) risks. The most flagrant example in this study was provided by the residents in Guarulhos, who were only in a very late stage informed about the decision to relocate them, presumably to mitigate flood risks. In 2011 they were informed, without any prior consultation, that this would happen to them without any further indication of what this might imply. Until the date of this writing (July 2014) no action has been taken, nor has any new information been provided. Also in Lima residents experienced that their risky location was used as an excuse for relocation, of which they were also only informed after the decision was taken. This pattern of excluding the affected from decision making processes and notable lack of even properly informing them, confirms the findings of the planning and implementation of mega projects in other Chance2Sustain cities (see WP2 final report).

Whereas forced relocation on the pretext of risk exposure illustrate the strongest cases of representative injustices, the more vulnerable segments of the population are also excluded on a more daily basis. The river basin councils that form part of the water institutionality in Brazil and Peru do not provide citizens the platform they need. In Peru urban residents or their organizations are not entitled to participate, in Guarulhos there are many barriers to active participation (Brandeler van den, Hordijk et al. 2014). In most cities residents have little possibilities to even voice their dissatisfaction with the lack of services (be it drinking water, sanitation or proper drainage) provided. Durban once more forms an interesting exception, where user fora have been set up to get user feedback on service provision. The municipality has also instituted 'eThekwini Sizekala Centres'; 'one-stop' centres that are located across the city where citizens can register service related complaints. Citizens can interact with these centres by visiting them, calling them on a telephone hotline and toll free number, sending sms's or emailing. Officials in the Sizekala Centres argue that it is important to address public concerns about service provision on an individual basis so as to ensure

customer satisfaction and avoid social protest (Sutherland et.al 2013). Elsewhere we have argued that this exemplifies a managerial, instrumental form of participation (Sutherland et.al 2014), which has little to do with the 'participation in decision making processes' essential for representative justice. In Dwarka it is difficult for citizens to know who to turn to to complain about failing provision, and participatory processes of decision making are absent.

Water vulnerabilities and the rights of nature

In terms of 'distributional justice' infrastructural interventions can have serious implications for ecosystems elsewhere. The environmental (and social) consequences of the alteration of local water cycles because of large scale hydraulic works are widely documented by for instance the world commission on dams (World Commission on Dams 2000). Hence, although the share of water needed for urban drinking water provision is low when compared to other water uses such as mining, agriculture and hydropower, the consequences for ecosystems can be substantial. The most blatant example of this are the consequences of the hydraulic infrastructures that bring water from the Amazonian basin to the other side of the Andean mountains, leaving several ecosystems in the headwaters of the river Rimac (and the peasants that depend on them) without water. "Nature's right to water' is not respected in these cases. Also the overexploitation of ground water bodies in all case study cities (except Durban, where groundwater is less used) can be considered a violation of nature's right to maintain its integrity.

The deterioration of ecosystems is often recognized, though not interpreted from a 'distributional justice' perspective. In that sense one could argue that there is a certain element of recognitional justice. Yet most often the harmful consequences are assessed from a utilitarian perspective: what does ecosystem deterioration imply for the sustainability of mankind (future generations). And although recognised in principle, and translated for instance in trying to regulate exploitation of water bodies by assigning water rights to different uses, as well as obligations to for instance ensure minimal environmental flows in rivers, such agreements are often not monitored sufficiently. The 'buen vivir' concept, in which nature's inherent rights to sustain itself are taken up, is a clear exception, and this concept has been gaining strength in Latin America over the last decade, as mentioned in the introduction, but this is still mainly a counter discourse.

Table 10: 'Splintered service provision': different levels of water provision and water pricing in Dwarka

Housing type	Ownership	Socioeconomic status	Water provision	Price (in rupees)	Water quality
DDA	60%	middle to high income	DDA supplies water to tanks. Water availability is for 24/7	150-1000	Poor water quality, use individual RO purification
CGHS	90%	middle to high income	Mainly private tankers supplying housing association tanks, so water is available for 24/7	500-5000	Poor water quality, salty, use RO purification
UA	100%	low to middle income	In house piped supply from DJB 2 hours a day. 40% mention water scarcity	200-600	Use basic filters (lower quality) for water purification. 40% respondents did not purify
Urban Village	90%	low to high income	DJB water tankers supply drinking water once a week. Water from other uses comes from groundwater	250-2000	drinking water of good quality but insuffcient. Ground water very bad quality and saline
Resettlement Colony	90%	low income	In house piped water supply from DJB for nearly 2 hours. Irregular supply causes stress, diseases and scarcity	75-600	Poor. In case of irregular water, the residents have to buy drinking water which costs from 20-60 Rs per day.
Plotted Development	70%	middle to high income	private bore wells and only a few are connected to DJB	0-400	60% perceives water to be good quality, no need for purification. Many of these residents though do not pay for water, but they pay a high price for electricity that reaches up to 5000Rs per month in some cases.

Source: Based on field survey in 2012



Scenario Building as a Social Construction of Knowledge Process

The use of scenario building process has been prevalent since the 1950s, initially for military purposes and later to address various local and global issues (Kosow & Gabner, 2008). They are increasingly relevant in the face of escalating complexity of socio-ecological systems attributed to climate change (Reed et al, 2008). The understanding of scenario building processes has evolved from the plausible description of what the future might hold (Kahn and Weiner, 1967), and 'stories about the future' (Heugens and van Oosterhout (2001) to "a systematic method for thinking creatively about dynamic, complex and uncertain futures and identifying strategies to prepare for a range of possible outcomes" (Reed et al, 2013: 346). One of the most frequently used definitions of the scenarios is "a vision which is internally consistent with the future can become not only a prognosis, but a possible future result" (Porter, 1985).

a. Scenario building as methodology

The modern techniques of construction of scenarios emerged within the military sphere of the post-war (1945) era as an orientation to develop armed strategies for the Cold War. In 1970s, they were modified to deal with the petrol crises by the petrol firms. More recently, their uses have been diversified and adapted for varied political and social context. In the environmental context, the method was applied for the first time by the Brundlandt commission in 1987, which was used in the United Nations Conference on Environment and Development in Rio de Janeiro. Since then, the method has widely been used for environmental studies at the local, regional and global level, and more recently for climate change analysis by the IPCC.

The scenarios have proven to be particularly useful in the areas of development, which cannot have a prognosis because of their complexity, susceptibility to interference and/or have dependency on human decisions. The key, according to Porter (1985), however, is the requirement of coherence. A scenario can reveal only one of the many possibilities of development. It distinguishes from an arbitrary concept in the future by the internal consistency of the formulated hypotheses. They can be used as a basis for planning, when their use is not based on "what is going to happen, but what may happen" (Mark & Metzger, 2010).

The construction of scenarios consists of an analysis and identification of a range of possible (future) results, by trying to underline or highlight at a large scale the forces which can direct the future into different directions. By making these forces visible, we are able to find the best way to make decisions now. The construction of scenarios has the objective to establish a logical sequence of events to demonstrate how the current situation (or any other situation given) can result step by step into a future scenario.

The scenarios are defined, and are often simplified, descriptions of how the future can develop according to a coherent set of assumptions and driving relations (Carpenter, 2005). They can be defined by qualitative or quantitative methods, or a combination of them. They can also reflect the assumptions of change or can describe the consequences or results of a specific process. Although the majority of them are written narratives, it is also possible to report them through numbers, graphics or other ways.

The scenarios are very useful in contexts in which no clear understanding of causal relations within a system exists. This understanding can be hard to quantify. Even though they show different ways to perceive the evolution in one situation, the scenarios do not pretend to be predictions or an authentic truth. Rather, they simply aim to stimulate, provoke and communicate visions of the future that may be ahead. For that matter, the technique is used widely in the evaluation of climate change to explore the uncertainty of the consequences of human actions about the environment and the responses of society to climate change.

Their flexibility and ability to incorporate a wider set of key issues, nonlinearities, feedbacks and surprises is particularly helpful in understanding complexities of different systems (Kok et al 2007). Scenario building has therefore been increasingly seen as an efficient tool of knowledge construction, even though the selected method, nature of participants and their participation are noted to vary in different studies as per their objectives. In this research emphasis is placed on developing knowledge of plausible futures through an inclusive scenario building process instead of defining or confirming tendencies or setting projections. Scenario building workshops were conducted in four cities of Lima, Guarulhos, Delhi (Dwarka) and Durban. As the selected cities are located across three

continents of different socio-economic and political contexts, the method, participation and outcomes of these scenario building processes varied significantly, which strongly influenced the nature of knowledge produced. The following paragraphs bring out some of the key differences in the process, participation, outcomes and discourses that emerged during scenario building workshops conducted in the four cities.

b. Process and Participation

An important objective of the scenario building process was to explore the plausible water futures in the four cities by building consensus among participant actors. The workshops were designed to include multi-scalar perspectives by using a participatory or action research approach. Although scenarios can be developed without any participation of key stakeholders, their participation is noted to be significant in the co-generation of knowledge that benefits both researchers and the participants, and to accommodate various trade-offs across scales (Kok et al 2007, Reeds et al 2013). However, the participation of various stakeholders is noted to be significantly influenced by the socio-political contexts of Lima, Guarulhos, Dwarka and Durban. Whereas, in Lima and Guarulhos the process was supported by a favourable participatory culture where actors are used to engage in such discussion, in Durban and Dwarka the workshops were conducted in highly professional forums with lesser degree of engagement with stakeholders from different backgrounds.

Lima: In Peru despite being a highly centralized country, a process of concertacion that involves the participation of a variety of actors has become mandatory in a variety of decision making processes. A key characteristic of the concertacion process is the practice of learning-by-doing which involves knowledge construction by using various social networks. The latter implies validation (or contestation) of a variety of knowledge by participating actors, and a highly sensitive and complex process of dialogues, negotiations, concertacion, conflict management and consensus building (Sara & Baud, in press). Such processes can be seen as cycles in which knowledge and decisions made are constantly evolving. A special feature of the scenario building process in Lima is that it combined several parallel processes including a technical Germanresearch project, a series of workshops driven by the municipality and finally three research projects of the Foro Ciudades para la Vida (FCPV). Apart from several round table discussions and interviews conducted, over 50 workshops were held to develop the scenarios at different scales which facilitated a high level of participation and

diversity of perspectives that came into play an active role. In Lima the process was facilitated by an inter-institutional network organisation, FORO that has a long standing tradition of participatory action research in heterogeneous networks under the sponsorship of the European Union project Chance2Sustain. They did so in a favourable political climate with strong commitment from the municipality as a driver of these processes, and hence the intention and outcome of the process were much more detailed than in the other three cities. The institutional culture of concertacion not just helped in building consensus on the issues relating to water, risks, climate change and urban development but also laid the foundation for future policy building. The scenario building process in Lima has been a multi-level institutional interaction including government, civil society, the academy and the private sector, in a multiscalar form (in dialogue with the metropolitan city, at the local-neighbourhood and macro-regional level), based on a methodological process of action research, focusing on political ecology and contributing to the social construction of knowledge. In this process the local community was not included. Therefore, in the discussion the knowledge that played an important role was scientific and coded knowledge along with contextual-embedded knowledge of key stakeholders.

Guarulhos: In Guarulhos, the process of scenario building workshops was conducted by the Brazilian Center for Analysis and Planning (CEBRAP) based in São Paulo, which led the process to be organized as one from outside rather than being embedded in the system. The scenario building process in Guarulhos involved a multi-scalar perspective with representatives from the Municipal public sector–Municipal departments of Guarulhos (urban development, housing, environment, public works and services), the Coordinating Office for Civil Defense; the Autonomous Water and Sewage Service of Guarulhos (SAAE); the Environmental Agency of the State of São Paulo (CETESB); the Water and Sanitation Company of the State of São Paulo (SABESP) 5) civil society - an organization that combines public, private and civil society actors to promote sustainable development in Guarulhos (AGENDE), a university professor and the Guarulhos nucleus of the Institute of Architects of Brazil (IAB). A high participation was thus noted from public officials, members from private sectors, civil society and university, but local community was not invited. The institutional culture of the place is noted to be highly scientific with codified knowledge. Almost all of the participants had university degrees, as most were engineers or had degrees in urbanism, chemistry, biology or geology. The only exception was a firefighter (who works for the Civil Defense). Participants with other academic backgrounds included a historian and someone who studied pedagogy. As the water management system in Brazil is reported to be well managed with fewer issues, actors were therefore, more willing to come and discuss the scenario.

The three workshops conducted in Guarulhos differed in terms of scale as one was based on the Tietê-Cabeceiras sub-basin, including its nine municipalities of which Guarulhos is part and the other two workshops were based on the municipality of Guarulhos, with the participation of key stakeholders related to water governance in the municipality. The city had well developed spatial maps to be discussed for the scenario building process, which made it a more inter-institutional interaction than an action research. The process led to the generation of lot of information but less in terms of extreme situations needing change in the system. In a short survey that was given to the workshop participants, it is observed that the professional as well as personal experiences through field observations were the most important knowledge sources. Also important, but to a lesser extent, were formal education and databases, memos, and other documents with codified knowledge.

Dwarka: Dwarka is a sub-city of Delhi, the capital of India, which is built without having full consensus from all

relevant bodies for sufficient water supply. Initially an uncertainty was noted when different actors including the responsible officials and residents were invited to come together on a same platform to discuss the controversial issue of water crises in Dwarka, however, with recurrent workshops participation was noted to be increasing and hesitation was fading away. A university team from the School of Planning and Architecture, Delhi conducted four workshops. The strong relationship of the school with officials along with a non-threatening and apolitical environment provided a safe space for various actors to communicate. Apart from the local people and resident welfare societies, participants from private sectors, nongovernment organisations, media, university researchers and public organisations such as Delhi Development Authority (DDA), Delhi Jal Board (DJB), Town and Country Planning (TCPO) and Indian Institute of Public Administration (IIPA) participated in these workshops. Although, actors associated with different aspects of water governance in Dwarka participated and presented their case, a greater participation of officials was observed when workshops were conducted within the university premise located in the central Delhi as compared to the workshops that were organised in Dwarka located at a distance in the southeast Delhi. Both distance and absence of participatory

Table 11: Characteristics of scenario building process in Lima, Guarulhos, Dwarka and Durban

Cities	Number of work- shops or proc- esses	Participants	Participatory/ Action Research	Theme
Lima	3 scenario processes (over 50 workshops)	Groups of participants bringing different kinds of actors together	Action	Water governance, CC and the metropolitan city
Guarulhos	3 workshops - 1 basin level, 2 municipal level	Basin committee – Mixed actors (municipal/state/CSO/ research)	Participatory	Urban water governance
Dwarka	4 workshops	Two workshops in Dwarka of one low and one high level of participation from residents and officials; Two workshop at the School of Planning and Architecture with medium level of participation of key officials and low participation of residents	Participatory	Vulnerability to water scarcity
Durban	1 workshop	municipal officials, environmental consultants and private sector	Action	Urban Development Line

Elaborated by Liliana Miranda, Shabana Khan, Michaela Hordijk and Catherine Shuterland

discussions among various actors working at different levels of water governance impacted on the outcomes. A key characteristic of the workshops in Dwarka was high participation of the local residents, which was not seen in other three cities.

The residents demonstrated a willingness to work with government to solve their water issues. The objective of the scenario building workshops in Dwarka was to develop collective understanding and knowledge about the nature of local water hazards and vulnerability in the current and climate change scenario by using a participatory approach. These workshops thus provided an important platform for the residents to communicate water needs, issues and potential solutions. Actors from private sectors and civil society were under represented in all the four workshops. The knowledge of the local population was based on the information from media and their personal experiences. The officials, on the other hand, had an access to scientific and codified knowledge. Spatial knowledge was also noted to be available with the engineers, academics and practitioners who participated in the workshops.

Durban: In Durban, a team from the University of KwaZulu-Natal in partnership with a leading environmental consultant who has excellent knowledge of the environmental politics in the city planned the scenariobuilding workshop. The team has a well-established relationship with the Municipality and a history of engagement with municipal policymaking. A consultant who has been actively involved in municipal programmes and projects over many years facilitated the workshop. A request by senior municipal managers, who are responsible for water governance and climate change in the Municipality, to focus on the future of the Urban Development Line (UDL) as a planning tool resulted in the Chance2Sustain team selecting a focused group of participants that had a strong interest in the role of the UDL in managing development, and water and sanitation service provision in the Municipality. The aim of the scenario building workshop was thus to debate the Urban Development Line in eThekwini Municipality for the city's political, social, economic and environmental futures. Participants for the scenario-building workshop were selected to ensure that local and national government officials (from the water sectors), planning and environmental consultants and large-scale developers in the private sector were represented. There were 25 participants in the workshop. Some of the invited Municipality representatives could not attend the workshop due to other work commitments. The water, housing and planning sectors were well represented. Community members were not included in the workshop. The participants not only worked on scenario building of the urban development line, but also addressed the

question to what extent the different possible futures of the line would affect the implementation of the municipal development plan. All participants in the workshop had received higher education, and brought in both academic and professional knowledge, mostly codified, with a strong spatial emphasis.

c. Outcomes and discourses

Variations in the process and participation of the workshops also influenced the details and nature of knowledge produced out of the scenario building exercise carried out in the four cities. While a large number of workshops and discussion sessions in Lima produced a wealth of information that helped to build possible scenario with greater details, in Guarulhos and Dwarka, the process resulted into enhanced level of interactions among key actors over water issues and possible strategies, and in Durban it was a debate on the Urban Development Line that helped the municipal officials to see its impact on future development. The interaction between different actors produced different kinds of knowledge and contributed to spatial knowledge construction. The broad outcomes in terms of knowledge interaction and knowledge produced from these workshops are shown in the following table12 The details of these are also discussed city-wise in following paragraphs.

Lima: The main conclusion that comes out of the scenario building process is of uncertainty, which means that no scientific truth exists about the climate change scenario of Lima in 2040 or 2025. In the situation of uncertainty, three plausible scenarios were drawn for the Lima city that included a scenario with dry conditions, one with incidental but more frequent heavy rains and one with combination of both (drier trends combined with incidental heavy rainy events/seasons (Table 13).

The expected impacts according to the first scenario, as shown in the table, attributed to heavy rainfalls include rise in overflows, landslides, mudslides and floods (with an increase of 6% of rainfall per year and a higher flow compared to the extreme meteorological conditions of recurring events (El Niño, Dana) together with the melting of glaciers. However, there is the opportunity of changing the patterns of daily life from an arid city to a green city (inside and outside the city, with a potential increase of agriculture areas or coastal areas) and with more warmth (opening new opportunities for tourism in summer). The second scenario indicates worst impacts from both types of occurrences, while the third scenario entails more extreme and permanent droughts (and decrease of 10% of

annual rainfall) an increase in water scarcity. This would have the consequence that water tariffs increase which will create conflicts about access to hydro resources and hydro energy (Peru depends for 68% of its water on electric generation). With an increase of population, rising demand for water and no implementation of policy towards recycling and reuse, the situation will become critical, particularly for the most vulnerable socio-economic groups. These three scenarios imply that the insufficient investment in sanitation and drainage infrastructure can cause increase in diseases transmitted through water. There is also likely to be an increase in dengue, malaria and other tropical diseases

attributed to rising temperature. Apart from this Lima also has structural vulnerability in residential occupation of the land susceptible to floods, on hillsides and gorges of high slope, with buildings of insufficient quality, bad road infrastructure, weak bridges exposed to landslides and overflows. Besides, Lima is also exposed to lowering of the ground water level, the loss of aquifers and wetlands, high climate variability risks to agricultural areas, coastal belts, loss of flora and fauna and rising sea level which further enhances the sensitivity and vulnerability of the city to climate change (Figure 15).

Table 12: Knowledge interaction and construction in scenario building workshops

Dimensions	Expert-scientific	Codified	Context-embedded	Tacit/social
Actors/ networks	Engineers, planners, university researchers	Land use planners, ground water experts, water supply engineers	Professionals working on water or water related factors	CBOs, CSOs, residents
Sources/data	Data related to water supply including meteorological data; field research, plans	Census data, Poverty map, Planning maps,	Workshops, interviews, seminars, advisory committees, consultations, focus group discussions	Interviews; participation in scenario workshops; pictures
Spatial knowledge	Climate change drivers and maps related to them	Maps of water distribution, consumption per capita and water inequality (Lima, Guarulhos)	Scenario mapping (Lima)	Maps presenting water vulnerabilities perceptions (Lima, Durban and Guarulhos)

Source: Adapted from the table done by Karin Pfeffer, Liliana Miranda & Isa Baud in WP5 ppt in Lima.

Table 13: Three plausible scenarios for Lima

Scenario 1:	Scenario 2:	Scenario 3:
Heavy rain and temperature increases at least 2°C ENSO more frequent almost permanent and rain increases +6% (normal 9 mm / year) +6,28% water flow	Mayor frequency of El Niño (ENSO), alternate conditions of scenarios 1 and 3 (+ precipitations in basis of more permanent dry periods).	Climate gets colder similar to "La Niña", rain decreases Less 9,6% = probable draughts 13,72% less of water flow

Sources: Adaptation Strategy for CC MML, Proyect MML/Foro Ciudades para la Vida/Avina, CAS-2011 (Expert Workshop MML 2012, LiWa 2012, IWS/ZIRN, Eduardo

In a highly participatory context of Lima, the development of the plausible scenario was associated with the presence of various actors who pulled the discussion in different directions which highlighted the interplay of multiple discourses operating in the system. In the beginning of the process, the dominant approach to water was noted to be sectorial facing various challenges of integration. In the presence of few experts, the discussion was primarily driven by the knowledge of engineers and economic drivers with a pro-growth or development agenda. After a midterm review, the number of participants and discussion topics were opened up to include a wider group of experts including landscape architects, urban planners and geographers. An increasing participation of nongovernment organisations and civil society network representing environmental team brought forth a "pro life/ green" and "water as a living being right" discourse. It is noted that each group of actors including private sector, public sector and NGOs produced their own set of drivers of water and climate change. The workshops from the Chance2Sustain added another dimension of spatial knowledge which further enriched the discussion by

helping it to visualise by mapping scenario, inequities, vulnerability and local knowledge. The dominant discoursed observed to emerged through these discussions was towards 'water as a right for all living beings' which combined a focus on ecosystem approaches with water as a basic human need with a 'pro-life/green development discourse (Miranda Sara and Baud 2014).

Guarulhos: The three workshops conducted in Guarulhos on scenario building process took a different direction and produced knowledge on varied tendencies of sub drivers rather than producing an overall scenario. The discussions were focused on people, urbanization and management, wherein eco-system vulnerabilities were recognized but not debated or discussed extensively. Based on first set of discussions, a list of sub-drivers was produced. These sub-drivers, considered to have the most impact (current and future) on water governance in Guarulhos, included "urban growth", "urban form", "economic development", "environment", "sanitation systems" and "planning and management". This list was presented to the participants, who then evaluated these sub drivers as a group and then

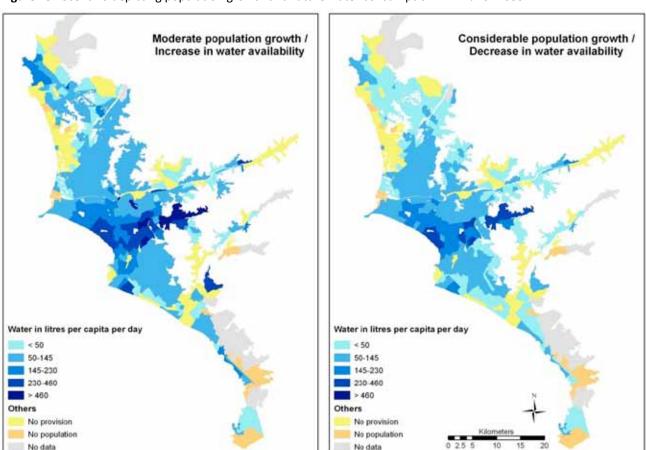


Figure 15: Scenario depicting population growth and future water consumption in Lima for 2035

 $Sources: \ Population census \ 2007 \ (INEI): Water consumption \ data \ 2007 \ (Sedepal): Population \ / \ water growth \ rates - Liwa project \ Elaborated \ by: Liliana \ Miranda, Karin Pfeffer \ and \ Todor \ Kesarovsky \ (2013)$

individually for their future trends (positive, negative or neutral) and influences on water governance in Guarulhos.

The table 14 summarizes the results of the process of identifying trends for each sub-driver. It immediately stands out that participants were much more optimistic in the second half of the activity (Group 2) than in the first half (Group 1). In the first half, the sub-drivers were largely related to growth and development (urban and economic) and these were seen as more macro-scale processes that were largely beyond the control of the municipality's management capacity. In the second half, on the other hand, many of the sub-drivers were linked to planning and management and dynamics within the municipality. Participants were optimistic about these trends and enthusiastic about some of the progress that has been made.

Overall, the participants from the two groups tended to agree over which sub-drivers had positive, neutral or negative tendencies. As the two groups were small, it is difficult to make sweeping conclusions regarding the sub-drivers that were assigned different tendencies. Partly, the composition of the groups may have influenced the results, as some participants play important roles in influencing these trends. For instance, as the Housing Department is involved in land use regularization processes in Guarulhos, the presence of a member of the Housing Department maybe have influenced the outcome of "land use regularization" having positive trend in her group (whereas the other group saw this trend as negative).

During the group discussions, Group 1 chose to distinguish between the integration of inter-sectoral planning and the integration of inter-municipal and intergovernmental planning (integration of planning between Guarulhos and neighboring municipalities, especially with São Paulo, and integration of planning between Guarulhos and actors at State and Federal level). Although they saw improvements in inter-sectoral planning they expected the latter two to worsen in the future. This is also consistent with the idea that participants saw more negative trends for factors that are beyond their control (and because the majority of participants were municipal representatives). All participants were very optimistic about the current instruments and elements in place to facilitate broader participation and inclusion and expected this to remain a very positive tendency. They acknowledged that certain instruments, such as the participatory budgeting program, required political support and could thus be harmed by changes in the municipality's administration. The participatory budgeting program was particularly praised as a success story. Nevertheless, it seems that water-related issues are not seen as the most salient and they are not that prominent in the participatory budgeting. This puts into question whether local (municipal) participatory spaces are adequate for the discussion of water-related vulnerabilities. Another participatory space is the river basin committees, entirely focused on water resources but at basin level (so larger than the territory of Guarulhos and bringing other municipal interests). Although many participants argued that the basin committees are important to address water related issues during interviews, they were barely mentioned in the workshops (2 and 3, the first one consisted of members of the sub-basin committee). This might reveal a low relevance of these spaces in the daily reality of water governance actors of Guarulhos, not for lack of recognition of their importance but possibly because there are few mechanisms to transform the committee's deliberations into concrete policies.

Workshop participants mostly claimed to see water as a socio-ecological good, and to a lesser extent as a human right. This indicates an important change in discourse at the governance level. However, at the same time many participants discussed water vulnerabilities from a sectoral perspective or, in fewer cases, as an economic good. This is also a reflection of the entities that they represent and these different views are not necessarily incompatible. Steps towards better regulation or legislation have also led to progress in land use regularization and towards initiatives such as the water charging system. These stem from a growing awareness among the population and decision-makers of the need to preserve water resources. Although there is a growing concern regarding water, there is scarcely any discussion of climate change, neither among the population nor in decision-making circles. This could be due to the fact that this theme is still very abstract in Brazil. Issues that have a more direct and visible impact (urban growth, large infrastructural works, etc.) are considered much more relevant in water governance by the workshop participants.

Dwarka: After an initial discussion of water scarcity and causes in Dwarka, the workshop participants were asked to identify the key drivers and their sub-drivers of water scarcity and draw the vulnerability scenario for present, 2030 and 2050 (figure 16). According to the participants the present vulnerability is low to medium, which is likely to intensify if the situation is not intervened. The main indicators of current vulnerability as identified by the participants included declining water table, salinity of ground water, non-revenue water, political interference, contamination of water, water tanker mafia, limited water percolation or ground water recharge, transmission losses, lack of government policies, and decline in number of ponds and water bodies in Dwarka. Participants noted that by 2030 vulnerability to water scarcity is likely to increase

 Table 14: Projected positive, negative and neutral trends of sub drivers

Sub-drivers	Group 1	Group 2
Demographic growth	_	_
Densification of construction patterns	•	•
Occupations patterns of the periphery		•
Land use regularization		
Economic dynamics - Industries and services		
Expansion of the airport / road infrastructure		•
Actions of the real estate sector	_	•
Large private investments - shopping malls, hypermarkets and logistics	•	•
Preservation / rehabilitation of green areas and biodiversity		
Value attributed to water		
Expansion of sanitation system (water, Sewage, solid wate, drainage)		
Final destination of solid waste		
Integrated planning (inter-sectoral)		
Integrated planning (inter-municipal and intergovernmental)	•	
Regular updating of sectoral plans		
Monitoring of the implementation of sectoral plans / Master Plan		
Production and implementation of legislation		
Access to information		
Participation and inclusion		
Positive trend Neutral tre Negative trend No data	end	

Source: Elaborated by Shabana Khan in basis of Table done by Karin Pfeffer, Liliana Miranda and Isa Baud, WP 5 ppt on Lima

primarily due to increased population pressure, lack of watershed development plan, lack of open green areas that enable percolation, increasing salinity and increase in water prices due to privatisation. The participants also mentioned a few positive aspects that they expected to see in 2030 which included increase in environmental awareness, technological improvement in waste water management, less transmission losses, and decentralisation of water management. Interestingly, for 2050 most participants viewed a low level of vulnerability. This is because of the increased score that they gave to the development of technological support system which they saw will be at peak by that time. They also saw a fully regularised water provision mechanism, alternate source of water, use of recycled water and improved water governance. On the negative side, they saw increased political crises and inter-state dispute, optimum salinity, and threat of desertification.

In order to confirm this result, another scenario building workshop was conducted that asked participants about their adaptation to water scarcity. This exercise also brought forth similar results by showing increasing level of adaptation by 2050, which will reduce the water vulnerability for the sub-city. At present, the level of adaptation was noted to be low-medium by the participants mainly because they find that the problem is still manageable as it is easier to buy water or use ground water when there is no supply. It is also reflected in the fact that while water harvesting is mandatory for high-rise buildings, only a few have working systems. However, all participants agreed the level of adaptation

would increase by 2030 and reach to its peak by 2050 with rising water scarcity and increasing population. Participants noted that new strategies would emerge for adaptation apart from the current one. The strategies identified by the participants included water treatment and recycling of waste water, rediscovering traditional water harvesting methods, modifying building designs, using nano technology for cleaning process, robust storm water collection, recharge system, increased awareness at societal level, strict regulation, new technology to reduce consumption, desalinisation, smart devices and so on. Overall, the participants seemed to be highly optimistic about the future of water in Dwarka despite their existing vulnerability.

In the fourth workshops participants were also asked to draw the interdependency of different drivers identified in the earlier workshops (table 4). The fact that governance is ranked as the most dominant driver can be primarily attributed to the nature of participants in the fourth workshops who were mainly from the public organisations engaged in research and practice. Design intervention and implementation along with political intervention are noted to be crucial with increasing urgency to provide water for all. Urbanisation is also noted to have high interdependency with other factors due to its direct influence on demand and supply of water in the sub city. Interestingly, environment is rather seen to be less influential. Climate Change is still not a currency in the common debate of water. It didn't emerge by itself even though people could see changing patterns in ground water and rainfall.

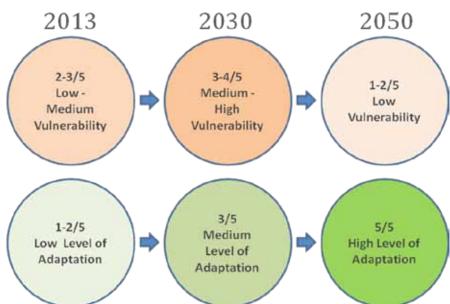


Figure 16: Vulnerability and adaptation scenario for Dwarka (2013 - 2050)

The dominant discourse associated with water was to view water as a sector. The participants from the public sector organizations responsible for water provision, development and research along with residents and members of the RWAs who were responsible for dealing with organizations for the supply of water viewed water as the state's responsibility. The knowledge of water and its spatial understanding therefore mainly exists in a scientific and codified language with planning and implementation agencies (Figure 17). At the same time, the presence of other discourses cannot be denied. Water as ecological good clearly emerged in the discussion brought forth by university researchers and nongovernment organisations on water harvesting, water

recycling and preservation of natural water resources. Increasing tanker mafia and water prices in Dwarka along with excessive dependence on ground water despite its degrading quality, on the other hand, pointed towards the dealings with water as commodity and as a human right. University researchers and non-government organisations primarily emphasised on the biophysical vulnerability while the residents also pointed towards the socioeconomic vulnerability of resettlement society and unauthorised areas. Spatial knowledge was dominantly present in the discussion from university experts and officials from Delhi Jal Board and Delhi Development Authority. While spatial knowledge helped the local community to understand the current situation, they were

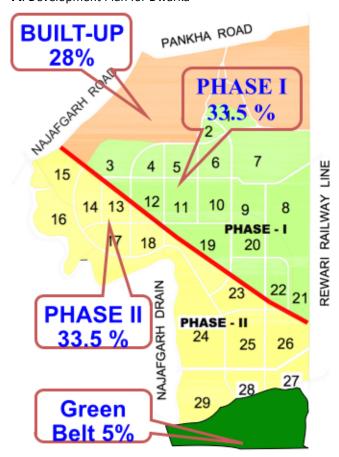
Table 15: Matrix of identified key drivers and their interdependencies

Table 15: Matrix of	identified ke	y drivers and	their interd	lependencie	S			
Interdependency	Urbaniza- tions	Environ- ment	Corrup- tion	Govern- ance	Design intervention & implementation	Institu- tional Inertia	Public awareness & partici- pation	Political Interven- tion
Urbanizations								
Environment						\bigcirc		
Corruption								
Governance								
Design intervention & implementation		\bigcirc						•
Institutional Inertia	\bigcirc							\bigcirc
Public awareness & participation								
Political Intervention								
Influences High Influen	ice 🗀) Medium I	nfluence	Lo	w Influence		No Influer	nce

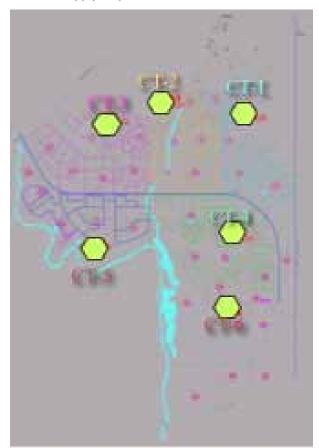
Elaborated by Liliana Miranda, Shabana Khan, Michaela Hordijk and Catherine Shuterland

Figure 17: Dwarka development plan, water supply and drainage planning map

A: Development Plan for Dwarka



B: Water Supply Map





Source: Delhi Development Authority, (2013). Planning for Dwarka. Powerpoint Presentation, School of Planning and Archi

eager to know the possible solutions for existing water scarcity. They found themselves limited to use such kind of knowledge in practical use due to constraints in availing organizational support.

Durban: The scenario-building workshop in Durban was designed to ensure that participants explored the likely effects of good and poor implementation of the Urban Development Line (UDL) concept as aspatial governance/ planning tool in achieving the Municipality's economic development, social equality, environmental management and good governance goals. The first set of drivers that underpin the need to a concept such as the UDL had been drawn from the secondary data, policy documents and the Spatial Development Framework. These included protection of agricultural land, protection ecological assets/environmental services (supporting rural/periurban lifestyle as well as wider city-wide benefits), ensuring different lifestyle opportunities; management of settlement patterns, financial sustainability of infrastructure/servicing (spatially differentiated services model) and promoting densification and address sprawl. The discussion with participants brought forth some new drivers which included resilient, efficient, sustainable city (long term), urbanisation/influx of people, land use change in periphery driven by declining agricultural returns/value/risks increase, topography (the Municipality has a very narrow coastal plain with steeply incised East-West valleys across the width of the city that are a major structuring element), linked particularly to many services and development efficiencies, and land availability for housing roll-out (UDL constrains the Municipality's ability to deliver on greenfield sites in the periphery).

A number of different maps, including the latest spatial development framework for the Municipality, were presented to the participants as a way of reflecting on the development of the urban development line (UDL) over time. Initially the urban edge, which demarcated the outer limit of waterborne sewerage provision in the city, was mapped in an attempt to control urban sprawl and to define the city as having an urban core and rural periphery. According to Sim et al (2014) the rationale for the urban edge was based on three main premises: cost-effective service delivery, densification of the urban core and protection of the upper catchment areas, all in the interests of sustainable city development, a core IDP goal (eThekwini Municipality, 2002). However, by 2010 the urban edge was increasingly being challenged, most notably by the development of the new King Shaka Airport and the Dube TradePort in the north of the Municipality. It was at this time that the new concept of the UDL was developed. The majority of the participants had a good understanding of and in-depth knowledge about the shifts in the urban edge

and the emergence of the concept of the urban development line and some had participated in its construction as a concept. Hence, the spatial knowledge that was presented in the scenario-building workshop provided the stimulus for a lively and contested debate about the evolution and value of the UDL in the Municipality.

The four scenarios associated with different levels of economic growth and the governance of the UDL, were assessed in relation to the goals of the Municipality stated in eThekwini's Integrated Development Plan (Figure 19). Workshop participants were presented with the set of 'municipal goals' that would be used to assess the effect of each scenario on the municipality's ability to deliver on its mandate. A facilitated process then followed in which workshop participants were required to argue for scores which they felt were relevant for each "municipal goal" under each scenario. The discussion and debate which happened through this process demonstrated a high level of engagement and interest by the group in the process.

The scoring was done on a 10-point scale, with 5 being the maximum positive score, and -5 being the maximum negative score. Zero was the mid-point in the scale. Positive scores reflected consensus that the municipality would be able to achieve its goals, zero score reflected that the municipality would not achieve its goals, and a negative score indicated that negative effects that would occur in regards to goals under the scenario's assessed. In summary, the scoring process indicated that governance (in this case effective management of the UDL) is the deciding factor on whether the city can achieve its goals, whether or not the city is in a high or low growth scenario. Far fewer goals are achieved if the UDL is poorly managed. The framing of the workshop in this way meant that the construction of discourses were related to and constrained by the dominant discourse that was being explored, namely the UDL.

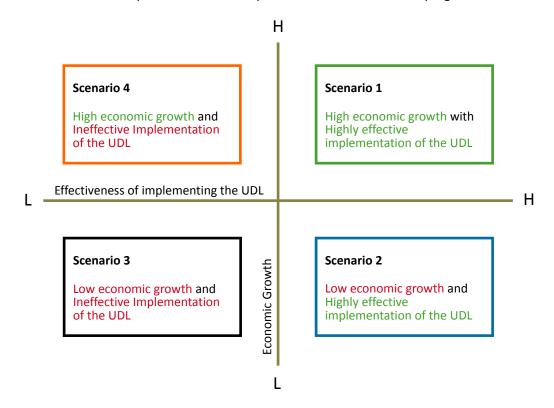
The UDL is a spatial discourse within eThekwini Municipality with an underlying rationality. It has municipal stakeholders that support it (within what we call the technical alliance) and it exerts power on city policy and decision-making, particularly concerning spatial planning, development and service delivery. The UDL is a highly contested discourse and hence the main aim of the workshop was to determine how economic growth and good governance shapes the legitimacy, value and implementation of the UDL. Among other discourses that dominated the conversation included resilience thinking, high costs of developing on the periphery, a need for master planning with controls based on engineering and infrastructure realities, urban and rural within one city, necessity of regional thinking, and a need for political debate about the line. Discussions on themes of urban

nanda Dam Bridge City Inchanga va Mashu Hillcrest Cato Manor Umbumbulu Amanzintoti Umgababa **Urban Core** Recreation and Tourism Opportunity Major Investment **Urban Development** Future Economic Investment **Coastal Opportunity Riral Development Urban Investment Nodes National Route** Urban Development Line **Rural Investment Nodes Environmentally Sensitive Major Rivers**

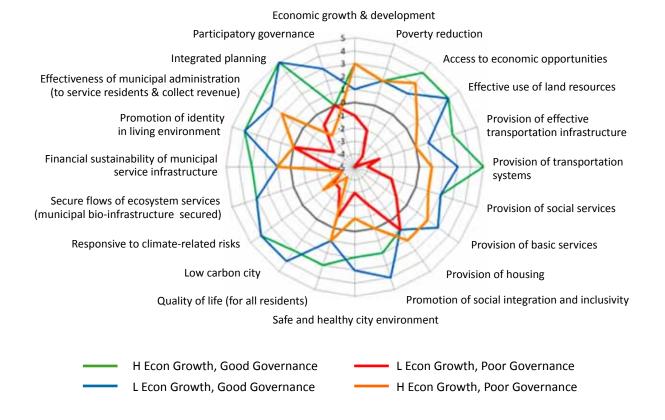
Figure 18: The Urban Development Line in eThekwini Municipality

Source: eThekwini Municipality (2012)

Figure 19: Four scenarios developed for UDL and their performance to achieve municipal goals in Durban



Comparison of all Scenarios



Source: Diederichs N. "Interpretation of Scenario's Outcomes – Chance2Sustain Scenario's Workshop Durban, 1 August 2013" (unpublished research report)

resilience and ecological buffer zones came easily, yet community knowledge was not included in the workshop. Biophysical vulnerability emerged in the workshop in relation to the protection of the ecological infrastructure in the Municipality, which is critical to water supply and water quality. Socio-economic vulnerabilities and how they relate

to the spatially differentiated service provision model that has been adopted in the Municipality emerged in relation to the UDL. The issue of social justice in the Municipality was also considered in terms of how the UDL supports or undermines social justice.



Conclusions

One of the most striking findings from this study is that despite the strong push from the globally driven Integrated Water Resources Management (IWRM) discourse for more participatory management of water resources, and despite decentralization of water management responsibilities and mandates to river basin authorities, in essence water is still quite centrally managed. Major infrastructural decisions that strongly determine water management options in the future are still dominated by the sectoral approach, fuelling the development of large scale hydraulic infrastructure to bridge the calculated demand-supply gap. This approach nicely aligns with pro-growth city development strategies driven by real estate interests. Yet it also seriously impedes the capacity to deal with the uncertainties and water related risks as a consequence of climate change. How this plays out per city is strongly influenced by specific actornetwork configurations, deploying specific discourses, and the extent to which counter discourses play a role.

Multi-level governance and multi-level decision-making contexts, so often discussed in the literature, are present in all cases. But the overlapping and competing mandates and responsibilities at different governmental levels complicates coordination. Also actors' capacities for coordination, collaboration, concertation, negotiation and conflict management differ considerably, and are contingent on the historically rooted governance cultures in each of the case study cities. In Lima and Arequipa, the multi-level perspectives attempt to integrate urban water system and territory governance, but have difficulties to counter existing power-imbalances and consequently lack implementation. In Durban - in contrast - a strong local government is able to lead process, and set precedents for higher levels of government. India is characterized by a hierarchical form of multilevel governance, whereas in both Brazil and Peru, there is a governance culture of participation and agreement (Peru) and deliberation (Brazil).

Discourses on water

From the four approaches identified (water as a commodity, water as a human right, water as a social-ecological good (and non-renewable resource) and water as a sector (and a renewable resource which management depends on technological choices and infrastructure), the 'water as a commodity' and 'water as a sector' most often are deployed in tandem. This results in a focus on the productive use of water. We found this strongest in Delhi, where water explicitly is considered a renewable resource whose management is considered from an economic perspective and based on pragmatic and technological considerations. Also in three other case study cities (Lima, Arequipa, Guarulhos), the dominant discourse considers water as a commodity or raw material for productive uses. But in all case study cities we also identified counter discourses gaining prominence. To a certain extent the globally driven discourse 'water as a human right' was voiced. Strongest in South Africa, where it is enshrined in the Constitution, but also in Delhi where it has become a political theme since the last elections, or by movements as 'people without water' (Lima). In a similar vein the 'water as a socialecological good' is gaining strength, mainly brought forward by environmental movements. In Latin America this perspective is being expanded to the right to water for all living beings and ecosystems.

The river basin councils, constituted in Brazil, Peru and India, with management responsibilities, mandates and laws reinforcing IWRM to a limited extent foster the exchange of contrasting discourses. The Brazilian councils studied are fully operational, and actually deliver most on the promise of a space for deliberation. In fact, we also found that discourses on water became more diversified in Brazil, although it is unclear to what extent this can be attributed to the deliberation in the councils. It is important to note that even in these most participatory institutions

technical knowledge dominated, which excluded ordinary citizens from meaningful participation. In Peru, new discourses about water as a socio-ecological good, gradually gained prominence in forums on water and climate change; and in India, the remoteness of the Yamuna River Basin Council and institutional complexity context makes it difficult to trace its influence on approaches to water management in Delhi.

The ideal of providing water to all (water as a human right) can also be supported by the sectoral approach, because it requires the extension of the infrastructural and distribution network to meet the demand. The case of Durban is special because it is the only city that offers free water to the unserved population by household connection, even though this free water basic is limited to 9 kl per household per month. Here the balancing act to provide 'water as a human right' but to protect water as a social ecological good has already resulted in approaches that seek to reduce water consumption, recycle and reuse water. Similar trends to combine increased coverage with ecological concerns-though less strong - were found in Lima. It is important however to note that they were driven by very different actor-network configurations, with different loci of power in water governance.

The fact that water is mainly considered a commodity, a vital product with a market value, makes its management centralised in power groups operating through companies the central government, as in the case of SEDAPAL in Lima, or monopolistic public private enterprises as the case of Sao Paulo. In Lima and Areguipa a very clear dominance of the private sector in the powerful coalition is noted; in Lima it is forged through private public partnerships (with the private sector in the initiating role), while in Arequipa the mining company is found to be dominating both a formal and an informal multi-actor network. In Guarulhos and Delhi/Dwarka central decisions on water management still remain in public institutions, though the 'public private' water company in Guarulhos is a powerful actor as bulksupplier at the state level and provider to the vast majority of municipalities in the state of São Paulo. It is clear however that whereas Brazil and South Africa have certain monitoring mechanisms in place to countervail powerful interest, these mechanisms are less strong in India and almost absent in Peru. The dominance of the sectoral/engineering discourse develops a storyline on the demand-supply gap as justification for more investments in expanding infrastructure. The dominance of this discourse also legitimises sectoral, engineering knowledge (technical and codified) over other knowledges. The dominance of this particular more traditional perspective of sanitary engineering, with its particular understanding of 'sustainability' misses out on a comprehensive

understanding of the hydrological cycle, and the challenge to close the loop. This generates various types of resistance regarding the acceptance of innovations and the generation of resources for adaptation to future climate. Quite functional to this discourse coalition and power relations, there is a lack of reliable data and difficult data transfer situation, which makes data inaccessible.

Durban offers a special case, in many respects. EWS is a globally recognized leader in water and sanitation approaches in developing countries and hence it is able to set precedents that national government responds too. A generation of municipal officers and consultants, dominated by engineers, has created a solid knowledge base and developed a culture of experimentation. The principle of 'ecological sanitation' was taken up at a relatively early moment, recycling and reuse of water is considered an option in the eThekwini Water and Sanitation Unit. The 'socio-ecological' discourse is also brought forcefully to the fore by the Environmental Planning and Climate Change department, equally considered as a champion. The Durban case illustrates an integration of discourses (water as a human right, a social ecological good but provision should strive for cost-recovery), even resulting in a discourse of 'spatially differentiated provision', strongly supported by the integration of (technical and codified) knowledge, which in turn builds on an integrated GIS database. What is evident in Durban is that decisions are taken in a relatively small circle of professionals from the municipality, consultants (who also form a stable group often contracted) and academia with whom close relations are maintained. There is a culture of social construction of knowledge, though in a small circle. Trial and error has led to many innovations, but also rendered decisions technical. This is partly in response to an overly politicised environment, that paralyses participatory processes.

Outcomes in terms of environmental justice

The emphasis on increased provision has led to a significant growth of urban water distribution networks and sewage in all case study cities, yet inequalities in access, kind of provision and water quality remain. In Durban this is evidenced in the differentiated services provided as an explicit policy, in Dwarka it results in very different forms of provision which is a consequence of a lack of policy. In Lima we were able to take an even broader look: Lima's unconnected families pay from 5 to 10 times more per cubic meter of water than families which are connected, and 50 to 120 times more than the most profitable mining companies in the upper river basin. This reveals that sectors with greater economic capacity are those that generally have more rights and better managed water service

provision in terms of quantity, quality and frequency. Poverty levels furthermore often coincide with exposures to the locally relevant water vulnerabilities.

There is recognition of the problematic hydric injustices within city boundaries: in general, it is acknowledge that the poor suffer multiple water vulnerabilities. As far as it concerns problems of inadequate access to drinking water, there are policies in place to redress this. Water vulnerabilities resulting from flood risks are acknowledged (i.a. risk maps exist), but there is much less effort to redress these injustices. In terms of representational justice, it has become clear that those who most suffer the consequences of the hydric injustice are most chronically excluded from decision-making processes. Even in Brazil, with its participatory governance culture and many participatory fora, ordinary citizens are in practice excluded from the fora where water governance issues are discussed. Consequently, their needs and knowledge are not taken up in the discussions. The strong predominance of a technical and codified management of water excludes and sets greater distances with consumers.

'Nature as a right-holder' is absent, both in terms of distributional, recognitional and representational justice, whereas to overcome the socio-nature binary recognition of nature with inherent rights is the very first step. Water in essence exemplifies the wholeness of nature, and therewith is emblematic for 'Buen Vivir'. Overcoming the 'socio-nature' divide in the sense of urban political ecology will not be enough, since a holistic understanding of water justice implies that we do not only consider the distributional, recognitional and representative dimensions from the perspective of human needs and rights, but also consider environmental justice for nature itself.

Water and Climate Change: The scenario building workshops

In the cities and countries with most obvious climatic vulnerabilities, a greater willingness to take account of climate change is found. Authorities recognise the problem, but with limited prospects and some levels of resistance or dissonance. For example, Lima and Durban have metropolitan strategies for adaptation to climate change, which has contributed to the construction of scenarios related to water and climate governance. The COPs have helped to raise awareness about that. However, Dwarka and Guarulhos show the absence of a national political

context favourable to climate change challenges, which was evident in the perception that government actors expressed about the risks of climate scenarios, although academia and civil society recognise it.

The four scenario building processes turned out to be different not only in the process and in participation, but also in terms of outcomes and discourses. While workshops in Lima proved to be highly participatory and concertative with representation of various actors, different disciplines and interests with their strong voices represented through an action research approach, in Durban and Guarulhos the process consisted of bringing together a purposively selected group of officials at different levels and other actors representing water and urban sector. A high variability is noted in the nature of participants in Dwarka where a high proportion of residents participated in the workshops, while in Durban there was high participation of officials, as a result of the methodology chosen based on the context of the scenario building process. It is noted that the nature of participation varied with the experience and positioning of different teams conducting these scenario workshops, and institutional culture of participation in these cities that not only had an impact on the inclusion of different types of actors but also on the nature of interactions and sharing of knowledge in these scenario building workshops. The outcomes of these workshops varied from a clearly defined scenario of water scarcity in Lima to trends identified for sub-drivers in Guarulhos, vulnerability and the interdependencies of various drivers in Dwarka and identifying four possible scenarios and the likely performance of UDL as per the municipality development goals in Durban. These outcomes also reflected interplay of different discourses and process of planning in the four cities.

The workshops allowed the exchange and transfer of different types of knowledge. Dialogues in workshops scenarios helped to achieve different levels of integration and agreements. Different approaches to water were brought forth, but nevertheless participants could reach certain levels of consensus. The participants were exposed to different approaches of water, which were discussed with their defining descriptors and plausible scenarios were drawn on the basis of consensus (Lima, Guarulhos, Dwarka). Multiplicity of knowledge types and knowledge generation processes from different actors added to the level of mutual understanding and it became a basis for building up agreements, and only if strong interest may oppose these may lead to collective actions (Lima).

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Annexes

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- Teddy Gounden, Senior Manager, Special Projects, eThekwini Water and Sanitation Unit, Durban, 11/07/2014
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- 23 Census from 2011 As the Chennai city boundaries were expanded in 2012 to almost double the population included, the census only represents the old city boundaries. The figure stated hère thus presents instead the metropolitan area.
- 24 Government of India 2011 Census
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Annex 2: Vulnerability Maps and Vulnerability Mapping in Lima

At the start of the Chance2sustain in 2010 we could only locate one vulnerability map for the Rimac river basin, developed by a private consultant in 2008. This map, titled Risk and Vulnerability of the Territory indicates high (alta), medium (media), low (baja) and very low (muy baja) risk, and circulated in a Power Point presentiation (see Figure 20).

This risk map can basically only be understood when analysed in tandem with the map 'environmental degradation' (see Figure 21) which indicates the flash floods (huaycos), landslides (deslizamientos), gullies resulting from torrential water (Cárcavas) rock falls (derrumbe), completed eroded areas (areas desnudas), soil erosion caused by wind and landslides (erosion laminar y eolica), floods (inundaciones), overgrazing (areas sobrepastoradas) and human waste contamination (contaminación por deshechos humanos).

In 2005 on the initiative of the Peruvian Association of Assurance Companies an earth quake risk assessment for Lima was developed. This indicates that losses expected because of earth quakes are higher than of any other potential disaster. It also illustrates that the initiative to develop such assessments often does not come from the public sector. This study, together with a study undertaken by the Peruvian National Institute for Civil Defence (INDECI) formed the basis of the vulnerability assessment in the 'Diagnóstico técnico participativo del plan regional de desarrollo concertadad de Lima 2012-2025', which also mainly focuses on risks of earths quakes and tsunamis. A study in 2012 supported by the Metropolitan Planning Institute (IMP) did however also identified areas in Lima prone to other water vulnerabilities. Figure 22 and 23 make clear that key actors downplay the risks, when we compare this with the expert perception. Figure 24 exemplifies how socio-economic vulnerabilities and water vulnerabilities are concentrated spatially.

Vulnerability and Risks in the Territory

high

cuenca del Rio Linin

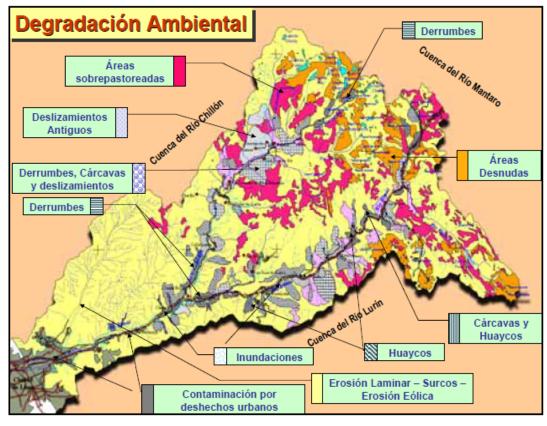
cuenca del Rio Linin

cuenca del Rio Linin

moderately high

Figure 20: Vulnerability and Risks in the Territory (Rimac River Basin)





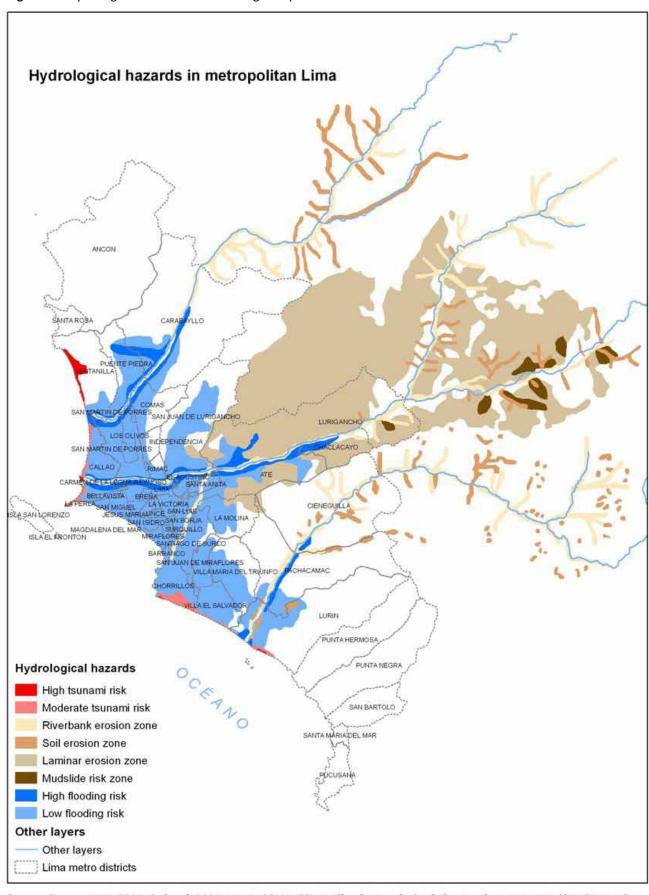
Source Figure 20 & 21: Lerrena Pinto (2010) Cuenca del Rio Rimac: Estudios preliminares para la gestión de un programa ambiental Cuenca del Río Rímac, powerpoint presentation available at: http://www.readbag.com/apfm-pdf-peru-workshop-20-example-in-peru (accessed 26-9-2014)

Sea level rise Housing on slope terrain Lack of infrastructure (water / drainage) River overflow zone

Figure 22: Hydrological risks according to Lima's key-actors perceptions

Author: Kaiser, JP. (2013) Map Source: Moncloa C. (2010), google.es

Figure 23: Hydrological risks in Lima according to experts



Source: Source: INEI, 2007; Sedapal, 2007; LIWA; CGIAR-CSI; T. Allende, Est. de Ciudades Focales MIRR, IMP/CENCA, IDRC; Conception: Liliana Miranda, Karin Pfeffer, Todor Kesarovsi, 2013

Socio-economic vulnerability very high high medium low very low districts Synthesis: - Vulnerability by age Economic vulnerability Social vulnerability Source: INEI 2007 71257 residential blocks with more than 5 dwellings

Figure 24: Vulnerability (Socio-economic and Physical) in Lima.

Water vulnerability mapping in Arequipa – Actor's perspectives

In Arequipa all key-actors interviewed were asked to indicate the major water vulnerabilities the city and the basin were facing on a map. For this exercise an existing map of the city and the basin were used. The results of this mapping exercise were transferred to GIS maps of the city and the basin, where the results of multiple respondents were made visible in one map. These maps do not pretend to present comprehensively the water-related problems in Arequipa, but rather to explore the extent to which knowledge on water-related issues converged or diverged among key actors, as well as among different members within one organization (Filippi 2014).

SEDAPAR managers had a broad analytical perspective on the area were in charge of. The budget and planning manager, for instance, paid attention to the whole water/sewerage system and was mainly concerned about the lack of tap water provision or the intermittent water supply in certain areas. The production and treatment manager focused on the water production and treatment processes and highlighted the pollution of water sources (river and groundwater) and the vulnerability of the main catchment areas as the main problems. Although managers' knowledge was embedded in the area in which they worked, this was closely related to their educational background. In short, their focus could be characterized as *professional knowledge*.

By contrast, for street workers, the main problems were those they had to deal with on a daily basis. They were

responsible for the maintenance and smooth functioning of the water and sewerage systems and when asked about the major issues in relation to water at the city level, they immediately referred to what they had to repair or change on a regular basis, namely pipelines and connections, either of the water or sewerage network.

They described not only what they could fix but also how (the resources they had), why (main causes of the problem) and where (most-affected areas in the city). The main problem identified by the street worker responsible for household water connections was the lack of resources (human resources, tools and training) within his department. For a city of almost one million inhabitants, there were only 10 street workers with two trucks and two "motocars" (three-wheeled motor vehicle) to maintain the domestic water network. They also made a distinction between dayto-day and extraordinary circumstances (for example, heavy rains or maintenance of the catchment channel), when problems tended to get worse and the number of complaints from customers rose. Street workers claimed they did not receive any formal training (for example, health and safety or customer service training) and that they basically learned from experience and through watching other experienced workers. Overall, street workers had what could be called technical/on-the-job knowledge (Source of both text and maps Filippi et.al 2014).

This exercise showed most clearly how the diverging approaches to water also results in respondents highlighting different elements in maps (pipes, plants or repair trucks; ecological degradation), and refer to different scales.

Miguel de la Cuba Ibarra La Tomilla Chilpina References and problems (Respondent 1, Budget and Planning) References in the map ISO-line Lack of tap water River Water treatment plant (SEDAPAR) Intermittent water supply due to low pressure Dry stream bed Water treatment plant (government) River pollution Metropolitan area Groundwater treatment plant Built-up area Reservoir Wastewater treatment plant Wastewater discharge References and problems (Respondent 2, Production and Treatment) Water treatment plant (SEDAPAR) Lack of drainage system Groundwater treatment plant Vulnerable water catchment area Groundwater pollution Coordinate system: GCS_WGS_1984 Authors: Marco Mazouzi, María Evangelina Filippi Transverse Mercator Projection: Data source: Fieldwork of María Evangelina Filippi (2012) D_WGS_1984 Datum: Background map: Municipalidad Provincial de Arequipa (2002)

Figure 25: Water problems in Arequipa according to respondents from the Water company

References in the map Capital city Reservoir Channel Local water authority (ALA) Fiver MAJES project References by respondents Daw project ofter 4 (Carrier Water-related problems Desertification Crought (due to glader retreet) /// Ineffcient irrigation by farmora 11111 Satisfaction River pollution Ossisinate system: GCS_WGS_1884
Projection: Transverso Mercetar
Datum: D_WGS_1984
Authors: Mario Evergelina
Filippi
Data Source: Plebbeck of
Maria Evergelina
Filippi
Projection Filippi annig Maria Energetino Filippi (2012) Proyecto de Modernización de la Gestión de Recursos Hidrico Chili (2012) Pacific Ocean Background map

Figure 26: Water related problems according to the respondents from the Water Authority (Basin Level)

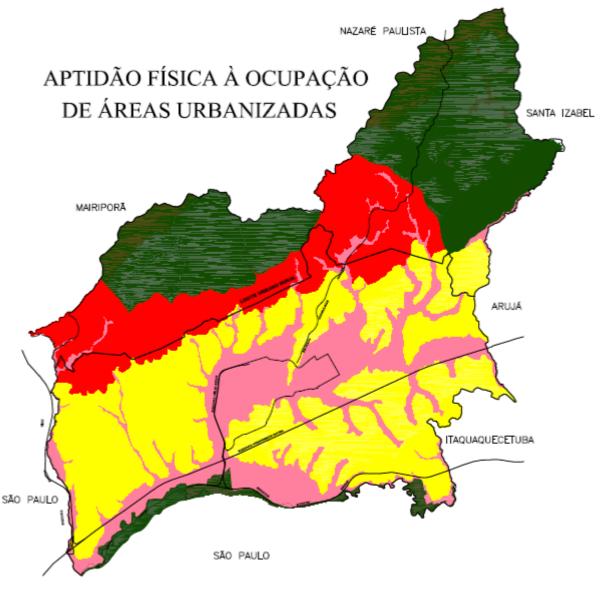
MAP 3 Water-related references and problems by ANA respondents

SOURCE: Marco Mazouzi and Maria Evangelina Filippi (2013) based on 2012 fieldwork by Maria Evangelina Filippi.

Vulnerability Mapping in Guarulhos

Existing vulnerability maps of Guarulhos evidenced that favela's are mostly located in vulnerable areas.

Figure 27: Physical Aptitude and Occupation in Urbanized Areas





Source: Environmental Secretariat of Guarulhos adapted from ANDRADE, 2001

Base: EMPLASA, Geological map of Greater

EMPLASA, Geological map of Greater São Paulo Guazulhos and Itaquaquecetuba section 1:500,000 1984 Cartography laboratory FFLCH/ USP

Source: Plano Diretor de Drenagem, Preifetura de Guarulhos (n.d.)

NAZARÉ PAULISTA **FAVELAS** SANTA IZABEL MAIRIPORA ARUJÁ **ITAQUAQUECETUBA** SÃO PAULO SÃO PAULO Favelas are marked in red dots

Figure 28: Favelas in Guarulhos

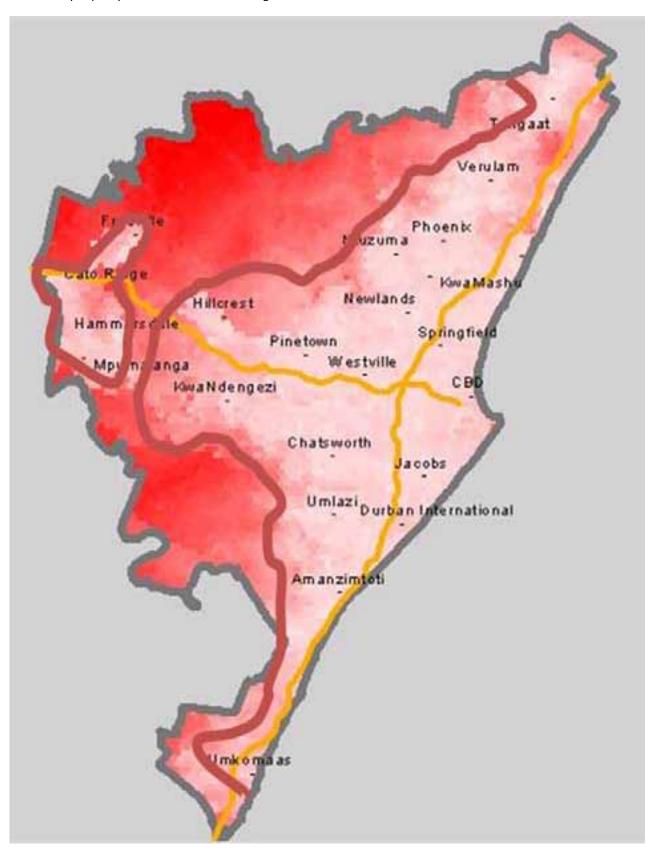
Source: Plano Diretor de Drenagem, Preifetura de Guarulhos (n.d.)

Water related maps in Durban

In contrast to the other case study cities eThekwini Municipality has a strong GIS based knowledge management system, with EWS as one of the driving pioneers (see WP5 Fieldwork report 2013). Much of the knowledge on water and water vulnerabilities is thus spatialized. This ranges from maps reflecting water quality in major rivers in the municipality to linking complaints to georeferenced infrastructure when residents call the toll free number to complain about dysfunctional services. Given the very strong use of GIS based technologies no participatory GIS exercises were undertaken in the key-actor interviews. Instead we present how spatialized knowledge does underpin the 'differentiated service provision' policy. The first Spatial Development Framework for the city with its new boundaries (SDF, 2002-2007) introduced a new and contentious concept, the urban edge. This was in fact not an 'urban edge' (since it did not contain urban development) but a 'services edge' indicating the city's ability to provide services infrastructure (particularly waterborne sanitation). Drawing the line of this 'urban edge' was supported by a GIS based cost-surface model. This 'Cost Surface' Model

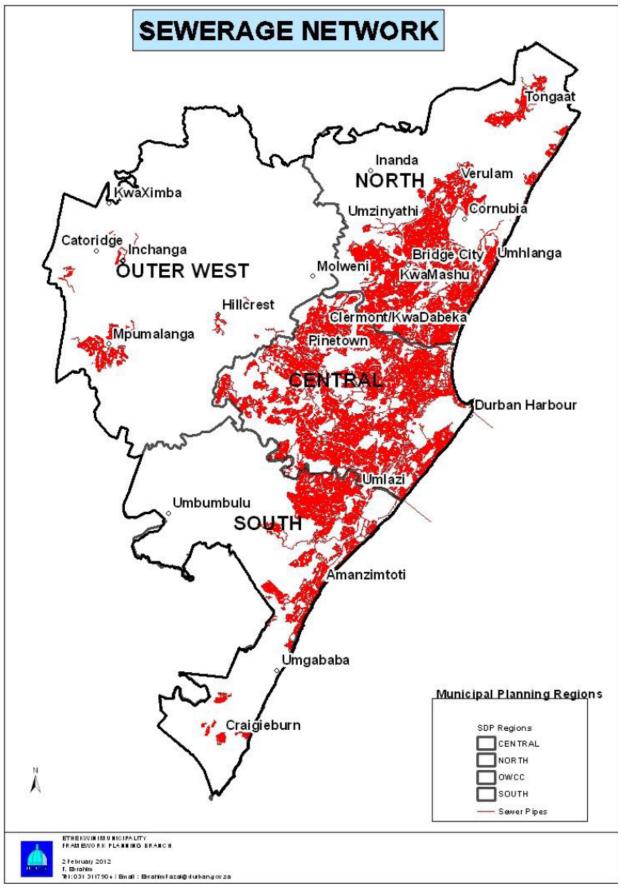
predicts the cost of servicing any piece of land in the city (WP5 fieldwork report 2013:14), and applied in Durban clearly showed the very high costs of providing infrastructure to the newly incorporated rural areas. The thick red line in the model roughly equals the Urban Edge, which later became the "Urban Development Line". When combined with the maps on service back-logs and on sewerage provision respectively, it becomes clear that providing the rural areas with especially water borne sanitation will be very costly. These maps play an important role in rendering the decisions on who gets what kind of service provision (drinking water and sanitation) technical. For the analysis of 'discourse-coalitions' it is important to note that the planners and engineers who introduced the Urban Edge more than a decade ago are still part of the 'discourse coalition' promoting the differentiated service provision. Several of them were also present in Durban's scenario building workshop, in which it was concluded that despite evident flaws the UDL was still an important planning concept in the city, especially taking into account the 'buffer function' of the rural areas vis-a-vis the water related risks of climate change (see for more recent UDL figure 14 in the report).

Figure 29: The Cost Service Model applied in eThekwini: increasing cost of providing service infrastructure to the periphery. The darker the red the higher the costs.



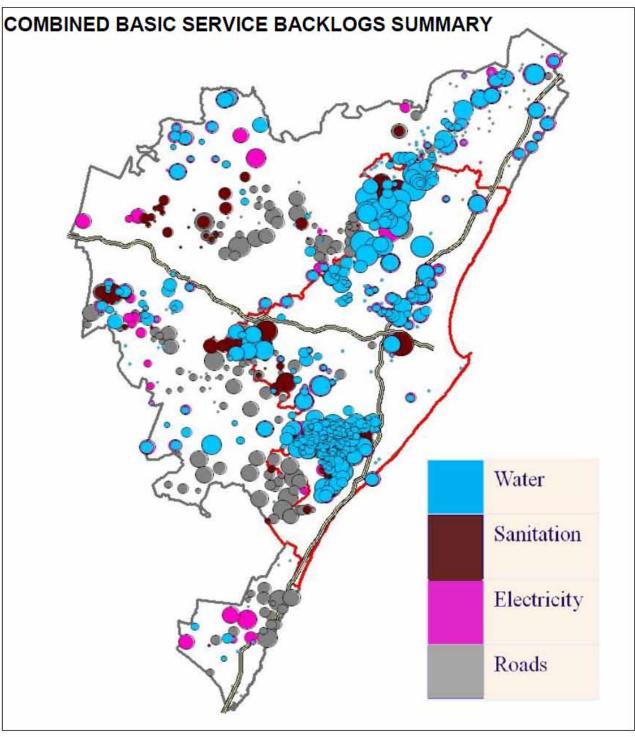
Source: MacGill, 2004 cited in Breetzke, 2009

Figure 30: Sewerage network in eThekwini munipality



Source: eThekwini Municipality, 2012

Figure 31: Combined service backlogs in the eThekwini Municipality



Source: eThekwini Municipality, 2012

Annex 3: Methodological annex

Table 16: Methods used in the different case study cities

	Lima	Guarulhos	Arequipa	Durban	Delhi/Dwarka
Number of key- actor interviews	39 respondents	35 respondents	23 respondents	23 respondents	12 respondents
Residents survey/ interviews	27 respondents in total, from three neighbourhoods	36 in total, from two neighbourhoods	29 respondents, one neighbourhood	90 respondents from three neighbourhoods and three different housing typologies	61 respondents from six housing typologies
Water Vulnerability mapping	Neighbourhood vulnerability mapping with respondents through participatory GIS,GIS based city wide accesability mapping, including scenario maps, validated in workshops with key-actors	Neighbourhood vulnerability mapping with respondents through participatory GIS	Neighbourhood vulnerability mapping with respondents through participatory GIS. City and basin wide vulnerability through participatory GIS with keyrespondents	Neighbourhood vulnerability mapping, including community enumeration in preparation for relocation	n.a.
Focus groups/ workshops	ca 40 focus groups and meetings workshops con community leaders and residents - many meetings with key actors	₽	2 focus groups with residents to validate vulnerability maps. 1 workshop with keyactors to validate actor map	3 focus groups with residents to validate findings / discuss community maps. Numerous return visits for validation purposes	n.a.
Participant observation in relevant meetings	Extensive, including action research in developing CC adaptation strategy, Concerted Development Plan of Lima and participation in numerous concertation processes	Some participant observation	Some participant observation	extensive	Some participant observation
Scenario building workshops	3 scenario processes (with over 50 workshops)	3 scenario building workshops	1 workshop (process discontinued)	1 scenario building workshop	4 scenario building workshops



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Chance2Sustain examines how governments and citizens in cities with differing patterns of economic growth and socio-spatial inequality make use of participatory (or integrated) spatial knowledge management to direct urban governance towards more sustainable development.

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