Peri-urban Water Conflicts

Supporting dialogue and negotiation

John Butterworth, Raphaèle Ducrot, Nicolas Faysse
and S. Janakarajan (editors)

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As cities expand, a key challenge is securing water supplies for urban populations and disposing of pollution while minimising impacts on peri-urban communities and the environment. The pressures of urban growth combined with the institutional and policy vacuum associated with management of natural resources in peri-urban areas ultimately often leads to competition, contestation and conflicts over water.

This book is about the dialogues and negotiations underway in many peri-urban cities in the South to address these conflicts. It shows how people and communities without good access to water and sanitation services depend upon alternatives to conventional service delivery from utilities, and it illustrates how these arrangements can be supported rather than hampered through searches for creative solutions.

It reports from three cities, Cochabamba in Bolivia, São Paulo in Brazil, and Chennai in India, where action research brought stakeholders together to help find better solutions to infrastructural development problems in peri-urban areas and shows how research can provide information, tools and approaches to facilitate these processes.
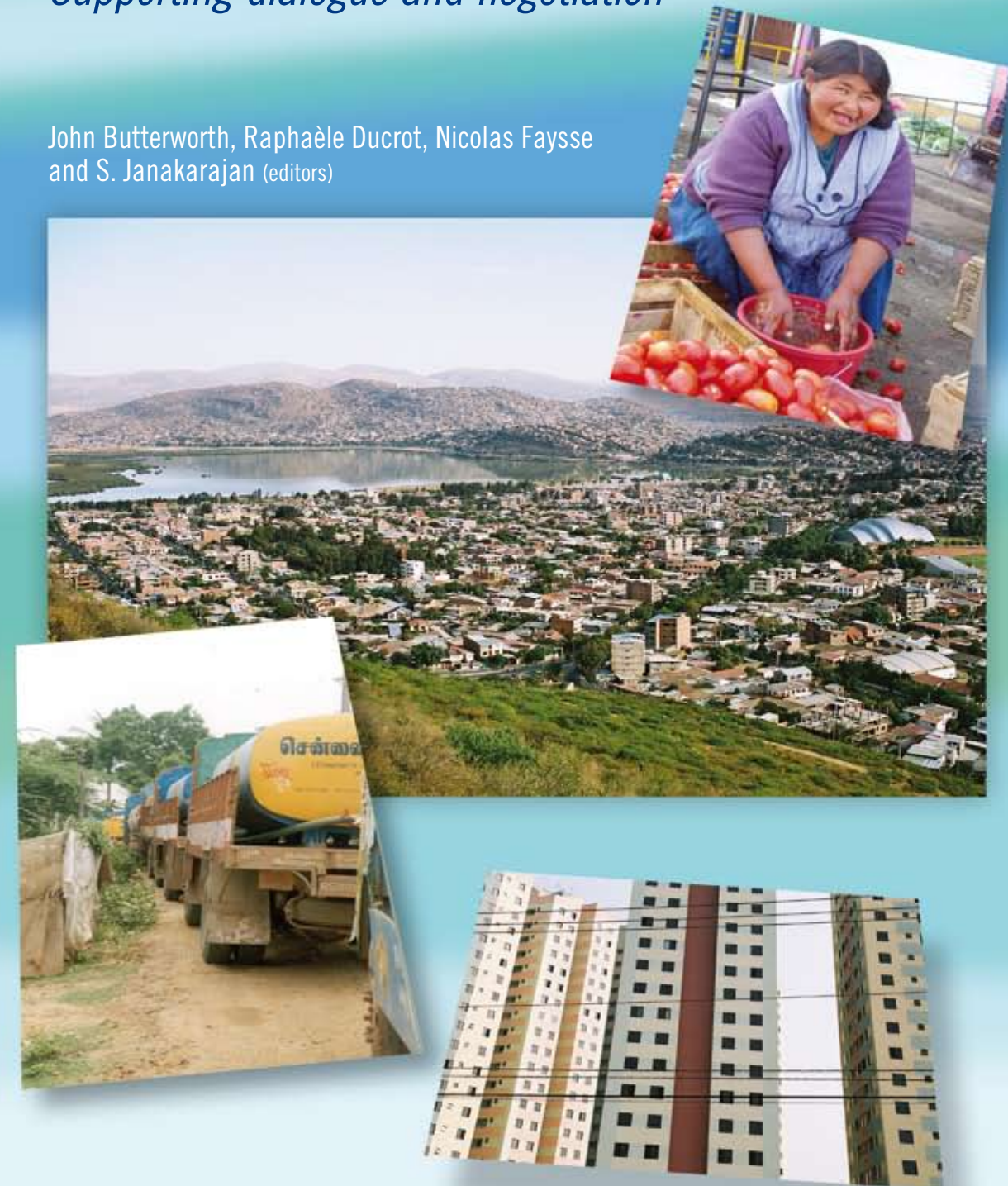
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Preface

This book is about the conflicts, dialogues and negotiations underway in peri-urban areas of many cities in the South. It is about how people and communities without good access to water and sanitation services in these areas depend upon alternatives to conventional service delivery from utilities, and how these arrangements can be supported rather than hampered if we are creative. We see how stakeholders can sometimes be brought together to find better solutions to infrastructural development in peri-urban areas and how research can provide information, tools and approaches to facilitate these processes.

The Negowat project was a four year (2003-2006) research initiative facilitating negotiations over water conflicts in peri-urban areas, involving partners from Europe, Latin America and India. It focused on developing tools to better understand competition and conflicts over water in peri-urban zones of developing country cities, and to help to facilitate negotiations between different stakeholder groups. Further details about the Negowat project and publications are available at www.negowat.org

CHAPTER 1

Introduction

John Butterworth and Jeroen Warner

Water limits at the city limits: A tale of three cities

On the outskirts of the city of Chennai (formerly Madras) in southern India, colourful tankers are a common sight streaming through the traffic. Travelling empty out of the city on congested roads to collect water purchased from the wells of farmers in the surrounding villages, they return full to deliver to houses, institutions and tanks by the side of the street. Many people rely upon these deliveries, given the state of other water systems and sources. The tankers fill a vital gap between the sporadic and inadequate water supplies available from the main piped water system, and the often saline groundwater sources in the city. But like most city water supplies, tankered water has impacts and costs that are too often ignored: energy costs associated with such an inefficient system of transporting bulk water; the health and social costs of a high number of road traffic accidents; and the impacts of groundwater abstraction on other water users in peri-urban villages. While some farmers make good money selling water from their wells, others lose access to a precious common resource for agriculture or village water supply. Against this background, some communities and movements (often led by women) in peri-urban areas of Chennai have protested, to defend their water rights and to protect their local access to water for their livelihoods.

On the other side of the world, in Cochabamba, Bolivia, most of the city's 420,000 inhabitants (Lavrilleux and Compère, 2006) have also had to make alternative arrangements for water supply. They get their water from small community-managed systems located around the city, rather than being supplied by the main utility operating in the central part. These community-managed systems frequently provide better quality water, for more hours per day and with more reliability, than the main piped water system, and at much lower cost. However, until recently, these systems have been largely ignored and rarely supported. All attention has been given to extending conventional services through the centralised utility to the unserved areas of the city, even though there is scant evidence that such a strategy will be successful and that real economies of scale exist. At the same time, peri-urban communities lack access to adequate sanitation systems as these are rarely provided by community-managed water committees. In zones where agriculture remains critical for many peri-urban residents, urban development is compromising the integrity of irrigation systems that supply water from the mountains through a complex system of watercourses, canals and traditional water rights. To defend the water rights of irrigators and the ownership of local groundwater resources and domestic water supply systems, protests, mobilisations and conflicts have been led by civil society groups. These

included the widely reported 'Water War' in 2000 and more recently, action over plans to construct the MACOTI water and sanitation system in the west of the city.

A much larger city in neighbouring Brazil, São Paulo, faces similar, if larger-scale, challenges to extend services to peri-urban communities and to collect and manage wastewater. Some of the largest slums, or *favelas*, are located in the catchment of key water supply reservoirs for the city, such as the Guarapiringa reservoir. The reservoirs receive huge loads of mainly domestic sewage with severe impacts on water quality and the aquatic habitat. Only through highly sophisticated and extremely costly water treatment processes can the water company supply potable water to the city from such polluted sources. Efforts to upgrade services throughout the *favelas*, where most people have access to piped water but not sewerage, have been largely unsuccessful despite some successes. In 2006, major movements catalysed by civil society organisations lobbied hard for more effective approaches to urban water management. For example, the *Instituto Socioambiental* (ISA) and 13 other civil society organisations organised a series of mass seminars around the Guarapiringa reservoir that led to the "Letter for Guarapiranga" expressing demands for the implementation of strategic actions (Instituto Socioambiental, 2006).

Although there are some important differences, we find several similarities across these three widely differing cities in Asia and Latin America. In each city, there are huge problems in service delivery to expanding populations in the peri-urban areas. These are probably insurmountable in the short term due to existing patterns of development in the cities. However, innovative, locally-inspired and alternative solutions have emerged to fill the gaps in formal systems. Sometimes these have clear overall benefits such as the generally well-performing community-managed water systems in Cochabamba, but sometimes they are associated with severe negative impacts, for example, the over-exploitation and inefficiencies associated with private water markets and tankering in Chennai. In São Paulo too, new solutions are being sought to tackle wastewater problems such as condominal sewerage and decentralised treatment, rather than the conventional approaches to sewage collection and centralised treatment. The dialogues and negotiations linked to these contested processes of infrastructure development are the focus of this book.

Box 1.1 What is a peri-urban area?

A peri-urban area is neither rural nor urban. Derived from the word `peripheral' the expression peri-urban could be defined as fringe, edge city, urban stretch/sprawl, or bordering villages. Effectively, these words also convey meanings of being less important, incidental to main activities, outer edge, fringe to the main, spillover, or overflown. Nevertheless, the term peri-urban is not easily explicable because of complexities and ambiguities. Thus the Organisation for Economic Co-operation and Development (OECD) in its report on peri-urban agriculture (OECD, 1979: 10) states as follows: *"It is a name given to the grey area which is neither entirely urban nor purely rural in the traditional sense; it is at most the partly urbanized rural area. Whatever definition may be given to it, it cannot eliminate some degree of arbitrariness."*

Separating peri-urban areas from the rest may however not be that useful. *"There is an increasing perception that rural, peri-urban and urban environments operate as a system rather than independently. Many development specialists conclude that rural development and urban planning are necessarily linked activities. Activities or interventions in one arena have consequences, which are often negative, in the other. At the same time, creative policies can turn liabilities into resources and bridge the rural-urban divide" (Iaquinta and Drescher, 2000).*

Allen *et al.* (2006) describe the peri-urban interface (PUI) as *"the location, on the one hand, of a mixed population which often disproportionately comprises poor households and producers, and on the other of important environmental services and natural resources consumed in towns and cities. Many of the localities in the PUI of metropolitan areas can be described as in transition from being predominantly rural to acquiring urban features."* They identify key characteristics from an environmental perspective including a mosaic of 'natural' ecosystems, 'productive' or 'agro-ecosystems' and 'urban' ecosystems. From a socio-economic perspective, characteristics include land speculation, economic activities of higher productivity and the emergence of informal and often illegal activities, and have a social composition that is highly heterogeneous and subject to fast changes over time, and multi-dimensional poverty. From an institutional perspective they identify institutional fragmentation as a key characteristic.

The scale of the urban water management challenge

The consumption of resources by cities, and efforts to promote more sustainable cities, are important when seen against the background of current urbanisation trends. The world's urban population increased tenfold in the 20th century, compared to only twofold in rural areas. Half the world's population now lives in urban centres (Table 1.1) compared to only 15% in 1900. By 2000 there were 387 million cities and 18 with more than 10 million inhabitants. Urbanisation continues in the developing world with further increases projected in Africa, Asia and Latin America.

Disputes over water resources and problems in dealing with wastewater and pollution, similar to that observed in Cochabamba, Chennai and São Paulo, can be found in almost any rapidly growing city in developing countries. The history of many developed world cities, most famously Los Angeles as depicted in books and film (see for example the book *Cadillac Desert* [Reisner 1993] and the film *Chinatown*), tells a similar story about California's water wars. Competition and conflicts over water resources to meet the growing urban demands, and risks related to pollution, are concentrated in the peri-urban interface where cities meet their rural hinterlands (for a definition see Box 1; see McGregor *et al.*, 2006, Allen and You, 2002). After exhausting local groundwater and surface water resources, most large cities are forced to develop extensive pipeline networks to access water from distant sources, often over tens or hundreds of kilometres. Aquifers and rivers close to cities, and often over large distances downstream, are also frequently threatened by pollution from industry and residential areas without sewage collection or treatment facilities.

Table 1.1 An urbanising world

	Urban population (millions) 2000	% in urban areas
World	2857	47.1
Africa	295	37.1
Asia	1367	37.1
Europe	529	72.7
Latin America and the Caribbean	393	75.5
Northern America	250	79.1
Oceania	23	72.7

Source: UNWWDR2

The expanding 'footprint' of cities desperate to secure new water supplies for growing populations puts cities into competition for scarce resources with other users of water at the peri-urban interface. These may include small towns, villages and farming communities who are determined to protect their water rights, or to ensure that they benefit from changes in the way that water is allocated and utilised. At the same time livelihoods at the peri-urban interface are changing fast. Agriculture is normally the major water user in the catchments around cities but this may decline as labour is drawn towards the better pay available in industries and services, or conversely, become more vibrant as farmers intensify efforts to meet new demand from closer markets.

Peri-urban catchments provide many important hydrologic services to cities including improvements in water quality and protection from flooding. But

with changes in land use, these services are also being modified by urbanisation processes. Risks of flash flooding in particular are increased due to the larger impermeable areas of land associated with urbanisation.

What leads to so many conflicts over (land and) water resources at the edge of cities? First of all, high and rapidly growing demands are met by a bewildering mix of formal and informal, structured and make-shift governance arrangements. Secondly, the different stakeholder groups have very different motives and expectations, which the existing institutions cannot adequately meet. As a consequence of competing claims and institutional gaps, those most in need of services often fail to get them. In developing countries especially, tensions over access to water and the risks of pollution are critical for some of the poorest people. In peri-urban areas, it is typical to find some of the poorest urban dwellers including new migrants (often living in slums) alongside existing populations struggling to adapt to changes including shifts in employment from agriculture to industries and services, and changes in lifestyles.

The water and sanitation services that people do get in peri-urban areas are frequently from alternative or informal service providers including the local private sector. Allen *et al.* (2006) show how the peri-urban poor rely mainly on a wide spectrum of informal practices to access services but that these often remain 'invisible' to policy makers and lie outside formal support strategies and mechanisms. They distinguish between 'policy-driven' mechanisms that are currently unable adequately to address the needs of the peri-urban poor, and the 'needs-driven' coping strategies that appear more effective in enabling poor people to improve their access to services.

Although some of the poorest slum communities remain unserved in cities and towns, investments in urban water supply over recent decades have raised access to safe water in urban areas in most developing countries. For example, in Bolivia, Brazil and India, the three countries that are the focus of this book, coverage is now around 95% (Table 1.2). However, many people still remain without access to safe water in the household, including half of almost 300 million urban residents in India. The sanitation situation is much worse. Access to sanitation in urban settlements always lags behind water access and in the three countries coverage rates are only 60-80% while the proportion of people connected to sewers is even lower (about 25-50%). Furthermore most collected sewage remains untreated, or is only partially treated due to the lack of wastewater treatment infrastructure.

Table 1.2 Rural and urban water and sanitation coverage in Bolivia, Brazil and India

	Population	Total coverage					
	Total	% Urban	% Rural	Water %	Water - house connec- tions %	Sanita- tion %	Sewer- age %
Bolivia	9,009,000	64	36	85	73	46	26
Brazil	183,913,000	84	16	90	79	75	45
India	1,087,124,000	28	72	86	19	33	9

	Urban coverage				Rural coverage			
	Water %	Water - house connec- tions %	Sanita- tion %	Sewe- rage %	Water %	Water - house connec- tions %	Sanita- tion %	Sewer- age %
Bolivia	95	90	60	39	68	44	22	2
Brazil	96	91	83	53	57	17	37	5
India	95	47	59	25	83	8	22	2

Notes: Figures taken from WHO/UNICEF Joint Monitoring Programme for Water and Sanitation based upon 2004 data (www.wssinfo.org). Total water and sanitation figures take account of all improved water or sanitation facilities, whereas water house connection figures are for access in house, yard or just outside. Sewerage figures exclude septic tanks, latrines and other forms of sanitation.

Multi-stakeholder processes

At the forefront in finding solutions to the issues introduced in Cochabamba, Chennai and São Paulo are new groupings, alliances and partnerships involving civil society movements and NGOs seeking better solutions from government and state-operated utility companies. These alliances do not fall from the clear blue sky. Stakeholders need to be aware of each other and to appreciate the other's legitimate interests. They have to develop a common picture of how much water there is, how much is needed, and why their activities block or pollute the streams. In other words, they become aware of their interdependences in both problems and solutions.

Where different stakeholders can see a shared problem and recognise their interdependence in the persistence of the problem and in facilitating the solution, they may be prepared to enter into a constructive, solution-oriented dialogue (Röling, 1994). The discourse of multi-stakeholder processes has become highly popular in the international water community. Dialogues, partnerships, and catchment fora are all terms used to describe participatory water resource management in deliberative platforms. Multi-stakeholder processes are found in the forestry, fisheries and coastal resources sectors, and water supply companies now organise stakeholder-type consumer panels. We are not aware of many multi-stakeholder processes in peri-urban areas, but in light of the problems and pressures we encountered, there appears to be considerable potential for their development.

Thus, in the following chapters, we'll meet new settlers bordering the springs of São Paulo, who cannot afford to live elsewhere. There are farmers and truck operators from villages selling water to the nearby mega city of Chennai, being confronted by other farmers and sharecroppers who see the groundwater table in their area fall, and still others who see local agricultural jobs disappear. There are the *nouveaux riches* of Cochabamba buying up plots for a second home in the green valley of nearby Tiquipaya, and farmers in the area who see their irrigation channels blocked by indiscriminate building. Negowat tried to bring such stakeholders together and found unexpected allies, for example municipal health workers in São Paulo, who could play 'brokerage' roles. We also tried to promote the creation of groups of 'change agents', such as a group of environmentally aware farmers in São Paulo willing to adjust their farming styles to more sustainable practices.

However, we realise that a water-only focus may be too narrow, especially for peri-urban areas where land markets and speculation drive many of the changes we see. People living in these areas also worry about things other than sustainable water management. Expulsion from their settlements, access to health services, employment opportunities, and the risks of violence may seem much more pressing to them. Any dialogue between stakeholders therefore needs to consider a wide range of concerns, so that positive linkages and quick wins are possible (Warner, 2005).

 The intended effect of participation is not to depoliticise issues, but to expand the legitimacy base beyond 'experts'. Different stakeholders are now invited in many places to participate and negotiate in the water management debate. Since it is hard to imagine a spontaneous process involving a great number of stakeholders, usually a facilitator is involved to accompany and steer the process. They look for problem definitions and negotiation modalities that are able to keep all the negotiators on board and harm no one. We call these fora, multi-stakeholder platforms (MSPs).

India, Brazil and Bolivia are all countries where civil society activism is well established, but where constructive state-society relations can be difficult. Governmental agencies can be stuck in technocratic ways and used to top-down planning and therefore find it hard to take citizens seriously. The distrust can be mutual when civil society sees governments as the problem. However, as shown by Negowat processes, with some support, stakeholders can be motivated to talk with each other about pressing water and sanitation problems.

Verhallen *et al.* (2007) found that in various places around the world, a variety of stakeholders regularly sit together to discuss how to allocate and manage their shared water resources. MSPs come in different forms and shapes. Some are aimed at alternative conflict resolution when formal processes break down. Others are specifically about joint learning for knowledge building, exchange and dissemination in situations where there are significant knowledge gaps around a planned intervention. Because the intention is to include a wide variety of users, and not only the powerful or the have-nots, the platforms can potentially strengthen the search for equity and democracy and hold strong emancipatory potential. However, there are a great number of misconceptions about what MSPs can and cannot do.

First of all, we cannot expect all stakeholders to come to the table. They may not be well-organised. They may judge it more opportune to approach government outside the platform. They may frustrate the process by using the platform as a delaying tactic or smokescreen, or their political strategies may frustrate any constructive outcome. The greatest pitfall is to underestimate power asymmetries between stakeholders.

Power differences mean that certain actors will not come, or will dominate the process, or exclude certain issues. Where the government is the initiator of the process, there is scope for role confusion, as other stakeholders do not usually see authorities as neutral facilitators. In post-conflict situations, MSPs can have great benefit as builders of social capital. As they meet and share ideas with some regularity, people almost cannot help but debunk engrained prejudices and urban myths about each other and so build confidence and positive relationships. An MSP can give a stakeholder a broader perspective of the problem in hand and enable more integrative and sustainable solutions.

Obviously, this requires trusting the good sense of stakeholders, and stimulating sympathetic facilitation that does not turn into manipulation. Stakeholders are only human, and may arrive at unsustainable or impracticable decisions. 'So be it', we may say. But where water issues are complex, we find stakeholders do call on experts for guidance. If done in a spirit of mutual respect, participatory water management can become a co-production of experts and lay people.

Much of the literature on MSPs has an idealist, depoliticised tendency (e.g. Hemmati 2002). Indeed, a multilateral, deliberative process can defuse actors

who are on a collision course, and as such be an alternative form of dispute settlement and vision-building. However, as Leeuwis (2000) notes, conflict is part and parcel of stakeholder processes, and can even be productive in making explicit the perspectives and interests that need to be accommodated. Multi-Stakeholder Processes therefore become a mix of 'learning and fighting' (Verhallen *et al.*, forthcoming).

Information and the role of methods and tools

The joint learning aspect of platforms is appealing, and should not be dismissed out of hand. Storytelling, participatory stakeholder analysis and role-playing games are all useful methods for eliciting stakeholder problem definitions and preferences for solutions.

In many cases a vast body of knowledge is available in government or scientific institutions. However, gathering relevant facts and figures for a specific task means searching for meaningful data and information for *this specific situation* (Checkland and Holwell, 1998). There may be different scales of time and space, specific indicators may be needed, or information on other causal factors may be sought. MSPs can help to structure and verify this information. The Hyderabad Water Information System (HyWAMIS) project for example sought to do this for an industrial area of Hyderabad, India (Anon., 2005). It is however of the essence to guide and, if necessary, train people in this process to improve stakeholders' understanding of what is going on. Experiencing a HyWAMIS session, it was easy to see that even very highly educated people found it hard to understand the benefits and practicality of this. A participatory Geographic Information System (GIS) is a great tool to shed light on what water is actually or potentially available but users may fear that information about where the water is, may be used for resource capture purposes that run counter to their interests.

We should therefore have an acute awareness of how information can play out politically. Not everyone is necessarily willing to exchange information. Knowledge is power; information is strategic. Stakeholders come to the table with two agendas: the group interest (if they are convinced there needs to be a joint solution), and a parochial interest (personal interests and the constituency's interests which are to be defended within the platform). Some stakeholders may only come to learn about new developments but keep their own cards close to their chests. We have heard of government representatives who mainly came to hear what citizens were worked up about, and then used this information to seek to repress unrest. So while joint learning can empower the whole group, we can also expect that learning often only takes place at individual or delegation level.

Some information is confidential. For example, plans for new infrastructural works may lead to land speculation. In such circumstances, platform participants may agree to be sworn to secrecy. What has happened in practice, however, is that participants in the platform leak information to their constituency, or to the media.

A platform takes a long time to develop, sometimes many years. In situations where there is not enough time to wait for a platform to establish itself, simulation games can be helpful (Ducrot *et al.*, 2006). In such games, real stakeholders agree to sit for a limited number of hours or sessions to play out how they would respond to and negotiate about certain plans or scenarios. Role-playing games are interpretation games in which players discuss and take decisions on a specific situation-problem. They are composed of three elements:

- a system of rules and an environment that provide the context and set limits on players actions,
- a facilitator, or game master who knows all the rules and orients the players,
- players who take specific roles and simulate actions and interactions (Mucchielli, 1983 in Daré and Barreteau, 2003).

Role-playing games combine playful aspects with the interpretation of role as in theatre, promoting experimentation with different aspects of the situation. As analysed by Dorn (1989), they are traditional instruments of education and training in the field of sociology. Other notable examples include use in environmental education or in training courses on negotiation in the area of public policy, for example the Program on Negotiation at the Harvard School of Law. Role-playing games have also been widely used as research tools in the social sciences to collect information and facilitate the interpretation and understanding of social reality. A common thread between the Negowat processes in each of the three cities was the combined use of methods and tools such as role-playing games with promotion of multi-stakeholder processes to facilitate learning and sharing.

An introduction to the Negowat project

The Negowat (facilitating negotiations over water conflicts in peri-urban areas) project was a four year (2003-2006) research initiative involving partners from Europe, Latin America and India. It focused on developing tools to better understand competition and conflicts over water in peri-urban zones of developing country cities, and to help to facilitate negotiations between different stakeholder groups. This included the testing and application of visioning, scenario development, modelling, role playing and other planning tools to support participation and more effective negotiation in integrated water resources management.

The use of these methods was, in each of three case study cities, linked to multi-stakeholder dialogue processes to reduce the growing tensions among competing groups of interests, and to develop negotiated approaches to improved water management for multiple uses, with better participation of civil society in decision-making processes. Specific objectives were:
- to develop, test and validate methodologies to facilitate discussion and negotiation over water access and land use problems among social organisations in peri-urban areas,

- to improve the participation and negotiation skills of communities commonly marginalised in decision-making processes.

In three cities, Cochabamba in Bolivia, São Paulo in Brazil, and Chennai in the state of Tamilnadu, India, local research teams, working with European partners, focused on the specific problems faced in each city and adopted different locally specific processes aimed to address the problems faced by peri-urban communities. Information about each of these cities is summarised in Table 1.3 on page 20/21.

What this book sets out to do

This book highlights the approaches, methods and tools that were developed and used in the Negowat project to support negotiation processes linked to peri-urban land and water conflicts in the three countries. Each case study places equal emphasis on the methods and the outcomes. It thus provides examples of how such methodologies may be used to support negotiation processes. The book brings together results from three very different contexts. While recognising that comparisons are difficult across such diverse cities, it aims to draw some common experiences and lessons.

In the course of our work, we encountered several of the pitfalls of multi-stakeholder platforms. As we shall see in the next three chapters, it not always possible to translate at the political or structural level what parties come up with to improve their lot. However, we reaped some surprising successes, too. We got people who normally would never meet to really engage with each other and arrive at new pathways for more sustainable water management in the Cochabamba valley, São Paulo and Chennai. In each of the three peri-urban zones, stakeholders enjoyed and learned from the process, expanded their social capital and knowledge base, and engaged with vigour. That experience is priceless and we aim to document it here.

Table 1.3 Background information on case study cities

City	Population	Water and sanitation coverage %	Estimated urban water consumption (including system losses)
Cochabamba, Bolivia	Pop.: 720,000 Pop. Growth: 5.0 %	In SEMAPA concession area 45% water and 49% for sewerage	150 litres per capita per day (according to SEMAPA) but lower for peri-urban committees
Sao Paulo, Brazil	Pop.: 18 million Pop. Growth: 1,6 % Area: 8,000 km²	97.5 % for water and 82.7 % for sanitation (including septic tank) in the urban area in 2000. However, only 33 % of all water distributed is collected as effluent and only 51 % of effluent is effectively treated.	300 lpcd
Chennai (excluding metropolitan area), India	Pop.: 6.5 million	Drinking water coverage 90%. Sewarage connection 70%	125 lpcd including own sources Water supplied by MetroWater Board alone is 70 lpcd (according to Board)

Administrative structures	Formal and informal WASH systems	Water related issues and conflicts in peri-urban areas
Seven municipalities. No city wide authority that includes peri-urban areas	Centralised utility serves central concession area. Locally-managed *comites de agua potable* supply most peri-urban areas.	Recognition and support of community management and control of assets and resources. Urbanisation threatening irrigation (and drainage) systems.
39 municipalities gathered in a Metropolitan Region with no overall administrative authority	5 interconnected and centralised water supply systems, with 5 main treatment stations, various reservoirs, canals, pumping stations and 5 centralised wastewater treatment plants. Water and sanitation is managed by one semi-public firm SABESP.	Flooding versus urbanisation. Urbanisation (or urban infrastructure development such as the road Rodoanel) versus water quality. Competition between uses (agriculture versus domestic and industrial, and effluent dilution). Mining versus agriculture in wetland areas. Conflicts between main water agencies over the management of the reservoir systems.
	Centralised (MetroWater Board) piped water system supplies limited quantities with 8 treatment plants and low quality of water with 20% leakage. Public and private water tankers provide additional supplies. Local groundwater sources provide further low quality water.	Groundwater depletion affects neighbouring farmers and village water supplies. Livelihood options in the peri-urban villages have been greatly affected due to groundwater depletion. Controls on abstraction are widely flouted. Sand mining threatens surface water sources. Pollution from industry, including textile processes and tanneries.

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Cochabamba, Bolivia: Top left, looking across Tiquipaya; top right, storage tank for a community managed drinking water system; bottom left, a role-playing game in action; bottom right, a peri-urban farmer in his fields – agriculture remains important in this area.

CHAPTER 2

Supporting local organisations in peri-urban Cochabamba, Bolivia

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Urbanisation and water issues in the city

In Bolivia, more than half of the population now lives in the three main metropolitan areas: La Paz – El Alto, Cochabamba and Santa Cruz. As in all Latin American countries, peri-urban areas of Bolivia have grown faster than rural or traditional urban areas. In the peri-urban areas of Cochabamba, the urbanisation process is driven by both rural-urban migration and migration from the city centres. Most important has been the arrival of poor immigrants from rural areas and mining centres of the Altiplano who can only afford cheaper land and housing in the peri-urban areas. But at the same time, relatively well-off households from the city are also moving out to settle and build large mansions in peri-urban areas, attracted by low land prices and the greener environment.

Tiquipaya is one of the neighbouring Municipalities of Cochabamba that is becoming more urban. It is divided into a valley part, which represents less than 10% of the total area of the Municipality but where urbanisation is concentrated (with 71% of the inhabitants of the Municipality), and a larger, less densely populated mountain area. The valley zone experienced a very fast urbanisation process in the 90s: the population was estimated at 30,500 inhabitants in the valley part of Tiquipaya in 2003, compared to only 3,500 in 1990 (Ledo, 2004). This very fast urbanisation process has led to rapid changes in patterns of land use in a traditionally important agricultural area. In Linde, a community in Tiquipaya, the already very small area under cultivation decreased from 110 to 40 hectares between 1983 and 2005 (Peñarrieta *et al.*, 2006). In the valley part of Tiquipaya as a whole, the urban area was only 1% of land use in 1984 but covered 18% by 2003 (Rocha and Iriarte, 2006).

Institutions at all levels face difficulties in addressing the rapid and profound changes in peri-urban areas. In Cochabamba, the Municipalities have little control over the urbanisation process, which has led to an explosion in demand for water and sanitation services that they are responsible for providing. This demand has not been met by the State or the Municipality and alternative modes of service delivery have developed to fill the gap. These include community-managed water systems, and small-scale independent operators selling water by

tanker. In the valley part of Tiquipaya, all domestic water services are operated by 37 local community-based drinking water committees with almost no role for the State or Municipality except sometimes providing a share of the initial investment. Such systems are common elsewhere on the peri-urban fringes of the city.

In Tiquipaya, there is only a sewerage system in the old city centre, with primary treatment provision (Imhoff tank). However, due to lack of maintenance the tank is full of sediment and is not functioning any more. The untreated wastewater is used by local farmers to irrigate crops. In the remaining parts of the city, families use individual latrines, or let their wastewater leak into the streets or into nearby irrigation canals. This leads to considerable health risks and pollution of the environment, both surface and groundwater.

A number of rivers pass through the valley of Tiquipaya Municipality. These rivers originating in the mountains above the valley are flood-prone torrents in the rainy season but vital watercourses to deliver water to irrigation schemes for the rest of the year. The lagoons to store water in the upper part of the catchment are mainly under the control of irrigation farmer associations. There are five main irrigation associations: four of them are in charge of the operation and maintenance of dams in the upper part of the catchment and of the canals. The fifth manages the year-round natural flow (known as *mita* in Quechua) in the Khora riverbed. These associations are also responsible for the distribution of the water, and are grouped into a federation, ASIRITIC (Association of Irrigation Schemes of Tiquipaya and Colcapirhua).

Water is used for flood irrigation, mainly to grow maize, alfalfa, cash crops and flowers. The water rights follow traditional practices, and are based on a pattern that was mainly structured during the 19th century. Though surface water is mainly used for irrigation, there is an old agreement that the drinking water committee in charge of supplying water to the urban centre of Tiquipaya receives one sixth of the Khora River natural flow. The irrigation farmer associations strongly defend their traditional water management practices and have to date successfully defended their rights, refusing to increase the small amounts of surface water that domestic and industrial water users withdraw. In Tiquipaya, competition between farmers and drinking water committees over water resources has generated tensions but has not yet led to open conflict.

Platforms and games to get people to talk and negotiate

The Negowat project in Bolivia undertook action research to design and test methods that supported conflict resolution and strengthened local organisations, in relation to land and water use in peri-urban areas. The project had a specific methodological objective of testing tools, such as role-playing games, to support discussion and negotiation over land and water use. The project focused its activities in the valley area of Tiquipaya Municipality (see Figure 2.1). The Negowat project in Bolivia was implemented mainly

by four institutions: a multi-disciplinary institute Centro AGUA from the local University of San Simon, the NGO CERES, a French research institute, CIRAD, and an English research institute, NRI. Activities were divided into three phases: i) a general diagnostic process from 2003 to mid-2004; ii) three negotiation processes between mid-2004 and end of 2005; and iii) a final phase of disseminating results in 2006.
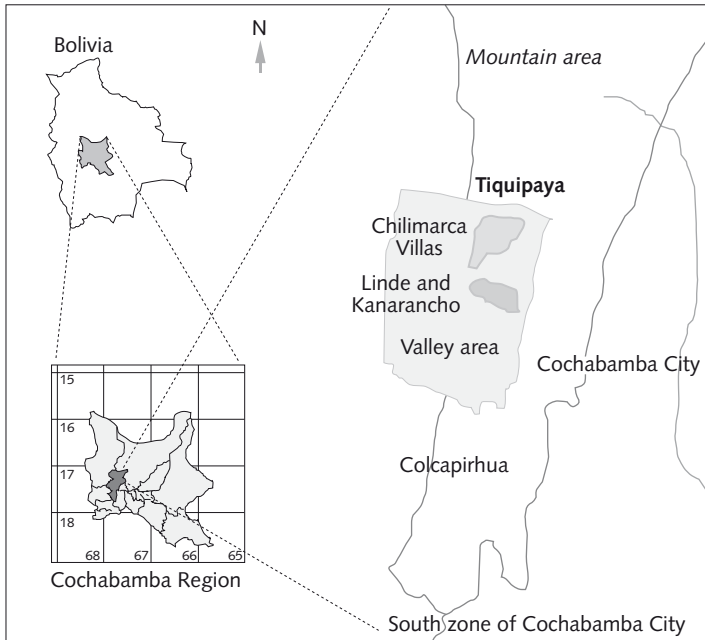
Figure 2.1 Project area within Tiquipaya Municipality

Development of research themes

At first, we in the Negowat team wanted to organise an overarching dialogue or multi-stakeholder platform on development in Tiquipaya Municipality with specific reference to urbanisation and water resource management. However, at the beginning of 2004, the Negowat team realised that this would be very difficult. A first constraint was that irrigators were not interested in opening up a dialogue over water resource management, since such a dialogue would bring to the fore the necessity to allocate less surface water for irrigation and more to domestic use. The irrigators were locally powerful enough to block any such discussion initiative. Second, there was no real willingness from the Municipality to try to regulate or to enforce regulations. For instance, while water used by irrigators is not well-managed and often spills over on the streets, some water committees face water shortages. Bolivia has very weak national and local government control over land use, water resources and water services. Urbanisation plans are designed but not implemented. The current law on water resources dates back to 1906, and in practice is almost defunct.

On the other hand, local user-based associations are strong and have proved that they have ample capacity to organise and sustain developments in their constituencies. However, these organisations also struggle with the rate of change in urbanising areas and the larger scale at which solutions now need to be found to manage competition for natural resources. Though these organisations have successfully provided access to drinking and irrigation water in many areas, they are unable to deal with some issues, such as the future of agricultural activity within the Municipality and pollution. Moreover, they are not able to deal with the increasingly urgent need to review the distribution and management of water resources, including the growing discrepancy between rights holders and demands for surface water, and the complete absence of management of groundwater, in terms of quantity and quality.

Once it appeared that the overarching dialogue or multi-stakeholder platform on development in Tiquipaya Municipality could not be realised, and after a general diagnostic phase had provided a baseline of land and water issues in Tiquipaya, we identified and characterised competing claims and conflicting issues. This led to the identification of existing, scheduled or possible negotiation processes that the team could usefully support. Figure 2.2 shows the results of this evaluation. Prioritisation was then based on the following criteria: i) social demand for a negotiation process; ii) the Negowat team's capacity to support a local process; and iii) the importance of the theme beyond Tiquipaya.

As a result of this analysis, three processes were selected for support:
*   A roundtable on a planned water and sanitation project. This was an opportunity that appeared just after the prioritisation process, arising from a request on the part of some stakeholders to have a general discussion regarding the sanitation project, and the willingness of the Minister of Basic Services to pay attention to this demand.
*   Improving drinking water committee management. This possibility arose from the initial diagnosis made with the drinking water committees, and from an assessment that these committees were completely invisible to local and national institutions and received no support in practice.
*   Addressing the impacts of urbanisation over irrigation canals. This issue increasingly emerged after a short study made during the diagnostic phase, which underlined the strong potential for discussion between irrigators and urban dwellers regarding local canal use.

	Drinking water and sewerage systems	Competition over groundwater	Competition over surface water	Vision of land use	Pollution of the environment
On-going multi-stakeholder process	Sewage network project in a district of Tiquipaya	Over-exploitation of groundwater resource between neighbours	Water allocation between irrigators and drinking water users	Natural Park Design	
Scheduled multi-stakeholder process				Design of a Land Use Municipal Plan	
Possible multi-stakeholder process	Support to drinking water committees		Conflict over water resource use in the upper part of Tiquipaya		
	Relation between urbanisation and drinking water supply				
	Relation between water committees, OTBs, and Municipality		Implementation of the Law 2066 regarding water services		
	Conflict over the MACOTI project		Shared use of canals between farmers and urban dwellers		

Figure 2.2 Identification of the possible themes for which the Negowat team could support a multi-stakeholder process

Note: Themes for which a negotiation process was eventually facilitated are shown in boxes with solid borders

Tools tested

Initially, there was a well-defined focus on the twin use of two specific tools for modelling and communicating resource management options: multi-agent systems and role-playing games. Multi-agent systems are computer-based object-oriented programmes that may represent some of the physical and social components of a given area and their interrelations and dynamics. Previous research (e.g., Barreteau *et al.*, 2001) had shown the value of this pairing of tools to address natural resource management problems. However, in the three organised negotiation processes, there was no real need to represent the dynamics of natural resource availability and use, and therefore it did not appear necessary to have a computer-based representation of the local reality. Consequently, after initial testing, we decided not to use multi-agent systems. The project finally focused on the implementation and evaluation of multi-stakeholder platforms (MSPs) and role-playing games. MSP approaches were tested in the case of the Technical Roundtable and the process of managing impacts of urbanisation on irrigation canals, while role-playing games were tested in the urbanisation and irrigation canal work as well as in the support to drinking water committees.

Baseline studies

In the first phase, a baseline assessment was undertaken. Land use change was evaluated through a comparison of land use in 1983, 1993 and 2003 showing how urbanisation had advanced. This also showed that farming activities were – paradoxically – becoming less intensive in most of the study area (Rocha and Iriarte, 2006). An analysis revealed that there was a very active land market (1,280 sales registered in the Municipality between 1997 and 2003). It also appeared that the decrease in land prices from US$ 30 per sq metre in 1998 to US$ 23 per sq metre in 2003 was due to an ever increasing offer of land from farmers willing to sell up in relation to a largely stagnant demand (Lizarraga, 2006).

In relation to water management, an initial study assessed the performance of the existing water committees, which until then had not been studied (Van der Meer *et al.*, 2004, Bustamante *et al.*, 2005). Another study, focused on multiple uses of water, showed that households often use the diverse sources of water they have (irrigation water, wells, springs, piped water supply) for multiple uses such as irrigation, gardening, and keeping livestock, as well as more typical domestic uses (Duran, 2005). Finally, wastewater re-use was investigated because untreated sewage is used as an important source of water and nutrients by some farmers (Ampuero and Van Rooijen, 2006). This showed a complete lack of monitoring of this activity which is associated with serious health hazards if undertaken in an unsafe manner.

The three negotiation processes supported in the second phase of the project, and the final dissemination phase, are described in the remainder of this chapter.

Facilitating a technical roundtable on a water and sanitation project

Given the rapid increase in population, Tiquipaya together with the neighbouring Municipality of Colcapirhua decided in 2001 to develop a US$ 4 million water and sanitation infrastructure project called MACOTI. A new sewerage network would collect household wastewater, while a water supply network would distribute treated water to the inhabitants. The project was funded through a loan from the National Fund for Rural Development (FNDR), which itself secured a loan from the Inter-American Development Bank. In 2003, as the project moved towards implementation, MACOTI began to be heavily criticised by many drinking water committees. They were concerned that: (i) the project plans were not properly communicated to the public and there were suspicions of corruption; (ii) the 25-year duration of the loan seemed too long and the interest rate too high; (iii) the two municipalities were initially planning to take over the assets and the management of the drinking water committees' infrastructure, in a compulsory way and without any compensation. The local association of irrigation farmers, ASIRITIC, also opposed to the project for similar reasons and because they felt that the project would speed up urbanisation, which would lead

to a further decline in the agricultural character of the area and would potentially threaten their control over the upstream lakes, in order to supply water for the water and sanitation system.

These tensions led to a series of conflicts in 2003, with the Army called in to intervene at one stage. As a consequence, the Mayor of Tiquipaya was forced to resign and one group of communities, the Chillimarca Villas, walked out of the project to set up their own alternative, a more decentralised sanitation project. The Minister of Basic Services sought a negotiated solution to the conflict. In June 2004, during workshops with the opponents of the project, he proposed to organise a Technical Roundtable (*mesa técnica* in Spanish) in Tiquipaya to undertake an in-depth review of the project and to try and reach agreement on the way forward. The Negowat team proposed to help facilitate this process, and this was welcomed by the Minister of Basic Services, the Tiquipaya Municipality and local organisations, as the team was part of the local University, which was considered having no financial or political stake in the MACOTI project.

The *mesa técnica* was implemented during the second semester of 2004 (Faysse *et al.*, 2006a). The official aim was to raise awareness, analyse project plans and provide a discussion space for the MACOTI project. The aim was to reach a negotiated agreement and a common vision of the project between participants and to propose changes to improve it. Five two-day sessions were held that in turn tackled technical, financial and institutional aspects. The *mesa técnica* was based upon a methodology to design and evaluate an MSP elaborated by the Negowat team. The methodology lists key points to be addressed during the ex-ante analysis, design, implementation and ex-post evaluation of the platform (Faysse *et al.*, 2005).

It took two months to obtain an agreement between local stakeholders regarding the formal composition of the *mesa técnica*. Both supporters and critics of the project initially objected to participation by the other side. Eventually, it was agreed that participants in the *mesa técnica* would be the stakeholder groups directly involved with the MACOTI project and its consequences, i.e., the Tiquipaya Municipality, the Vice-Ministry of Basic Services, the OTBs[1] and drinking water committees located in the valley part of Tiquipaya, and the ASIRITIC irrigation farmers association. Other MACOTI stakeholders, such as FNDR or the constructing and supervising contracting companies, participated in some sessions. Though the MACOTI project included both Tiquipaya and Colcapirhua municipalities, it was decided that there were already many conflicts in Tiquipaya, and that adding those in Colcapirhua would lead to an unmanageable roundtable. After the *mesa técnica* had started, participants agreed

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1   In Bolivia, so-called ´Base (or Grassroots) Territorial Organisations´ (OTBs) were defined by the 1994 People's Participation Law as the formal representation unit at community level. Under this law, the government also provides an annual Popular Participation sum for each municipality.

that anybody could participate as long as he or she brought constructive elements to the discussion.

Several recommendations for improvements to the project were reached by consensus on the technical and financial components (Box 2.1).

Box 2.1 The mesa técnica's main recommendations

The main recommendations that came out of the mesa técnica were the following.

- In view of an agreement signed with Cochabamba City municipal company to abstract surface water, plans to drill wells in the Khora riverbed should not be carried out.
- The data used for the project was reviewed, and it was accepted to use from 4,000 to 6,000 connections in Tiquipaya at the start of the project.
- It was agreed that in any future institutional structure to run the MACOTI project, Tiquipaya inhabitants would keep control over the management of water coming from the upper part of the Municipality, and control would not be handed over to an inter-municipal organisation.
- The participants of the mesa técnica committed themselves to look for other possible ways to pay for services. For example, OTBs might decide to use their share of the Popular Participation municipal budget to lower connection fees paid by users in their communities.
- Individual OTBs would be free to decide whether to join the project or not. If they decided not to join, their share of the Popular Participation municipal budget would not be affected by any future financial problems faced by the MACOTI project.

However, in 2005 and 2006, the conclusions of the *mesa técnica* were neither implemented nor officially rejected. A new municipal government was elected shortly after the last session of the *mesa técnica*, and the new municipal team did not feel bound to implement the motions approved during the roundtable. The main reason for this was that the *mesa técnica* did not give clear recommendations on the technical proposals, gave some for the financial aspects, and only really achieved clear proposals for the institutional part. On the other hand, the MACOTI project faced technical problems and significant delays in 2005 because of disagreements between the two Municipalities, the banks providing the credit and the constructing and supervising companies. Furthermore, the new team in the Municipality prioritised the execution of the project and postponed any discussion regarding the payment of debt and the institutional design until after the project had started running. In particular, while there had been in-depth discussions about how to manage the burden of debt during the *mesa técnica*, this new municipal team preferred to put the issue aside, and wait for the project to be completed before lobbying the government to have the debt cancelled. By mid-2006, the key institutional component that would be critical for the operation of the system had not yet been considered. Because recommendations from the *mesa técnica* were largely ignored, several participants formed the

opinion that participation had been a smokescreen to calm the conflict and keep the actors busy talking, while continuing to pursue the original plan.

The *mesa técnica* was built on Habermasian principles that all stakeholders should participate: "no party affected by what is being discussed should be excluded from the discourse" (Habermas, 1993, cited by Flyvbjerg, 2000). While power might have been reasonably fairly balanced between local actors, other important decision-makers such as the FNDR or the construction and supervision companies clearly had a different kind of power that enabled them to remain uninvolved in the debate. A more strategic approach to take into account these power relationships would probably have been needed to ensure genuine involvement of these stakeholders in negotiation. Moreover, the Negowat team might have done better to have linked its participation as facilitator to a halt in the project implementation.

A major weakness was that the *mesa técnica* was set up when the project was already at the beginning of its implementation stage, when the design had already been completed and where there was limited scope for change. Moreover, participants' lack of knowledge to understand and critique the technical components of the project limited their ability to come up with significant proposals for change on these issues. For instance, they could not question the diameter of the planned pipes (nor could the facilitators) though later in 2005 it appeared that several of the calculations had been wrong. In fact, since there were initial expectations from participants of a complete review of the project, one could have forecast from the outset this lack of technical expertise. In 2005, after the completion of the *mesa técnica*, a monitoring committee was elected to follow up the project. This committee initially planned to undergo a detailed revision of the technical design, but later decided that this was beyond the reach of a committee working on a voluntary basis, and that it would be much better to enforce the contractual obligation of the supervision company to evaluate the project. However, the Municipality did not follow the committee's advice to take a stronger stand with the supervision company.

This experience shows that in 2004, during the *mesa técnica*, the technical evaluation issue would have been better handled if it had focused on questions of power: instead of a costly evaluation of the project, the issue could have been how to ensure that the supervision company would comply with its contractual obligation to evaluate the technical design. A final weakness of the *mesa técnica* was that the Municipality saw this much more as a way to ease tensions than as a real opportunity to improve the project.

However, the *mesa técnica* did manage to move the debate in Tiquipaya from general judgments, and even insults, between local leaders and other representatives to much more detailed and positive discussions on the different aspects of the project. Local leaders gained the capacity to understand different components of the project, and two proposals for an institutional model for the

entity to take charge of operating the water and sewerage system were formulated. Moreover, two models for the institutional design of a future organisation were developed. The majority of the participants supported the idea of a federation of existing drinking water committees to manage the MACOTI project. A minority preferred a cooperative belonging to all water and sanitation end users, with no direct participation of the drinking water committees.

The cost of implementation of the roundtable was approximately US$ 20,000 all told. This amounts to just 0.6% of the total costs of the MACOTI project, which means that this process could have been planned for during the design stage of the project, with no major impact on the budget. However, in the MACOTI project, as in many similar projects, the priority for the engineers who designed the project and for local authorities, had been to come up with a complete design as soon as possible, as deadlines for getting a loan from the Inter-American Development Bank were tight and they judged that any discussion with other actors would lead to loss of time and an unproductive sharing of decision-making. The paradox is that local governments only seem to be interested in organising public discussion about a project when conflict seems unavoidable… which may be too late for the fruitful involvement of the public, as appears to have happened with the *mesa técnica*.

Capacity building of community-managed water supply systems

It is estimated that around 500 autonomous community-based drinking water committees supply water to approximately 500,000 inhabitants in the metropolitan area of Cochabamba.

In the Southern zone of Cochabamba, where the poorest inhabitants of the city live, water is generally delivered by private water tanker-trucks and bought by individual households at a very high price (US$ 2.5 /m³). Moreover, consumers are not guaranteed good water quality, since tankers get water from springs and neither the source nor the truck tank has quality control. Some communities have invested in local networks that are still filled by the same private trucks but at a better bulk price of US$ 1.2 /m³.

Box 2.2 Community-based drinking water committees

In Tiquipaya, 37 self-managing committees serve an average of 200 families each. National and local governments have no contact with them, except for a share in the initial investment in some cases. User families in the community are shareholders of the committee and the ultimate decision-making body is the general assembly. The committee is managed by an unpaid governing board, operating either on a voluntary basis, or employing one or two permanent staff, depending on the size of the committee. Half the committees do not have any legal status and their water supply activity is not recognised by national or local government.

80% of these committees pump groundwater, the others get water from the rivers. Half of them provide water 24 hours a day. However, analysis during the MACOTI project found that 18 out of 52 samples from boreholes, tanks and taps were contaminated with coliforms and that only one of the 37 committees purifies the water. Despite a large increase in groundwater use over the past 15 years, there was no evidence of groundwater over-exploitation in Tiquipaya.

The drinking water committees charge a relatively low fee of $US 0.1 /m^3 – interestingly, almost all the water committees that use boreholes have installed and use water meters on their own initiative. However, the entrance fee is rather high, on average US$ 300.

Sources: Lavrilleux *et al.* (2006) and Van der Meer *et al.* (2004)

In the peri-urban area of Cochabamba, the water committees have managed to provide a continuous service for many years, especially in the areas with better groundwater availability. However, many of them face technical, economic, and organisational problems. Generally, consumers will only accept paying a low tariff that just covers operation costs. In the Tiquipaya area, this is due to a lack of trust in the management of the committee, while in South Cochabamba, it stems from the very high price of water compared to household incomes. As a result, after years of functioning, most committees have not managed to enter into a spiral of improvements in quality of service, management and sustainability.[2]

In Bolivia, much work has been achieved in designing and implementing methodologies for supporting drinking water committees in rural areas (Quiroz, 2006). However, there is a marked absence of such methodologies for supporting peri-urban committees, which are very different from rural (and urban) systems. Compared to rural systems they are technically more complex, involve operation costs and tariffs that are generally 5 to 10 times higher, and users often have more formal education. To fill this gap, the Negowat team worked to develop

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2   In Bolivia, the figure for larger-scale systems is actually as diverse as that for the small-scale water committees. Cochabamba´s municipal company has also not proved able to enter into such a virtuous circle. On the other hand, medium-scale entities such as the Montero cooperative in the Eastern part of the country, have managed to achieve satisfactory management.

and test a methodology to strengthen the management of the community-driven drinking water committees in peri-urban areas (Ampuero *et al.*, 2006). Four pilot communities were supported: two in Tiquipaya that have their own groundwater resources, and two committees in the Southern Zone that are supplied by private trucks.

The methodology aimed to improve the capacity of the management team and of grassroots users. To achieve this, it created a space for discussion and followed a participatory approach to find locally-specific solutions to the problems faced by the committees. Many grassroots members participated in an active and informed way. As Negowat was a research project, it was impossible to invest in infrastructure, but this actually proved a useful constraint since it helped to encourage a focus on the critical management issues.

The whole process was a classic three-phase sequence. First, we undertook an analysis of the system, identifying problems through individual interviews with persons from the different zones and sub-groups of the community (e.g., women). Problems were prioritised during a general assembly (with an anonymous voting procedure in one committee). In the second phase, for each priority problem, we supported a small group to discuss alternatives and solutions. Thereafter, general assembly (plenary) meetings selected options and took key decisions. The methodology scheduled a third step involving the definition of a long-term vision and an action plan, but because of the slow rate of implementation, this step could not be taken (Figure 2.3).

During group sessions after the diagnostic phase and in parallel with the commissions (working groups), we tried out two tools to help communicate the issues and encourage participants to find better solutions: role-playing game and scenario analysis. We tested a role-playing game called SosteniCAP (for Sustainability of Drinking Water Committees). This is a generic game that can be adapted to help raise awareness and discuss the problems faced by different committees (Faysse *et al.*, 2006a). We played the game six times overall in three of the four supported committees, with on average 13 participants per session.

In three of the committees, a group of committee members identified possible future scenarios focusing on financial management of the committee (Box 2.3). This work helped to inform a debate about possible changes in the tariff system. The main issue was generally how to increase the tariff in order to be able to make some savings every month and to plan for future possible replacement costs.
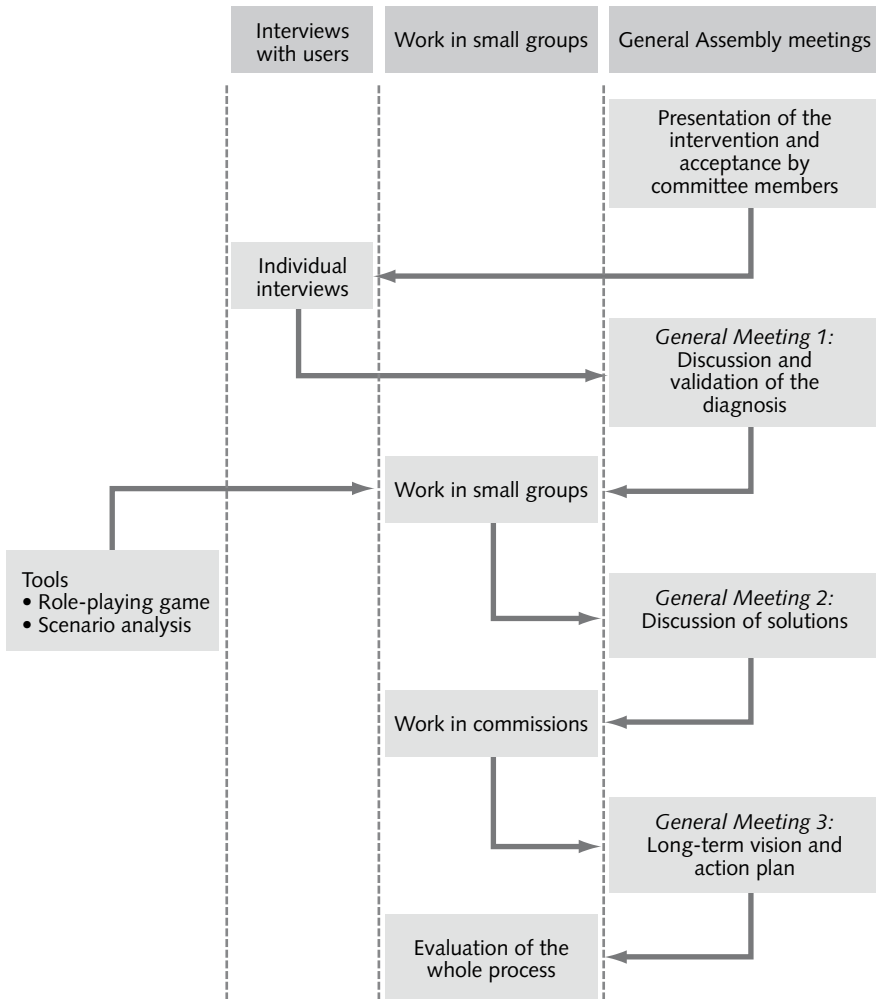
Figure 2.3 The methodology to support drinking water committee management

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Box 2.3 Scenario analysis

A group made up of grassroots members and management team members is first elected during a general assembly meeting. This group details all the costs incurred and income received by the committee. Calculations are made on a white board and group members follow the calculations using a pocket calculator. In particular, replacement costs are estimated. Once the financial balance is made, a simple spreadsheet is used to test the impacts of different factors, especially taking into account:

• costs that had been previously ignored in calculating the tariff, such as the cost of replacing equipment,

• the willingness and capacity of users to pay a certain tariff. Group members propose tariff structures that are tested with the spreadsheet. The group eventually selects one or more tariff structures, which are later submitted to all committee members during a general assembly.

In practice, no real changes could be made to the tariff structure: grassroots members were sceptical about paying more than the minimum required for operation and maintenance for fear of corruption and misuse of possible savings. They were especially worried because in the committees that do not have legal status, the bank account is under the name of a member of the management team. The most obvious solution to this problem would be to obtain a legal status for the committee and a specific bank account in the name of the committee. Management of this account will need various signatures, which will reduce opportunities for corruption. But both of these proved very long processes and could not be achieved before the end of the Negowat team's presence.

Although tariffs remained unchanged, the methodology made it possible to address a range of problems that committees are facing. First, the two older committees in Tiquipaya valued very much the diagnostic document, as a baseline which would enable them to measure their improvements in committee management later. In these committees, an improved organisational model was defined and, through a lengthy participatory process, the by-laws necessary for getting legal status for the committee were discussed and implemented. In the discussion based upon the scenario analysis, one committee expressed interest in using computer software to facilitate the financial management. Such software was later developed based on the financial management undertaken in a drinking water cooperative of Colcapirhua.

The Negowat team also supported committees in undertaking negotiations with external organisations. Previous lobbying by the Cochabamba region irrigator's organisation had won a specific tariff category for electric pumps set up in wells for drinking water. The tariff may now be reduced by between 50% and 70%. However, most of the committees in the peri-urban area of Cochabamba were not aware of this, let alone of the required procedure to achieve this category.

In one of the Tiquipaya committees, the Negowat team enabled the change of category, which meant a significant reduction in monthly operating costs, so that the committee was able to hire a manager. In the two systems in the South zone, the priority was to decrease water purchase costs. The Negowat team supported negotiations between the committees, the Cochabamba City water company and private tanker operators so that contracted trucks could get treated water from the Cochabamba City network. As a result of these negotiations, water costs for the committees were reduced by 20% and the water became safer.

In one of the Tiquipaya committees, the local church had historically been involved in the management of the committee. This had led to internal tensions. New by-laws were discussed and enacted that no longer made reference to the church. Together with the new legal status, this led to the restoration of links between grassroots members and the committee.

Role-playing games were used to build the skills of people who usually remained passive during formal meetings but who actively participated during game sessions. However, such short game sessions were clearly insufficient alone to lead to visible changes in terms of empowerment of weaker groups within the communities, especially to improve women's participation in discussion and decision-making in general assemblies, and to ensure they are represented on the management team. To make a long term difference this exercise would need to be followed up. However, some members of the management team did improve their ability to interact and negotiate with external organisations.

In sum, this game enabled its participants to build capacities of members regarding the functioning of the committee (e.g. how the accounts of the committee were calculated); to create awareness on the problems faced by the committee such as debts or tariff levels; to discuss problems in an open atmosphere; and to ensure some improvement in the participation of more marginalised community members, such as women, young people and seniors who generally do not express their opinions during formal general assembly meetings.

This approach is especially relevant for systems that have been functioning for several years, since these committees tend to have more management problems than newer systems. A constraint however, is that support implies a long process that needs follow-up. Another limit is that the benefits of such processes (such as the implementation of new by-laws) are not always clearly visible to members. In the communities where the Negowat team worked, these members were used to short-term participation by external institutions with rapid results, with participation of grassroots members only in terms of funding and collective work. Finally, the success of the whole process depends highly on the active participation of one or several legitimate representatives of the community, who become intermediaries between the facilitation team and the community.

Addressing the impacts of urbanisation on irrigation canals

Linde and Kanarancho are two communities in Tiquipaya where the water table is close to the surface and there are many springs. In this low-lying area, flooding from upstream rainfall and from local springs is common. The local irrigation canal network has a double function. In the dry period (winter), the canals convey irrigation water to the fields from local springs and the mountain lakes. In the wet period (summer), the canals play an important role in local drainage. Though the canals are not large enough to deal with peak flows during heavy rain, they play a key role in ensuring adequate drainage after the event, so that water does not remain stagnant in houses and fields for days or even weeks. Local irrigation farmer associations operate and maintain the canal network.

Given their proximity to Cochabamba City, the urbanisation process is especially rapid in these two communities, but development is not well planned. Many newcomers build houses and garden walls without knowing local rules or patterns of drainage. As a consequence, they often block drainage or irrigation canals. Urban dwellers often do not maintain the canals crossing their properties. They discharge sewage water, trash or green waste into the canals and sometimes even move them or fill them in. Around 20% of the canals in the Linde and Kanarancho communities face problems due to urbanisation (Peñarrieta *et al.*, 2006).

At the same time, farmers also lost some motivation to continue maintaining the canals, due to a decline in the flow of springs. As a consequence, operation and maintenance of the canals became poor, leading to increasing problems for farmers in irrigation, as well as increasing drainage problems for both new urban dwellers and farmers. In spite of this common problem, there was generally no communication between the two groups. Community members saw the canals as the property of the irrigation farmers, and believed that drainage issues should be dealt with by them alone.

In that context, we organised and supported a negotiation process (Peñarrieta *et al.*, 2006), based on the idea that retaining functioning canals was of interest both to new urban dwellers and to irrigation farmers, and that, whatever the future pattern of land use, canals would still be needed, at least for their role in drainage. The process defined its official goal as being to motivate and facilitate a negotiation process at local level between farmers and urban dwellers to organise the common management of urbanisation impacts over irrigation canals. The objective was to prepare a dialogue, raise awareness and motivate participation, and to facilitate a negotiation process, oriented towards searching for possible alternative solutions to prevent and solve problems. Since the general objective was a bit theoretical for local inhabitants, it was important also to foster more concrete goals: to design small projects to protect and improve the canals in the communities.

The process attracted great interest from grassroots inhabitants, as during the previous rainy period (November 2004 to February 2005) extensive and long-lasting flooding had taken place. The process was designed by the Negowat team, but leadership was assumed locally by the OTB (grass roots organisation) in Kanarancho and by the local irrigation association in Linde.

The negotiation process again was divided into three phases (Figure 2.4). First, an assessment of the communities was undertaken to reach a local consensus on the causes and impacts of urbanisation. The analysis also enabled the Negowat team to learn about the area and the inhabitants and, of course, for the inhabitants to get to know the team. The diagnostic phase was finally completed by a local stakeholder analysis to assess the possibilities of facilitating a negotiation process.

Secondly, a role-playing game was played with inhabitants. The game, called *Larq'asninchej* ('our canals' in Quechua), aimed to help local inhabitants understand the issues associated with irrigation canals (Box 2.4). Each of the two communities was divided into four areas, and a session of the role-playing game was played in each of the defined zones, with on average 11 participants per session.

Box 2.4   The Larq'asninchej role-playing game

Larq'asninchej represents a peri-urban community. Players are irrigation farmers, urban dwellers and the local OTB representative. At the beginning of every turn (which represents one year), the 'farmers' decide which fields they want to cultivate and possibly irrigate, meanwhile 'urban dwellers' decide where to build houses. Both groups may decide to set up walls to protect their house or crops from thieves. For both groups, it is cheapest to build walls that infringe on the nearby canals. Farmers situated downstream of blocked canal sections face difficulty in obtaining irrigation water. At the end of each turn, the OTB representative leads a meeting, during which the "local community" analyses problems arising from walls being built too close to canals and possible solutions. If no agreement is reached locally, the Municipality, represented in the game by a mere set of cards, eventually takes a decision. Fig 2.4 gives a schematic representation of the process.
The game aimed at improving inhabitants' understanding of other points of view held by different residents by getting the players to put themselves in each other's shoes. So, in the game, irrigation farmers were invited to play the role of a new urban dweller, and vice versa. Moreover, the game aimed at raising awareness of local inhabitants, in terms of understanding the issue at the scale of the whole community and not merely at neighbourhood level. The game enabled the participants to discuss possible alternatives to canal infringements. Rather than actual testing of possible alternatives, it enabled local inhabitants to jointly find solutions and implement them, and to show that cooperation between the two stakeholder groups was possible.

Preparation of the negotiation		Discussion and negotiation process	
Phase 1⁰	**Phase 2⁰**	**Phase 3⁰**	**Results of the process**
Baseline situation and stakeholder analysis	Role-playing game with local stakeholders	Analysis of possible alternatives to prevent and solve problems	**1** Agreement at municipal level **2** Local collective proposals and actions
April-Nov. 2004	May-Aug. 2005	Jan.-Feb. 2006	

Figure 2.4 General structure of the negotiation process about urbanisation impacts on irrigation canals

After the role-play phase, a third discussion phase aimed to trigger concrete proposals for work to improve some sections of the canals and to reach agreements between stakeholders regarding the operation and maintenance of the canals. This phase started with an identification of specific problems in the canal network and general ideas for solving them. Then, possible solutions were discussed and prioritised and agreements were established. Finally, a detailed design of priority solutions was undertaken. Figure 2.5 shows some of the identified problems and proposed solutions.

Specific problems

- Overflow due to obstruction, insufficient canal capacity or lack of maintenance
- Excessive humidity in walls and houses due to filtration from canals or due to inadequate drainage in areas encompassing springs
- Difficulties in accessing canals situated on private property to undertake operation and maintenance
- Lack of coordination between the Municipality, the farmer association, the OTBs to design plans and actions

Proposed solutions

- Improvements to some critical parts of the canals (street crossings and bottlenecks)
- Concrete lining and tubing of canals
- New drainage canals in urban areas situated close to springs
- Realignment of canals in relation to the public street
- Ensure access to private property
- Design consultation mechanisms which involve the Municipality, the irrigation farmer associations and the OTBs

Figure 2.5 Some of the identified problems and proposed solutions

This process enabled the two stakeholder groups to come closer together. Their vision and discourse changed radically from thinking only about their sectoral interests to thinking instead about multiple use of the canals. The local community, the Tiquipaya irrigation farmer association, and the Tiquipaya Municipality signed an agreement to formalise the use of some canals as part of a general drainage system: During high peak flows, irrigation canals would be used to drain out rain water from a higher urbanised zone that is usually detained in Kanarancho. The agreement also stipulated that the Municipality would help with the maintenance of these canals. Work to improve the canals was also discussed and accepted, and the Municipality started to implement them in 2006. However, six months after the agreement was signed, the work had not been started, as the issue had gone down the Municipality's agenda. This shows that the main weakness of this process was lack of capacity in local institutions. Local community-based OTBs, farmers associations and the Tiquipaya Municipality are fairly weak, and many agreements and agreed work may not be implemented because of a lack of a leading institution to ensure follow-up.

In terms of local impact, the project improved the management of irrigation and drainage in the Linde and Kanarancho communities. Internal management of four drinking water committees was improved. Local stakeholders emphasised the changes in their vision and their increased local management capacity. This is an important success, since usually stakeholders tend to value only tangible results such as new infrastructure. A local leader of a drinking water committee testified that, "Negowat helped us to be more unified"; another irrigation farmer association leader said, "Negowat opened our eyes". At national scale, awareness was raised about the existence and functioning of drinking water committees in peri-urban areas.

Dissemination

In 2006, the final phase of the project focused on dissemination of results through different types of publications and activities and academic training based on the project experiences. First, the findings were used to organise a specific course within the University at Centro AGUA. This course was organised around three modules: i) diagnosis of a peri-urban area; ii) methodologies and tools to support negotiation processes; iii) role-playing games[3]. Second, a range of publications were produced for different target groups (Box 2.5).

Apart from the results in the communities where the processes were implemented, dissemination of the experiences was organised with a view to encouraging these approaches at a larger scale. The Negowat experience about the impacts of urbanisation on irrigation canals was presented in a regional workshop attended by various irrigation farmer associations of the Cochabamba Valley. Scaling up was done at a professional level, with publication of a book that

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3   Training materials as well as most other publications mentioned can be downloaded from www.negowat.org.

collected experiences of support for drinking water committee management from 10 institutions from Bolivia and Colombia.

Box 2.5 Publications for various audiences

Publications for a broader public
Three cartoon based books to raise awareness about the problems related to land and water issues in Tiquipaya. They address: urbanisation; the drinking water committees in Tiquipaya; and the MACOTI project and related problems.

Publications for drinking water committee management team
Three cartoon-based books to help strengthen the internal management of committees, which address respectively: the legal issues (and how to obtain legal status); how to design a tariff structure; and how to manage the accounts of the committee.

Publications for NGOs and professional institutions
A guide to design role-playing games (Peñarrieta and Faysse, 2006).
A book recounting experiences of support for the management of drinking water committees in Bolivia and Colombia (Quiroz *et al.*, 2006).

Publications in scientific and professional journals
An assessment of existing drinking water committees in peri-urban areas of Latin America (Courivaud *et al.*, 2006).
An assessment of the potential and limits of multi-stakeholder platforms (Faysse *et al.*, 2006b; Faysse, 2006).

Lessons learned

Institutionalisation of negotiation processes

In Tiquipaya, there was no institutionalised space to address these water and land issues so the Negowat team had to design the three processes from scratch. This was a very different situation from the one in Brazil where Negowat activities revolved around existing River Basin Committees. An advantage of the Bolivian case was that it was possible to organise the whole negotiation process in a coherent way, especially in terms of choosing where to insert the role-playing game sessions (one of the methodological objectives). Another advantage was that the Negowat team was to a certain extent able to control the rhythm of the process. The main drawback was that the processes were not institutionalised, which led to subsequent problems with implementing agreements after Negowat ended its activities.

Local stakeholder involvement in research design

Local stakeholder involvement in research design appeared a key issue. Negotiation processes have to be demand-led if local stakeholders are to become fully involved. The initial planned processes in the Negowat project were based on an assessment of the needs as seen by external scientists, and not related to the demands of local stakeholders. The three negotiation processes later designed met the explicit demands of involved stakeholders.

However, this involvement leads to its own issues, especially when the local stakeholder organisations are weak. First, when the organisation is weak, it will respond to urgent demands and lobbying much more than to analysis of the important themes to tackle. For instance, between 2003 and 2005, there was no real interest from the Tiquipaya Municipality to tackle the theme of land use. This interest came in 2006, when this Municipality started designing its Municipal Development Plan. Second, there are many themes related to natural resource management that are of high importance in Tiquipaya, such as water management at catchment level, or the regulation of groundwater use. However, given the local context and stakeholder strategies, it will not always be possible to tackle the themes that appear the most urgent from an external point of view. This shows the necessity of a stakeholder analysis and of the local political scenario, which will show possible differences between the themes that are important from an external point of view, and the ones that can be dealt with given the local context. Third, interest (and demand) from grassroots dwellers and local organisations does not guarantee that they will be able to actively co-lead a process to address an issue. In Linde and Kanarancho, all involved institutions (Municipality, OTBs, farmer associations) were genuinely interested in addressing the problems of urbanisation of canals. However, while in 2005 many discussions were held and agreements made, in 2006 the theme began to fall progressively down the agenda, and many agreed proposals remain unimplemented.

Negotiation support approaches and tools

In terms of the scientific work, the aim was to develop and test tools for supporting negotiations about access to land and water in peri-urban areas, and in that regard clear results were obtained. In particular, detailed evaluation of the potentials and limits of multi-stakeholder platforms and role-playing games was undertaken.

MSPs are a way to tackle problems that are becoming more and more important. These MSPs are usually designed for 'horizontal' situations, where there are no large power asymmetries between stakeholders. Other approaches have been designed in 'vertical' situations of power asymmetries, and often refer to the empowerment of the weaker groups in the negotiation.

The negotiation processes were designed from a Habermasian perspective, where win-win solutions were thought possible and sought[4]. Power relationships were not given a specific focus. It would have been possible to take a more political and conflict-sensitive approach. For instance, it would have been possible to work on the issue of water resource control between communities in the upper part of Tiquipaya and the irrigation farmers in the Valley area or the issue of competition over water in the valley between irrigation farmers and drinking water users. These themes are of great importance in Bolivia. However, firstly, addressing these themes would have entailed using an approach based on power relationship and geared at empowerment of specific stakeholder groups, rather than a multi-stakeholder platform as originally planned. Secondly, although local actors such as drinking water committees or upstream communities were demanding more surface water, they did not express the demand for an open negotiation process on these themes, which had not led yet to open conflicts.

The Negowat team could have refused to facilitate an MSP on the MACOTI project and could instead have supported some groups in their refusal of the project. However, with such a power-centred approach, the very interesting and constructive discussions between supporters and opponents of the project on the institutional component, which took place during the technical roundtable, would not have taken place. The lack of a more comprehensive theoretical framework was one reason for the little mention of power centred approaches in the *Mesa Técnica* methodology. There is currently little documented research on facilitation of MSPs that taps into social learning opportunities, while engaging at the same time with power asymmetry analyses and related empowerment actions. Clearly, more research is needed on this topic.

Role-playing games proved to be a useful tool, though their purpose, to move participants away from real conflicts, made it difficult to precisely measure results (Faysse *et al.*, 2006b). Furthermore, it appeared a rather heavy tool to design and implement – although any tool that aims at involving grassroots users in active discussions will necessarily require a lot of work to implement.

The importance of having a local stakeholder strong enough to adequately co-design a research project that aims at improving land and water management has been pointed out earlier. This condition is actually also a necessary one for the relevant use of negotiation tools. The Negowat project was based on the idea that methodologies and tools for negotiation were well suited for addressing the lack of adequate planning and management of local resources in peri-urban areas. Our experience showed that methodologies may be of limited use in situations where all the local organisations (including the Municipality and local user-groups) are weak. The experience showed the importance of assessing the capacity

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4   Habermas' theory of communicative ethics is the theoretical basis often used by those who see lack of genuine communication as the main stumbling block to efficient negotiation processes (Faysse, 2006).

of local partner organisations to continue and follow up on processes once the facilitation phase is over. In areas such as Tiquipaya, strengthening possible partner organisations may be necessary to ensure that results obtained during the facilitation process do not remain isolated successes.

The cases presented show how it is possible to get a shared use of the water infrastructure. In the Bolivian context where so little has been achieved in terms of integrated water resource management, experiences of sharing water infrastructure use may help to tackle the issue of co-management of water resources later.

Support to local stakeholders

Drinking water appears high on the agenda in Bolivia. Beyond the work on methodologies, there is a need to think about how to organise support to these committees at larger scale, and how to design a long-term vision for the provision of the water services, that may entail the transformation and merging of drinking water committees. These communities have a proven capacity to carry out a major part of the management of water systems, but they do need external support. This confirms the conclusions from earlier studies on rural drinking water committees in several other developing countries (Moriarty and Schouten, 2003).

In Tiquipaya, many community-based drinking water or irrigation organisations would be willing to enter into a process of internal improvement of structure and management, possibly with the support of an external facilitator. However, other associations have weak internal social control and the management team may not be interested in improving the management and opening it up to external scrutiny. If such support is to be institutionalised, it should also come with monitoring from the government.

In the same way, in such peri-urban areas, the Municipality needs to take more and more responsibilities. Due to the very fast urbanisation process, the Tiquipaya Municipality proved unable to propose a vision and to cope with the changes. Strengthening this organisation should also be part of the support process to local stakeholder organisations.

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Water scarcity in Chennai – the winners and losers: Top left, residents in Chennai carrying water they have to collect from the tankers; top right, water being pumped from farmers' wells for sale in the city; bottom left, women are often the worst affected by groundwater over-exploitation in peri-urban areas; bottom right tankers waiting to fill up from private wells outside the city.

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CHAPTER 3

Strengthened city, marginalised peri-urban villages: stakeholder dialogues for inclusive urbanisation in Chennai, India

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Dialogue in a water-stressed city

Chennai, a city of almost seven million people in Tamilnadu State, is one of the most water-stressed cities of India. While the population keeps skyrocketing[5], the amount of water available for them is dwindling. Scarcity intensifies conflict between Chennai (formerly Madras) and its peri-urban areas[6], which cannot be resolved while there remains a great institutional vacuum. When all else fails, can a multi-stakeholder dialogue help to get the situation unstuck? The Negowat project team in India succeeded in getting many key stakeholders around the table and creating quite a media stir in the process.

In this chapter, we will analyse how water conflict developed in two peri-urban villages of Chennai, and explore to what extent a multi-stakeholder approach can provide long-term, sustainable solutions to growing problems of mega-cities such as Chennai. After introducing the Negowat process in the city, its objectives and methodology, we will discuss the overall nature and intensity of water conflicts in Chennai and its peri-urban areas. Then we consider the methodology, outcomes and difficulties encountered in developing multi-stakeholder platforms and dialogues. A further section outlines the results of a water resources audit carried out in the context of Chennai and peri-urban areas that highlighted major differences between official data, the conventional wisdom and facts on the ground. Finally, we summarise key lessons learned and policy options available to move forward and have a more positive impact.

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5   According to the Registrar General and Census Commissioner of India, the urbanisation rate in India is likely to go up from 27.8% in 2001 to 38.2% in 2026. Three-quarters of the population of Tamilnadu State will be urban in another two decades – a much more rapid change than the average for the whole country.

6   The term peri-urban is used in its widest context, not least because Chennai's water demand is met by inter-basin transfers of water from many hundreds of kilometres away in the Cauvery and Krishna Basins. As 'sustainable' water resources in these basins are fully allocated in all but the wettest years, these transfers have a direct impact on water users in the basins.

Chennai's fragile water balance

According to the Chennai MetroWater Supply and Sewerage Board (MMWSSB), Chennai gets an average annual rainfall of 1,290 mm, much more than the national average. But in the urban areas only about 5% of this rainfall actually seeps into the ground. By now, 80% of Chennai's groundwater has been depleted and any further exploitation could lead to further salt water intrusion.

Table 3.1 Main water sources for Chennai

Water body	Depth (m)	Normal yield (mcm)*	Capacity (mcm)
Poondi reservoir	2.2	76.7	77.91
Cholavaram reservoir	3.4	22.5	25.13
Chembarampakkam			103.03
Red Hills lake	3.8	71	80.65

* mcm: million cubic metre

The Chennai river basin[7] consists of a group of small rivers such as the Araniyar, Kusathalayar, Cooum, and Adyar Rivers. The four rivers once supplied fresh water to the city[8]. Currently however, Chennai City does not have access to a perennial river and has to depend primarily on three major former irrigation tanks (reservoirs) and one small reservoir across a river that floods only for a few days during the monsoon.

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7   The total Chennai basin covers an area of 7,282 km². A good three quarters of this area, 5,542 km², is found in Tamilnadu State, the reminder is in the adjacent Andhra Pradesh State.

8   For instance, the Araniyar, which runs to a total length of 132 km, drains an area of 1,470 km² of which roughly 50% falls within the state of Tamilnadu. It drains into the Bay of Bengal near Pazhaverkadu village. The Kusathalayar joins with the surplus from the Kaveripakkam tank (which is a part of the Palar Anicut system), across which the Poondi Reservoir has been constructed in 1945 with a view to supplying drinking water to the Chennai City in the year 1945. The capacity of this reservoir is 77.91 mcm. Below the Poondi Reservoirs, two regulators were constructed (namely, Thamaraipakkam Anicut in 1879, and Valur Anicut in 1872) basically with a view to regulating water during flood seasons. While Cooum river takes from Kesavaram Anicut (constructed across Kosatha-laiyar river in the upstream), the Adayar river carried the surplus water to the Chembarambakkam tank. There was another water course – a man-made canal called Buckingham Canal constructed in the year 1806 linking up various lagoons all along the east coast to a total length of 618 km of which 161 km lie within the State of Tamilnadu. During the past, it served a navigational purpose.

The north-east monsoon and surface run-off from the Araniyar and the Kortalaiyar rivers replenish the Poondi, Cholavaram and Red Hills reservoirs. These reservoirs are shallow, spread over a total catchment area of 3,513 km^2. On average, the total freshwater yield from these three sources is 200 million litres a day (mld). To augment this shortage Chennai City currently draws about 100 mld of groundwater from the Araniyar-Kortalaiyar basin (AK Basin). The estimated sustainable yield from this basin is 100 million cubic meters (mcm) per year but the current total extraction is 300 mcm per year, three times the sustainable yield. This over-extraction from the AK Basin leads to sea water intrusion into the aquifer and shortages for local water users.

All these sources together supply about 300 mld in a year with average rainfall, which is nowhere near enough. During the dry seasons, these sources therefore have been supplemented for the past two decades by groundwater pumped from agricultural wells in peri-urban villages in North Chennai and in particular in Manali industrial area. These supply about 125 mld of water, which is roughly equal to the shortage in normal years for city water supply. Together with the 300 mld from the AK basin, total supply comes to around 425 mld.

But the current water needs of the city and its urban agglomeration are almost double this amount, of the order of 750 mld. By 2011, at 100 lpcd (litres per capita per day), the city would require an estimated 760 mld for a population that will have grown to 7.6 million. For the rest of the Madras (Chennai) Urban Agglomeration, an estimated 300 mld would be required for its 3 million population. If the estimated industrial requirement in 2011 is also added (another 250 mld), then the total requirement of the city and its extended urban areas would be of the order of 1,310 mld. If conveyance losses are assumed to be 25%, the water requirement at the point of supply will be of the order of 1,638 mld. Excluding losses, the projected demand in 2021 is going to be around 1,763 mld (Metro Water Board, Chennai, 2006). These are only conservative estimates, but even at these figures, the current supply from the surface sources is nowhere near what is needed.

Water scarcity for the Chennai City is not a new constraint. The city has been historically in water deficit for lack of perennial rivers. Successive governments in the State of Tamilnadu have spent over Rs. 40 billion on various drinking water supply augmentation measures for the city. In recent times two large-scale water supply schemes have been implemented: the Telugu-Ganga project (an inter-basin transfer project to get water from the Krishna basin from the State of Andhra Pradesh over a distance of about 400 km) and the New Veeranam project to take water from the Veeranam tank at a distance of over 250 km. In addition, a large number of well fields have been identified from the two adjacent districts of Tiruvallur and Kancheepuram which have been a big source of conflict between the Metro Water Board and peri-urban villages. The latest attempt by the government (still in early stage) is desalination plants to generate 100 mld. (see Figures 3.1 and 3.2).
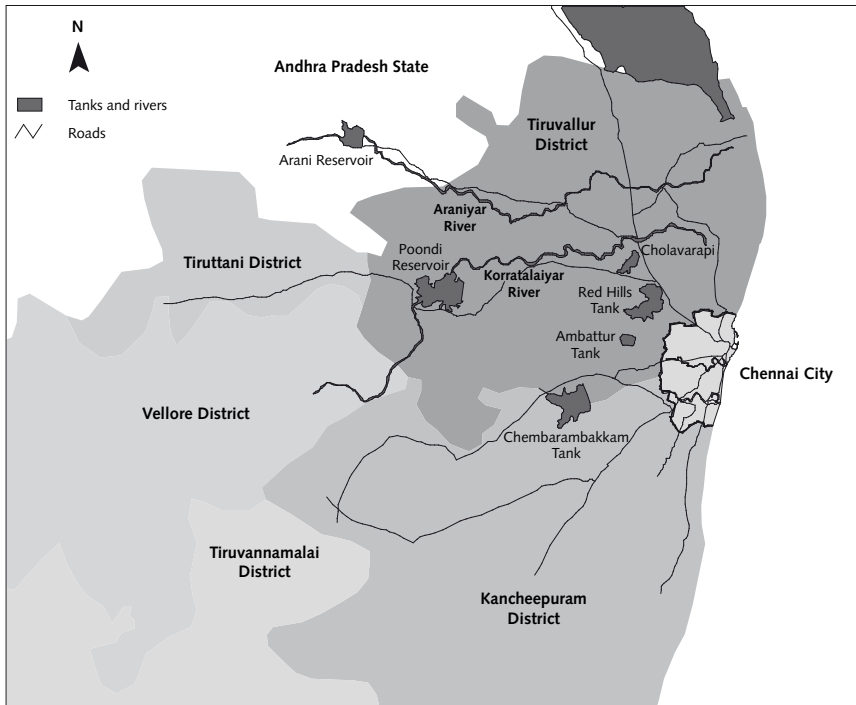
Figure 3.1 Map of city river basins and reservoirs

Despite these measures, water scarcity persists. Per capita water supply in Chennai is now hardly 76 litres a day, which is lower than any other city in India (Ruet, Saravanan and Zerah, 2002). But even this supply is irregular and, if conveyance losses are taken into account, the point-of-supply figure is nearer to 50 lpcd. Only in exceptionally good years is something like 76 lpcd supplied without interruption. In bad rainfall years, which are not infrequent in Chennai, water hardly flows through the pipes.

At such times, tankers directly transport raw water from peri-urban villages into the city. The Metro Water Board started pumping groundwater from peri-urban villages to supplement the city's water requirement as early as 1965. It identified rich aquifers (well fields) in the A-K as well as the Palar basin. The first well field identified was in Minjur in the A-K basin, about 40 km north of Chennai. Until recently, as much as 100 mld was pumped from the A-K basin well fields. Another 40 mld was pumped from the Palar Basin. Giant borewells in these well fields were installed for round-the-clock pumping. The continuous pumping from these well fields has damaged agriculture in these localities and the aquifer has become saline in parts due to seawater intrusion. During peak seasons, the Metro Water Board transports at least 6,000 tanker loads of water each day to the city from these well fields. In addition, numerous private operators also transport water from various peri-urban villages to supply many commercial establishments, hotels, construction sites and hospitals.

Acute water scarcity coupled with the ineffectiveness of government action has made the tanker water business a lucrative industry over a short span of time. In July 2000, for example, the piped water supply was only able to provide 59 lpcd. In response, the Metro Water Authority installed 4,525 tanks and hired 400 trucks of 9,000-12,000 litre capacity to make water deliveries to under-served areas. We estimate that over 13,000 tankers are mining the surrounding farmlands for water (Srinivasan, 2005) and every day at least 3,000 tanker loads of water go into the city to meet the needs of multi-storied apartments, hotels, hospitals, other commercial establishments, construction activities etc. During peak summer months this number shoots up steeply.

Figure 3.2 Map showing well fields around Chennai City's peri-urban areas

Inevitably, bottled water companies are also increasing in number in India. According to the Bureau of Indian Standards, there are now 1,200 water bottling companies across India, 400 of which are in Tamilnadu and over 200 in and around Chennai City. These companies make huge profits, and pay no license fee for groundwater extraction. Box 3.1 gives an impression of the bustling water market that has sprung up in and around Chennai.

Legal remedies? Chennai's groundwater laws

There have been several legal attempts to regulate Chennai water supply and wastewater management. The first attempt was Chennai Metropolitan Water Supply and Sewerage Act, 1978. The three main objectives of this Act were:
*   to promote and secure the planned development of water supply and sewerage services,

- the efficient operation, maintenance and regulation of the water supply and sewerage systems in Chennai Metropolitan Area,
- to prepare immediate and long-term measures to meet future demand for water and sewerage services in the Chennai Metropolitan Area.

Box 3.1 Bottled water markets in Chennai City

Tamilnadu accounts for 50 per cent of the total bottled water business in India. There are more than 400 registered units in this state of which more than 220 are located in and around Chennai. The water sales figures quoted by the South India Packaged Drinking Water Manufacturers Association are stunning:

Type of packaging	Price per unit	No of units sold per day	Total daily valued of sale (Rs)
250 ml polythene sachet	Rs.1	5 million	5.0 million
One litre bottle	Rs. 10 to 12	75,000	0.75 to 0.9 million
12 litre cans	Rs. 20 to 30	100,000	2.0 to 3.0 million
25 litre bubble top containers	Rs. 25 to.40	25,000	0.625 to 1.0 million
Water tankers carrying 10,000 to 12,000 litres	Rs. 600 to 1000*	10,000	6.0 to 10.0 million

Note: *The price variation is due to factors such as water quality, distance transported and season (summer or monsoon months).

The total spent on bottled water or water from tankers is therefore:
Rs.14.3 million to 19.9 million / day (US$ 0.3 to 0.4 million)
Rs.429 million to 597 million / month (US$ 9.5 to 13.3 million)
Rs.5.15 billion to 7.16 billion / year (US$110.4 to 159.1 million)
This would be enough money for 2.82 million to 3.92 million people to buy 500 grams of rice a day each (at Rs.10 per kilo of rice) for a whole year (515,000 to 716,000 tons of rice in a year).

Unfortunately, 25 years after the promulgation of this Act, Chennai's water problems have grown worse. To fill the growing gap between supply and demand, the Board resorted to tapping groundwater from the peri-urban villages of the Chennai City. So rapacious was the Chennai Metro Water Board that with a view to protecting the long-term water supply to Chennai City, the Chennai Metropolitan Area Ground Water (Regulation) Act was enacted in 1987, prohibiting groundwater extraction in 229 notified villages around the Chennai City for any purpose other than domestic use. Since then, the Act has been amended twice to increase the number of protected villages to 243 and then to

302. Even though the main purpose was to control groundwater extraction and illegal transportation of water from these areas into the city, the Act is apparently grossly violated not only by private individuals but by the government itself.

Metro Water Board is very much a party to the over-exploitation of ground water in these villages, contributing to a serious threat to livelihoods. Furthermore, in many villages groundwater quality has turned brackish or even saline due to seawater intrusion. Thousands of truck operators are still involved in commercial transaction in water in these villages and, worse, in some villages water companies have even been established. For example, in Mathur, a village listed in the Act, there are at least two water companies – Polo and Acqua – which pump, purify and sell raw water. The Tamil Nadu Groundwater (Development and Management) Act of 2003 has been enacted and received the assent of the President, with a view to protecting groundwater from hazards of over-exploitation and to ensure its planned development and proper management. But will these Acts make any difference to the water problems of the Chennai City and its peri-urban villages? Would these Acts be an answer or add fuel to the growing conflicts between urban and peri-urban areas? So far, we are seeing little change on the ground.

Social consequences and conflict in Chennai and peri-urban areas

Water transport from Chennai's peri-urban villages has been on the road for nearly four decades since the Metro Water Board started pumping groundwater, which has led to salinisation and groundwater depletion. But the conflict has intensified since the year 2000, since when Chennai and its peri-urban villages have faced continuous drought leading to a serious decline in the water table and water yields. To make up for the reduced yields, the Metro Water Board started purchasing water from private agricultural wells. Over 180 private agricultural wells were identified from which raw water was purchased at prices varying with the season and quality of groundwater. From each well at least 10 to 18 loads of water were pumped (0.1 to 0.2 mld). Many of these wells are now connected to the existing Metro Water system. The total estimated cost of hiring these agricultural wells is Rs. 85 million per year including the cost of civil works, hiring charges and current consumption charges.

We have seen that the water resource base is deteriorating. But what about the social aspect? To what extent is the decline in agricultural employment compensated for by non-farm job creation in peri-urban villages? To what extent is the conventional notion that cities are engines of growth true? This side of the story is even more depressing. The water transported from peri-urban villages to Chennai has created serious livelihood problems in the villages (Janakarajan, 2005). Continuous water transport to supplement the city's drinking water needs has drained water resources in peri-urban villages. The water table has dropped to an unsustainable low and in many parts groundwater has completely dried up. Existing surface water bodies are either completely neglected or encroached on.

Many farmers have become heavily indebted due to large investment that has gone into developing well irrigation without adequate returns. This has seriously affected agricultural activities in the peri-urban villages resulting in decimated agricultural incomes and considerably reduced employment opportunities. As a consequence, unemployment is now emerging as a major problem in the villages. Many landless agricultural labourers and marginal farmers have started migrating to other villages and towns and cities to find employment, becoming a sort of footloose population, putting extra pressure on the already stressed urban infrastructure.
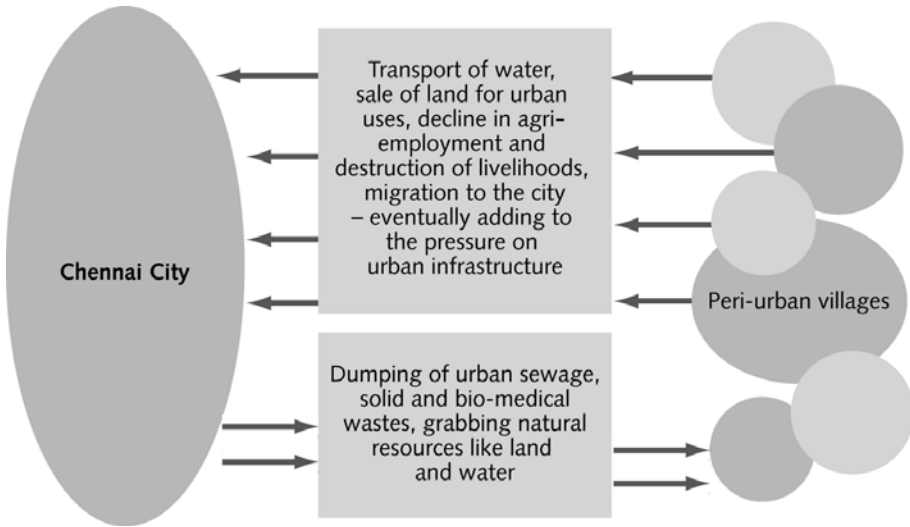
Figure 3.3 Pressure building between urban and peri-urban areas: The vicious circle

Whatever non-farm job opportunities have emerged in the peri-urban villages are incidental and unplanned. Some groups have obviously gained in the last two or three decades – water sellers, those employed in urban areas, traders, sand miners, brick manufacturers, a sugar factory in Palayaseevaram (PS) village, many bottling water companies, chemical units, etc. (See Box 3.2). The majority, however, have suffered from lack of assured and gainful employment, whether on-farm or non-farm. Even water sellers who benefited greatly by supplying the Metro Water Board started feeling the pinch after their bore-wells started drying up. Quite a number of water sellers started constructing houses when business was good; many of these houses remain incomplete. The drying up of aquifers led to the cancellation of contracts between the water sellers and the Metro Water Board. Many purchased tractors on loan but, in some cases, these remain disused because of lack of agricultural activity.

Many new housing colonies and settlements have sprung up recently in Chennai metropolitan area without adhering to any planning rules or regulation. Haphazard urban expansion has resulted in severe problems in managing civic

amenities such as drinking water supply, sanitation, solid waste and sewage management. Hundreds of civic associations in these areas struggle with local administrations (local *Panchayats* and municipal towns) to get people connected to such basic amenities. The facilities are not a patch on what is needed. As a result, not only the city but also the newly developing towns around metropolitan areas dump their solid and liquid waste in peri-urban locations.

A vicious circle has developed in which people migrate to the city for want of employment, for reasons such as the drying up of groundwater resources, the decline in agricultural employment and the overall degradation in the ecology and environment. On the other hand, the city experiences increasing demographic pressure which in turn puts enormous pressure on urban infrastructure such as land, housing, drinking water, sanitation, solid, liquid and bio-medical waste management, etc. To ease this population pressure, the city keeps extending its limits and thus the vicious circle continues (Figure 3.3).

The main reason for conflicts in the peri-urban areas of Chennai is that urban stress is transferred to peri-urban areas leading to a drain on natural resources such as land and water. Urban settlements and housing colonies in peri-urban villages are mushrooming, escalating drinking-water demand and posing a much bigger threat from solid-waste and wastewater disposal (Lakshmi and Janakarajan, 2005a and 2005b). This problem is aggravated by an institutional vacuum in peri-urban villages. Urban infrastructure such as good roads, drainage facility and sanitation, solid waste management and so forth are absent in these areas. The existing democratically elected bodies such as the *Panchayat* suffer from lack of resources and support from government.

Industries relocate to peri-urban regions to gain access to land and water, so that peri-urban land is bought for urban use. Increasing urban activities in the peri-urban areas lead to pollution and degradation of natural resources.

The village commons - land and traditional water bodies such as tanks - are encroached on or suffer neglect. The dramatic changes in land-use patterns in turn lead to falling agricultural employment in peri-urban areas, and serious livelihood problems. Women who lose agricultural employment are the worst hit.

Box 3.2 Changing occupational characteristics in peri-urban areas

A study in two of Chennai's peri-urban villages compared the number of people in various types of employment in 2005 with the situation in 1985. The results from this study are summarised below:

Type of occupation	Magaral			Palayaseevaram		
	Past	Present	Present/ Past (%)	Past	Present	Present/ Past (%)
Cultivators	71	70	98	87	39	45
Landless agricultural labourers	442	510	115	445	324	73
Total agricultural	443	580	131	532	363	68
Govt. employees	14	20	143	52	62	119
Business	5	25	500	21	81	386
Industries and transport	7	39	557	7	132	1886
Other workers	14	61	436	115	338	294
Livestock	2	11	550	4	23	575
Total non-agricultural	42	156	371	199	636	320
Studying	162	382	236	240	598	249
Children below 3 years	182	166	91	351	200	57
House work	76	181	238	65	233	358
Unemployed	Not available	71	---	2	284	14200
Sick, retired and old age	Not available	95	----	Not available	133	---

Both villages are severely affected due to over-exploitation of water resources but there is a major difference in occupational characteristics between Palayaseevaram and Magaral villages. In Magaral, agriculture continues to be the major occupation whereas in Palayaseevaram agriculture as an occupation has reduced in importance. The main reasons for this difference are the location of the villages and the different hydrogeological conditions. Palayaseevaram is located close to the national highway and is well connected by road and train. Since there are major towns on both sides of the village and since the Chennai City is also easily accessible, people find it easy to commute and seek employment elsewhere. In contrast, Magaral is not well connected by road, which makes it difficult for people to commute.

Another notable feature, which indicates decline in the importance of agricultural employment, is the increasing number of women reporting housework as their major occupation at present as compared two decades ago. For instance in Palayaseevaram, 65 women reported housework as their major occupation in 1985 and this number has gone up to 233 in 2005. In Magaral, this figure has gone up from 76 to 181. Similarly, there is a large increase in the number of people reporting to be unemployed in both villages. Unemployment did not exist in either village two decades ago.

Farmers whose land is most in demand for urban activities – roadside plots and those that have good groundwater potential – are real gainers and make windfall profits, but there are only few of them. A few landless agricultural labourers who migrate temporarily or permanently to look for jobs, are likewise better-off due to better wages. But for a majority, opportunities are scarcely available for a decent living (Janakarajan, 2005). The worst affected are women and the aged who are confined to villages and undertake all kinds of odd jobs for a meagre wage.

In between these two extremes are those farmers whose lands are not in demand (or suitable) for urban activities and who can no longer undertake successful cultivation due to a lack of labour force and water, as traditional irrigation institutions such as tanks and springs become defunct. This class of farmers faces a dilemma of whether to stay in villages and agriculture or seek different employment and leave the village. Prospects and opportunities for a decent living are not easily available.

Responses to all these pressures are not uniform. Some villages have meekly surrendered to the urban pressure; in others frustration with the situation has translated into widespread conflict and unrest. What follows are two examples, one each from the A-K basin and the Palar basin showing how water scarcity has precipitated tensions in two villages, Velliyur and Palayaseevaram. Many villages face similar issues.

Velliyur village in the A-K basin

Velliyur village[9] is located 50 km from Chennai in the A-K basin, with a population of 4,379 (2003 survey). Conflicts broke out here and took a violent turn after continuous pumping of groundwater for over 30 years. Although the village has one large tank, with a command area of 804 acres, groundwater remains the primary source of irrigation for paddy and groundnut, the main crops.

Since 1990, at least 60 dug wells have been abandoned due to the falling water table. While in 1980 there were 280 agricultural wells dug to a depth of 50-80 feet, now there are 220 wells and the depth is in the range of 130-160 feet. Water quality has also deteriorated compared to 10 years ago. Local domestic water supplies have been affected. While in 2000 drinking water was still supplied round the clock from four bore wells, by 2004 a total of 12 bore wells were required of which four have already stopped supplying water while the others can supply water for only two hours a day.

In 1969, 11 bore wells were installed to pump water from the common land of the village to supplement water supply to Chennai City and to supply nearby industries, representing a total of 16 mld. By 2000, however, 9 out of these 11

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9   Total land under irrigation 834 acres; total rain-fed area: 966 acres; total government land
    200 acres.

bore wells had failed. Since then water has been purchased from 75 farmers in the village, collecting at first 40 mld, an amount that fell to 16.84 mld in 2004. Of 75 bore wells which originally supplied water, only 55 were working by 2004. Moreover, the Tamilnadu Water Supply and Drainage (TWAD) Board[10] was planning to install seven more bore wells in the common lands of Velliyur in order to supply water to Thiruvallur town. Due to resistance from farmers, only four were actually commissioned.

Until 1995, the people of Velliyur village had been quite passive. They did not resist water being pumped from the common lands of the village for more than 30 years. But as the groundwater table decreased progressively, farmers had to spend substantial sums on deepening wells. Agriculture was very badly hit resulting in reduced farm income and employment, especially affecting the livelihoods of small farmers and landless agricultural labourers. It should be noted that groundwater levels are also falling in villages that are not a source of water supply for Chennai. In most cases, this is a result of unsustainable groundwater extraction for irrigation.

Local self-help groups (SHG) started to oppose transporting water out of the village in 1995. SHGs insisted that the village Panchayat should pass a resolution banning water sales from Velliyur village. But the Panchayat declined, since groundwater is pumped only from government land. When water purchases from farmers started in 2000, the village population again revolted. Again the village Panchayat refused to pass a resolution against water sales on the grounds that individual farmers sell water from their own land. Since the property rights on groundwater are undefined, nothing much could be done. Some village residents filed a court case to ban water sales from the village. They were successful in getting a stay but this was quashed by an appeal petition filed by a water-seller supported by the Metro Water Board. Under such duress, in the year 2003, almost all the agricultural land was left uncultivated and the landless population either had to seek engagement from companies that mine sand from the river or to migrate in search of employment.

As a consequence of extensive sand mining, water yields from wells reduced considerably[11]. When water-selling farmers protested against it, the Metro Board took up the issue with the government and stopped the sand mining. This has affected the livelihoods of landless agricultural labourers. This is another vicious circle in which agricultural labourers were pushed into sand mining due to the distressed state of agriculture, and when sand mining was banned, they also joined the protesting masses of the village. Thus, violent conflict broke out on 15 August 2004. Over 400 people gathered near the Metro Water Board pumping

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10   While the Metro Water Board is responsible for supplying water to the city, the TWAD Board is responsible for supplying water to all other parts of the state.
11   Sand mining, which is quite extensive in the Kosathalaiyar riverbed, also drastically reduced water yields in the riverbed aquifer.

station. Metro Water officials and higher officers of the revenue department arrived on the scene and tried to resolve the issue. To stem the crisis, a peace committee was formed consisting of water sellers, non-sellers, SHGs and officials. During the peace committee meeting, it was decided that water sales from farmers to the Board would stop after 15 September 2004. Everyone including the Metro Water officials, sellers, non-sellers and all other villagers agreed to abide by this decision.

But on 15 September 2004, Metro Water officials reported that water purchases would not be stopped, since the higher authorities at Metro Water did not agree with the agreement. Water-sellers were also willing to continue to sell water, and had meanwhile tried to obtain a stay from the court against the decision taken during the peace committee meeting. Since the non-sellers suspected the sellers might seek legal protection, they had also moved the court to award a stay on water sales. Both moves were unsuccessful. On 16 September 2004, the entire village gathered near the Metro Water Board's giant water storage tank from where water was pumped, and at 11am blocked the road. When the higher revenue department officials arrived, they refused to agree to stop water purchases from private wells. At this point, some people from the protesting group broke the pipeline structures, which belonged to the Metro Water Board. After this, the police arrested 44 people from Velliyur under the Public Property Damaging Act and remanded them in judicial custody for 15 days. The Metro Water Board demanded compensation of Rs. 30,000 from the protestors. The court in fact instructed the arrested farmers to pay the compensation but the Water Board case has never been withdrawn. Water selling started again, and Metro Water officials are openly soliciting more farmers to come forward to sell water. The Board put up a notice and even circulated it among the farmers stating that whoever is willing to sell water can approach Metro Water to have a one-year agreement.

Palayaseevaram village in the Palar basin

This village of 5,285 people (according to the 2001 census) is located 50 km from Chennai City close to the national highway. Its location right on the Palar River means that it has benefited a great deal from the river water for irrigation. This used to be an agriculturally prosperous village that had access to 8 surface sources for irrigation with a total command area of 1,191 acres. Groundwater only provided supplementary irrigation. In 1980, there were 71 wells (24 in wet lands and 47 in dry lands) supplying water from depths in the range of 24 to 27 feet. Now there are 150 wells (50 bore wells, 100 open wells) whose depth is in the range of 60 to 100 feet. At the time of the survey in 2004, only 20 of these wells were in use. The quality of water has declined drastically along with the water table. Agricultural land was fully cultivated until 1985, but by 1990 the area under paddy and sugarcane – the main crops – had reduced to 200 and 100 acres respectively, and by 2004, to only 15 and 10 acres. Weeds and wild vegetation currently invade most of the area. Drinking water services in the village have worsened to the same degree. In 1990, drinking water was supplied for 5 hours per day; by 2002 the service had reduced to one hour per day.

In 1972, it was decided to pump water from the Palar riverbed at this village to supply water to areas adjoining the city such as Alandur, Pallavaram, Chrompet, Tambaram, Anakaputhur, Pammal, Chithilapakkam, Vandalur Zoo, etc. The people of Palayaseevaram village opposed this move on the grounds that it would affect the groundwater availability in the region. A memorandum was also submitted to the District Collector and the issue was taken up for discussion at the Chief Minister level. However, in the end, the government took a decision in favour of the city and, accordingly, that same year the TWAD Board dug five wells and subsequently six more wells in the Palar riverbed. For the past five years, supply of water in these wells has fallen drastically. By 2004, the estimated demand for this region was at least 45 mld up from 22 mld in 1972. Six more wells were dug in 2004 on the other side of the river bank, which is part of the village called Pullambakkam / Thirumukkodal. The main reasons for the dwindling water supply from these wells are round-the-clock pumping for over three decades and substantial and illegal sand mining in the riverbed far beyond permissible limits. All these have adversely affected the agriculture in the village. Groundwater has even become scarce for drinking.

Not only Palayaseevaram, but all villages in this stretch, including Thimmavaram, Athur and Palur, were badly hit due to round-the-clock pumping either by the Metro Water Board or by the TWAD Board. In fact, there is a virtual competition between these two State agencies in pumping water to supply to their respective constituent populations. And wherever these agencies were not pumping, private tanker trucks pumped water to sell in the city. The sugar mill, which was constructed in 1987 in Palayaseevaram village, was strongly opposed by the people. At present, the mill generates a good deal of effluent and discharges it into a village tank that provides irrigation for 423 acres in this village. The sugar factory has also blocked the water flow in one of the main canals that eventually supplies water to the big tank of the village. In parallel to the damage caused by the State agencies, the sugar factory has also been instrumental in destroying livelihoods in the village.

Several petitions and memorandums were sent to the government and a group of NGO organisations organised a series of demonstrations and a public hearing. The jurists of the public hearing committee (one of them a retired Supreme Court Judge) severely condemned the illegal sand mining and competitive water pumping and suggested that the Government appoint a Committee to investigate the damage done to the river. But despite these efforts, both activities continued.

The response on the part of the people of this village was weak and passive. People either absorb the shock of water depletion or leave the village for urban employment. Many have sold their lands and many more are planning to sell. If there are no severe conflicts despite severe damage to the ecology and livelihoods of this village, it is because of reasons such as the following:
• The village is located on the main corridor linked to Chennai.

- Sand mining is a lucrative activity for the small farmers and landless agricultural population.
- There is a growing number of absentee landlords.
- A very powerful sugar mill lobby has the highest political connections and local people feel intimidated.
- There has been growth of non-farm employment such as the construction industry in urban areas, railway contract work, employment in the local sugar mill, vegetable and fruit selling in urban areas, other petty business etc., and a scarcity of farm labourers who find more gainful employment in non-farm activities such as sand mining, and construction.

Intervention objectives and methodology

The Negowat project in Chennai aimed to document and analyse the impact of unregulated and unchecked horizontal urban expansion on natural resources, in particular water and its impact on poverty, livelihoods, environment and health conditions of people living in peri-urban areas. We also developed and tested tools and institutional structures to support and enable effective stakeholder-led water resources management for negotiating emerging conflicts and water rights. These aimed to draw upon contemporary developments in Integrated Water Resources Management (IWRM), and decision support methodologies that can be readily understood and adapted to meet the needs of multi-stakeholder groups. Broadly two segments of the Chennai peri-urban area were identified: the A-K and Palar catchments.

The methodology of the study comprised a variety of components. Besides official sources of data, we conducted a meso-level survey in these adjoining basins of the city (covering 23 villages and 41 villages respectively from Palar and A-K river basins) and, in 2004-05, a detailed survey in two villages (Palayaseevaram in the Palar and Magarel in the A-K basin) with a view to collecting information on various aspects such as poverty and livelihoods, current and past water use pattern, nature, extent and history of rural-urban water market, impact of water sales on agriculture, employment, income, ecology and environment and so on. We conducted a water resource audit in MAG village block and the Chennai City. We used Geographic Information Systems (GIS) to map over 2000 surface water bodies (tanks) in the two adjoining districts of Chennai City. Furthermore, we built agent-based models or Bayesian networks, and carried out stakeholder analysis and conflict analysis to understand and characterise multi-stakeholder groups and their conflicting interests. Last but not least, we developed multi-stakeholder platforms (MPSs) and user groups for shared learning and for a sustained dialogue to promote stakeholder-led Integrated Water Resources Management. The next section relates our experiences with two of our methodologies: multi-stakeholder dialogue and the water source inventory.

Stakeholder analysis

An in-depth conflict analysis between urban and peri-urban areas throws interesting light on clashing viewpoints of various stakeholders. This is summarised in Table 3.2.

Table 3.2   Stakeholder perspectives on water conflict in peri-urban Chennai

Type of stakeholder	Reasons for conflict	Challenging whom?
Farmers / well owners / water-sellers	Reduction in profit due to not selling water to Metro Water Board	Those who protest against water sales to Metro Water and TWAD Board
Farmers (non-water selling well owners and all others in the village)	Destruction of livelihoods in villages due to declining water table and agriculture	Water sellers, Metro Water Board and TWAD Board
Landless agricultural labourers	Loss of income and livelihoods	Metro Water Board, TWAD Board, water- sellers who protested against sand mining since their wells do not recharge due to sand mining
Metro Water Board	Compulsion to supplement the city's water needs	Village population protesting against water sales and competing with TWAD Board
TWAD Board	Compulsion to supply water to the city's adjoining areas	Protesting village population against water sales and competing with Metro Water Board
Private tanker operators	Reduction in profit	Those who protest against water sales to Metro Water and TWAD Board
Water companies	Reduction in profit	Those who protest against water sales and civil society organisations
City dwellers and residents' welfare associations	Reduction in drinking water supply	Metro Water and TWAD Board
Civil society organisations	Destruction of livelihood and falling water table	Water sellers, illegal sand miners, Metro Water and TWAD Board

From this stakeholder analysis, four sets of stakeholders can be identified in the context of Chennai peri-urban water markets. These are:

- The State (all official agencies and political leaders)
- Peri-urban agricultural and non-agricultural population
- Other urban stakeholders
- Civil Society

Table 3.3 details the different groups that belong to those categories.

Table 3.3 Inventory of stakeholders by category

State Representatives	Peri-urban population	Other urban interests	Civil society

• Metro-Water Supply and Drainage Board
• Tamilnadu Water Supply and Drainage Board
• Chennai Metropolitan Development Authority
• Village Administrative Officer (VAO)
• Block Development Officer (BDO)
• Thasildar (the Revenue Department taluk-level head)
• District Collector
• Public Works Department (water resources)
• State and Central Groundwater Boards
• Chennai City Municipal Corporation
• Departments of Agriculture, Revenue, Forest and a few others concerned with water
• Tamilnadu Pollution Control Board
• Member of Legislative Assembly (MLA) and Member of Parliament (MP)
	Farmers:
	• Land and well owners
	  o Water sellers
	  o Non-water sellers
	• Land owners who do not own wells
	• Tenant cultivators
	• Landless agricultural labourers
	• Women Self-Help Groups
	
	Non-farmers
	• Village Panchayat
	• Village-level informal institutions
		• Tanker-truck operators and their Association
		• Water companies who sell purified drinking water
		• High-profile hospitals and hotels
		• Educational institutions
		• Commercial enterprises, industries, major educational institutions and government offices. Flat promoters, Residents' Welfare Associations and other urban water users
			• Non-Governmental Organisations (NGOs)
			• Activists
			• Researchers
			• Media

Relative strengths and weaknesses of stakeholders

The State has enormous power, control and authority. Other urban stakeholders go hand-in-hand with the State in the context of exploiting resources from peri-urban villages. This set of stakeholders also demonstrate urgency and claim legitimacy in transporting water from peri-urban areas. In other words, the State and other urban stakeholder groups strengthen each other and eventually their strength and power develops so that they become a really threatening alliance. They constitute a market that is profit-driven rather than anything else. The third set of stakeholders, civil society organisations, activists, researchers and media, indulges in investigating, writing and campaigning against depletion and pollution of resources in the peri-urban and rural areas. They play a critical role, but this set of stakeholders lack power and may not have a clear constituency.

Unlike other stakeholders, the peri-urban population does not constitute a single homogeneous group. The water-selling farmers align themselves with the State and urban stakeholders and make a short-term profit. But it is very difficult to say whether they sell water voluntarily. Available evidence suggests that water-sellers are encouraged or even feel compelled to sell water to Metro Water Board. In other cases, farmers feel entrapped into selling water to private truck operators or private companies. All other farmers perceive the water sellers as enemies, and ultimately all are affected, since their wells go dry due to round-the-clock pumping. They are a voiceless and powerless community, suffering the brunt of water transport and other damages to the local ecology and environment. They are left with two options: to stay and suffer or to flee to the city. The second option is generally exercised by a few who are educated and resource-rich. Even the democratically elected village Panchayat Board becomes powerless. As a result, we find a virtual institutional vacuum.

Building multi-stakeholder platforms for dialogue

An ideal situation would be one in which both Chennai City and peri-urban villages co-exist and co-operate with each other for each other's benefit; while cities can act as engines of development of both city and peri-urban areas, the latter can contribute to urban development in a win-win situation.

But how do you move from conflict to cooperation? It is neither easy to define this path nor to define the time frame for the trip. After all, conflicts occur in this case primarily because a group of independent operators who are politically and economically powerful can dominate decision-making. This group will lose out if a high degree of cooperation is achieved among all stakeholders. On the other hand, the majority of the peri-urban population are losing out anyway, so they are more than happy to participate in dialogue and reach a level of cooperation.

In this situation it is possible that, until one reaches a threshold level of crisis, those who have so far gained may not be interested in dialogue because of the advantage of the free operation of the market and the support they enjoy from the State. This does not mean that one should not start the dialogue process

before a crisis develops. This is precisely where MSPs and multi-stakeholder dialogues (MSDs) can play a key role.

In the case of Chennai City and peri-urban villages, conflicts have reached an intense level but not yet reached the threshold level of crisis – unlike the situation in the Palar and Cauvery Basins[12]. Nevertheless, we managed to initiate an MSD in Chennai's peri-urban area. A committee of stakeholders with 64 members drawn from all sections of society has been formed and held a series of multi-stakeholder meetings. Since July 2004, many key issues have been brainstormed and the process continues to date. The stakeholder committee has discussed at length, not only threats to livelihoods in peri-urban villages, but also possible solutions to the drinking water problems of Chennai City. Several issues and solutions were discussed.

Firstly, there was unanimity in emphasising the need for revamping water storage bodies such as tanks in peri-urban villages and suggesting ways and means to the government for modernising and strengthening them. Through this measure, an improved groundwater level would not only protect local agriculture but also enable the excess or unclaimed water to contribute to the City's needs. This was seen as a priority issue.

What have we done so far?
• All records about water in 2,600 tanks in two adjoining districts have been collected from government records.
• We gathered all relevant topographical maps relating to the year 1971 and digitised them in GIS.
• All the details recorded in the original tank records are being fed into the digitised maps.

What are we planning to do next?
• The next step is to get the latest satellite imageries and super impose them on the 1971 maps.
• A survey of the current state of all 2,600 tanks will be fed into the database. A survey of 30 tanks has already been conducted with the help of stakeholders.
• Building up a picture of the state of the tanks at three different time periods will help us identify those tanks that are still in retrievable shape. We will work out the rehabilitation costs and submit a bid to government through the stakeholders' committee.

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12   The lead author has initiated MSD initiatives in the conflict-ridden river basins of Palar and Cauvery in South India. In these river basins, conflicts have reached a threshold level of crisis in which even the highest judicial authority of the country could not travel too far. When everything has failed, the MSD among all stakeholders seems the only option for arriving at some kind of consensus and cooperation.

Secondly, the committee of stakeholders felt that solutions to the Chennai water crisis need to be approached carefully and not with *ad hoc* measures as in the past. Many stakeholders expressed the opinion that before launching any mega projects – like bringing water from other basins, such as Telugu Ganga or Veeranam – it is absolutely necessary to examine what is available locally. It is true that Chennai City is neither located on the banks of a perennial river nor has any big perennial reservoirs from which water can be drawn, but local resources is still an extremely relevant question. There are at least 70 temple tanks and ponds in different parts of the city, which used to fill during the monsoon months. Now most of them are silted up, and the supply channels have disappeared under building work. The need of the hour is to restore all these tanks to their original condition and to restore the flow of rain/flood water to them during monsoon months. The simplest way would be to link storm water drains with these tanks; at present huge amounts of floodwater flow into sewage drains or into the city's polluted rivers.

This measure would not cost much, compared with what is spent on big projects. The potential benefits would be significant. However, this measure can only be part of a solution to Chennai's water supply problems because the scope for augmenting water resources via tank rehabilitation is relatively small when compared to current and project demand. Similarly, the proposed construction of a series of check dams along Araniyar and Kosathaliyar rivers is likely to augment water resources, particularly during above average rainfall years, but have only a limited impact in terms of overcoming current and projected imbalances between water demand and water supply. The simple fact is that Chennai's current and future water supply can only be met by accessing large volumes of ground and surface water (i.e. 'blue' water) from peri-urban and more distant rural areas.

The city also generates about 680 mld of sewage water which is at present not properly utilised. Except for 100 to 150 mld, supplied to Chennai Petroleum and others after primary treatment for industrial uses, the rest is let into the city's rivers either untreated or after primary treatment. There is huge scope for recycling this water, even for domestic uses. Environmental engineering experts point out that the cost of sewage water treatment is lower than seawater desalination.

Multi-stakeholder dialogue in the final analysis

On the whole, a threshold level of crisis seems to be necessary to make the dialogue initiative more sustainable and to ensure the active participation of all opposing stakeholders. Otherwise, only one set of stakeholders – those who are already losing out – will participate. In the case of Chennai peri-urban villages, stakeholder participation is less than expected and many villages are getting swamped in the urbanisation process.

Box 3.3 Water resource audits

The rationale behind water audits is that, in the absence of good quality information, stakeholder dialogue is uninformed and stakeholders have no basis to challenge factually incorrect or biased positions. Similarly, effective cross-sectoral and/or multi-scalar planning is near to impossible if stakeholders are working with their own differing information bases. Hence, the main challenge of water resource audits is to establish a common information base that is acceptable and accessible to all stakeholders.

The initial steps in performing a water resource are to:
- Specify initial spatial and temporal boundaries for information collection. The spatial boundaries can be physical or institutional, for example village boundaries, watersheds or aquifers. The temporal boundaries are the time limits (both past and future) for considering key trends. While the focus of analysis may be primarily at one particular level (e.g. the intermediate level), it is important to collect sufficient information at higher and lower levels to be able to make judgements regarding, for example, upstream and downstream impacts and dependencies.
- Specify the required degree of disaggregation of information collection and analysis, the scales of maps, and levels of precision that are required.
- Identify sources of easily available secondary information; and decide what primary data will have to be collected to fill gaps and to bring existing information up to date.
- Decide on the level of specialist support (if any) and analytical tools that may be needed.

Although there is no fixed formula or iterative sequence for undertaking a water resource audit, in generic terms, there are five main steps:
- **Awareness raising**. This is vital if stakeholders are to become fully involved. Particular attention has to be given to ensuring that the poor and other marginalised groups are both aware of what is happening and are able to participate or are sufficiently represented.
- **User group analysis**. This is critical to ensuring that water resource audits are poverty and gender focused. Essentially this step revolves around building a complete understanding of different water-user groups; who has access and who maintains control over water.
- **Gathering information and quality control**. This involves identifying and accessing sources of secondary information, quality controlling and consolidating this information into an information-base using the Resource-Infrastructure-Demand-Access (RIDA) framework* and, where necessary, collecting and quality controlling additional primary data (primary data collection will almost invariably be required for access and demand related aspects). Triangulation between data from different sources and levels is useful in ensuring internal consistency.
- **Data analysis**. This can involve a whole range of analytical and statistical techniques that include time series and water balance analysis, structured using the RIDA framework1. The aim of data analysis is to further investigate the causes (and possible solutions) of water-related problems. This step will require the development of information systems, using at least spreadsheets and GIS, and in more complex cases data-bases and modelling.
- **Dissemination**. Dissemination of information to key stakeholders in a format that will support stakeholder dialogue

* The RIDA Framework helps to structure water audits logically in a way that aids and improves analysis and stakeholder dialogue. The concept of RIDA framework is simple. It is that users (their demand for and access to water) are linked to water resources by water supply infrastructure. And, that each of these three components of water systems has its own institutions and issues.

Dialogue is never smooth: a lot of ups and downs should be expected. Sound research as well as active and sustained support is therefore a necessary condition for undertaking and carrying forward dialogue. In this respect, the MSD needs an untiring facilitator who can carry on with the job of facilitating and sustaining a platform where the dialogue can continue.

Multi-stakeholder dialogue is not a panacea; the final outcome is uncertain and difficult to judge. Still, in the absence of a viable alternative, there is a case for pushing the dialogue initiative as far as possible until one approaches a viable solution.

The water resource audit

The Negowat-India project also made a wider assessment of the capacity of the Chennai City to manage the available water resource within its command, both for the current and the expected population (Janakarajan *et al.*, 2005). The main motivation behind this exercise was to:

- identify and evaluate potentially viable options for tackling Chennai's water problems,
- develop a water-related vision for what might be achieved by 2015,
- develop a range of demand scenarios that take account of some of the most important factors that influence demand,
- develop and evaluate a number of strategies for achieving the vision taking account of demand scenarios and negative impacts on peri-urban areas.

The best estimates of Chennai's water supply and water demand indicate that the amount of water that can be accessed and used practically is of the order of 75 lpcd in good years – or at best approximately half the demand based on a domestic demand of 150 litres per capita per day (lpcd). Demand is increasing rapidly, in line with a rapidly increasing population, increasing rural–urban migration and industrialisation. Taken as a whole, the available evidence suggests that Chennai's water supply situation is at crisis point, in particular, for the poorer social groups.

As households in relatively wealthier areas of the city are reportedly using well above this daily volume of water, it means that households in poorer areas use much less. There are also severe problems with sanitation and sewage treatments, and there is also plenty of evidence that indicates that Chennai's ever-increasing water footprint is causing real hardship for many water users in peri-urban villages. In this study, it is estimated that by 2015 the demand of the Chennai metropolitan area will be in the range of 425 – 830 mcm/year.

Most demand estimates do not include pipe leakages or losses from tankers. Quite obviously the lower these losses, the lower the infrastructural capacity required and the lower the pressure on water resources. Estimates of demand calculated here include a 25% allowance for conveyance losses.

The starting point for better management of Chennai's water services must be a long-term vision that also takes into account water resources development in the

districts from which water will be supplied to the metropolitan area. This vision should be SMART (Specific, Measurable, Achievable, Realistic and Time-bound) and be the output of a consultative process that has the active involvement of all primary stakeholders.

Four scenarios have been developed from the water resource audit, based on the assumption that issues linked to changing demand and population growth will continue to be the major drivers of water demand. Many other factors will also have a major bearing on demand for 'blue' water (surface water or groundwater) as opposed to recycled water, treated wastewater or desalinated seawater.

The audit report lists twenty-two options for tackling Chennai's water problems. None are entirely new; they have all been identified by individuals and organisations with a long history of working in and around Chennai. With the help of demand scenarios, which themselves include options for demand management, the report identifies different water supply strategies and then evaluates these against the vision.

If Chennai's demand continues to increase at current rates and if the major source of 'blue'water supply is rainfall in the metropolitan area and adjacent districts of Kancheepuram and Tiruvallur, we estimate that – in an average rainfall year – domestic and urban demand in the metro area and these two districts will be equivalent to 50% of all the renewable 'blue' water.

Summary, lessons learned and moving forward

We have tried to answer some fundamental questions in this study.
- Since urbanisation is an inevitable process, should we let the peri-urban population and areas suffer?
- Is there a way in which the spread of urbanisation could be harnessed better for the advantage of both populations?
- Why have most policy options tried so far failed in this regard?
- What policy measures would not only contribute to resolving urban and peri-urban conflicts but also contribute to improving livelihoods and environmental conditions in peri-urban villages?

For a long time, social-science or hydrology-related research has focused mainly on urban or rural issues. However, peri-urban problems have surfaced as a major issue, which policymakers no longer can ignore during the last couple of decades, as is clear from the way that many urban expansion plans have stalled due to stiff resistance shown by peri-urban farmers[13]. Most approaches towards solving urban

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13   Two important projects of the Government of Tamilnadu could be cited as examples in this regard. First the project which entailed shifting of the entire State secretariat to peri-urban villages at a distance of 40 km in about 2,000 acres. The second was the construction of a satellite town at a distance of 50 km from Chennai in an area of over 4,000 acres. Both projects, announced in the State Legislative Assembly, had to be abandoned due to stiff opposition from the peri-urban population.

problems and water stress have so far failed because rural, peri-urban and urban issues were treated in isolation. There is now an urgent need to view urban, peri-urban and rural segments of a region as a part of a single but integrated livelihood and ecosystem. In other words, all three segments are very much a part of an integrated socio-economic developmental process of an economy, or as Iaquinta and Drescher (2000) express it: "rural, peri-urban and urban form a linked system (R-PU-U), which constitutes an uneven multidimensional continuum". A fragmented approach would only bring about rural/urban and peri-urban/urban divide, besides contributing to the destruction of ecology, environment and livelihood options in the rural and peri-urban areas.

Horizontal urban expansion encroaches upon natural resources, in particular land and water, enjoyed hitherto by rural and peri-urban communities. As a consequence, severe competition and conflicts flare up between urban and peri-urban areas. While Municipal Corporations, Housing Boards and State Metro Water Agencies collectively negotiate claims over land and water rights on behalf of urban areas, the peri-urban areas are represented individually and often are subject to threats. These kinds of negotiation are often one-sided because of the unequal bargaining power enjoyed by these Agencies. This is precisely the context in which a collective multi-stakeholder dialogue approach and a participatory planning process would be useful for a better negotiated democratic settlement.

Although urban interests are deeply committed to making the most of the available land and water resources in rural and peri-urban areas, hardly any State Agencies pay sufficient attention to documenting or analysing patterns and intensities of vulnerabilities and their long-term implications. The peri-urban population depends upon land for livelihood, commons for fuel wood and water for agriculture, animal rearing and drinking. Therefore, the whole range of livelihood options is affected when water is transported to urban areas. These areas are in a state of decay, in particular for those who depend upon agriculture for their livelihoods, who make up the majority population. Those who benefit from the spillover effects of urban development (e.g. enhanced land values, or water sales) constitute a minority. It is important to focus on how the majority, whose livelihoods are affected, cope with these effects. Are there any institutional mechanisms to cope with peri-urban issues relating to natural resource management? Are Panchayat bodies aware of this and what concrete actions have they taken so far to deal with urban expansion? The State institutions do not take any coordinated action to preserve the local natural resources; instead they pull in opposite directions – due to a fractured institutional set-up. There is no legal mechanism to protect livelihoods and the ecology of peri-urban areas.

This was the context in which the multi-stakeholder dialogue in the peri-urban areas of Chennai was organised. In the stakeholder committee meetings, several measures were discussed to see if we could come up with solutions that were good for both Chennai City and the peri-urban areas. The MSD meetings created a stir in Chennai, with the media reporting extensively on the dialogue process.

Most importantly, the multi-stakeholder dialogue initiative has an agenda of social learning as well as a negotiation process that seeks a win-win settlement. This process provides an alternative to centralised decision-making, which often fails. But clearly there is a limit to the extent a researcher can sustain the MSD process. NGOs need to be trained in conflict resolution. Ensuring stakeholder participation in multi-stakeholder dialogue is a gradual process that requires research and ongoing stakeholder analysis.

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São Paulo, Brazil.
Top left: Informal settlements
in areas outside the city; top
right: a roleplay game in action;
middle: despite urban growth,
agriculture remains important;
bottom: Guarapiranga Reservoir.

CHAPTER 4

Building capacities to tackle the infrastructural and environmental crisis in São Paulo: Role-playing games for participatory modelling

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"Foi bom sentir na pele como é ser enganado, não me informar direito (eu comprei terras que estavam sendo invadidas), a impotência diante de uma postura imprevista do prefeito e como é difícil ter uma visão global das coisas (lucro com agricultura irrigada e qualidade da bacia)."

"It was good to feel in my skin what it means to be cheated, not to be able to inform myself (I bought land that had been invaded by squatters), my impotence in front of the unexpected posture of the mayor and how difficult it is to have a global vision of the situation (for example of the benefit of irrigated agriculture or water quality in catchment areas)."
(A player's comment at the end of a role-playing game)

São Paulo's peri-urban problems

Peri-urban São Paulo is facing a serious water crisis. It is not for lack of rain – on average the area receives a comfortable 1,500 mm per year. It is also not for lack of institutions, water governance is embedded in highly institutionalised formal structures. Neither is it for lack of policies, since there are now highly progressive integrated land and water management policies in place. But conflicts between the main agencies, weak representation of local communities in the participatory bodies, large social inequalities and asymmetry of information and decision-making power make for a weak and ineffective implementation of land and water policy. As a consequence, water quality suffers, and adequate supply and sanitation services are lacking. To try and get the different actors around the table, the Negowat team in Brazil devised computer-based and real-life games. This chapter explains the background and experiences with this approach.

The Metropolitan Region of São Paulo (RMSP) is the most populated and industrialised region of Latin America, hosting some 18 millions inhabitants in a conurbation of 39 adjacent cities (Braga, 2000). The Alto Tietê catchment, upstream of the river Tietê includes most of metropolitan São Paulo.

Urbanisation processes have impacted enormously on the Alto Tietê catchment. As the river cannot supply all the domestic, industrial and agricultural water demand for such a large urban centre alone, half the domestic water supply (estimated at 61 m³/s in total) is imported from the neighbouring Piracicaba Jundiai water basin (FUSP, 2001). Moreover, there is heavy demographic pressure on water resources: while population growth has fallen to 1.4% per year city-wide, the peripheral areas are continuing to grow at an average rate of 3 to 5% (FUSP, 2001). The water supply system in the metropolis, six centralised and interconnected production systems managed by a public-private enterprise, SABESP (*Companhia de Saneamento Básico do Estado de São Paulo*), is reaching its limits. Supply problems are anticipated by 2010 (Porto *et al.*, 2003).

Figure 4.1 Location of the Metropolitan Region of São Paulo within São Paulo State
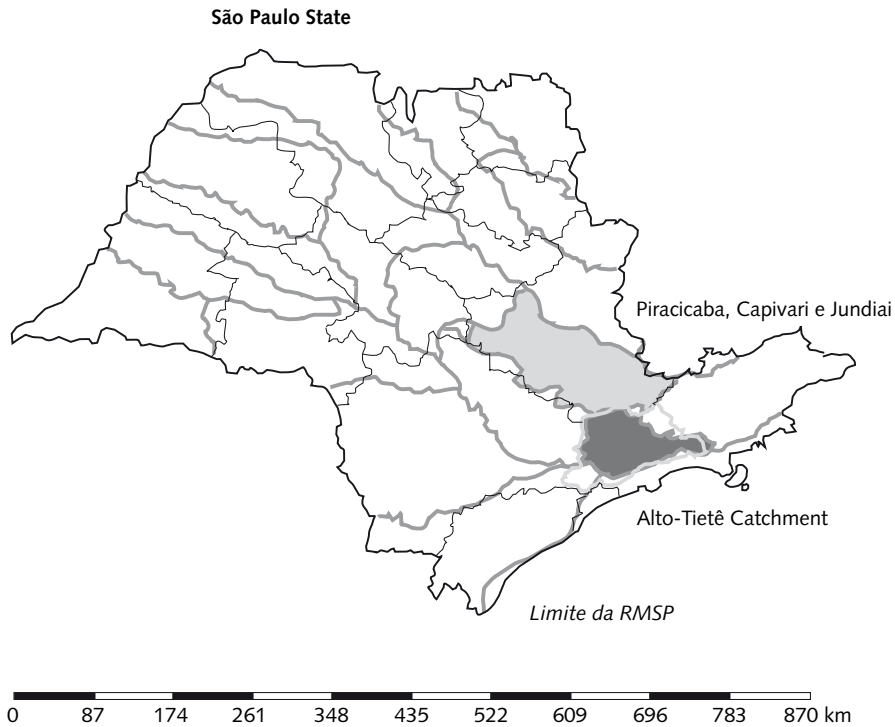
Figure 4.2 The different water management areas of São Paulo state

While drinking water distribution has an excellent coverage rate (close to 100%) in the regular urban areas, it is more precarious in peripheral areas. Moreover, except for the Cabeceiras-Tietê sub-catchment, water quality is low in the whole catchment area (Porto, 2003). The pollution that degrades the water bodies primarily comes from non-point sources, such as surface run-off and non-treated domestic effluent.

SABESP also manages a centralised system of sanitation: six large effluent treatment stations, which together cover most municipalities in the metropolis. However, the collection of domestic effluents remains incomplete. Despite recent investment, only an estimated 65% of effluent was collected and only 32% treated in 2000 (Porto, 2003). Domestic wastewater collection is especially low in the peri-urban areas, which are particularly affected by the rapid development of sub-standard settlements.

Social inequalities in Brazil are great and housing policies poor. As a consequence, poor people often see no other option but to settle on the margins of the city. Unfortunately these marginal areas also happen to be in the catchment headwater areas (*mananciais*) where springs arise. Ironically, the same legislation that aimed to protect the *mananciais* caused land values to fall, as all the land adjoining them

is public. This attracted many poor newcomers, leading to slum areas without water and sanitation services, and much human waste polluting the springs (Marcondes, 1999; Bellenzani, 2000). Almost an estimated million people have now settled in the protected areas of the municipality of São Paulo. In the remaining unsettled areas, a lively land market has developed.

Legal progress

To reduce pressure on the *mananciais*, water legislation has focused on their protection especially in the spring areas. In the beginning of the 1970s, a command-and-control type of legislation (*Lei de Proteção dos Mananciais)* was implemented to control land occupation and to protect the Alto Tietê catchment from polluting land uses. These measures however failed to significantly contain the urbanisation processes or reshape city growth (Marcondes, 1999; Bellenzani, 2000). Illegal settlements without sanitation infrastructure continued to spread. This led to a decrease in water quality in the main reservoirs, which growing competition between agencies and a corporatist vision of water management was ill-equipped to tackle (Prette, 2000).

In the 1980s, things seemed to take a turn for the better when Brazil adopted a policy of integrated water management, combining various legal instruments at federal and state level to facilitate management of water at catchment level. This takes into account different water uses and promotes participation of civil society in the management process. In each catchment, a river basin committee has been created as a discussion and consultation body, composed of representatives of the states, municipalities and civil society (local universities, local corporations, unions, local environmental NGOs, district associations, etc.) (Porto, 1999). A basin agency is in charge of implementing the specific measures elaborated by the basin committee. A specific funding agency (FEHIDRO) supports the agency, and will in due course be funded through water licence fees. As part of these policies, watercourses are classified into four classes with respect to water quality, according to their main uses, thus providing a mechanism to manage water quality. Because of the increasing complexity of water management, the Alto Tietê catchment is now divided into five sub-catchments, each with its own sub-committee (Figure 4.2).

In 1997, the federal law was reviewed to provide better coordination between water and land management to protect the springs. Municipalities were made responsible for land management. A federal City Statute or *Estatuto da Cidade* was adopted to try and reverse the urbanisation mechanisms in a different way. The legislation recommends the use of incentives rather than sanctions, and promotes new urban management practices ranging from participatory planning at municipal level to a process of legalising illegal settlements depending on the specific context of each case (Rolnik, 2001). But implementation of this legislation is very slow. Moreover, there is no real integrated regional policy related to metropolitan management in the Metropolitan Region of São Paulo. There remains at best a juxtaposition of various sectoral policies (transportation, housing, health, security). Sectors are not necessarily co-ordinated within

and between the different municipalities – with the possible exception of transportation policy, which is now defined at metropolitan level.

Table 4.1 Land and water management instruments at different scales

	Metropolitan level	Local	Microlocal level
Water management	Catchment planning (by the Alto Tietê catchment committee)	Sub catchment planning (by sub catchment committee)	Communities represented in the sub catchment committee and participative planning process at municipal level
Land management	*Not really operational*	Spring catchment protection instruments (planning, zoning) at sub catchment level	
		Municipal territorial and budget planning	

The new water and land governance framework strengthens the need for discussion between different stakeholders and levels of management. But the efficacy of the legislation is undermined by functional difficulties faced by the committees. Their role as discussion platforms is weakened by important asymmetries in power and access to information between a fragmented and poorly represented civil society, powerful actors such as SABESP, and municipalities whose strategies are often driven by short-term electoral strategies (Neder, 2000; Ducrot *et al.,* 2003). These difficulties are common to any multi-stakeholder platforms, including the French Local Water Commissions on which the Brazilian *comitês de bacia* were modelled (Latour and Le-Bourhis, 1995; Cacquard, 2001). But they are all the more difficult to overcome in the metropolitan region of São Paulo, where inequalities in skills and political power are particularly large, and the key communities in the periphery are socially and economically marginalised.

Peri-urban conflicts

As in so many peri-urban areas, competition between multiple water uses, specific environmental challenges, the degree and speed of change, unclear governance frameworks, and the urgent need to develop specific urban infrastructure create a scene where *conflicts* are likely to emerge. In São Paulo, there are acute, if not necessarily open, tensions over:
- access to water and sanitation infrastructure, land speculation, and housing demand vs. control of pollution of surface waters,
- mining activities for the supply of building materials vs. agricultural land use,
- transportation infrastructure versus control of urbanisation and preservation of spring areas,

- joint water quantity and quality management (dilution of effluent or bad quality water, management of series of reservoirs) vs. increasing competitive demand.

This last point includes conflicts between the different agencies traditionally involved in water management (hydroelectricity, flood control, water supply, sanitation) over responsibility for the management of the reservoir systems.

The dominance of formal agencies in management and the complexity of the catchment and water system gives scientific information an important place in the management of the system. Authorities display a clear preference for engineering and technical solutions to resolve tensions and conflict. For example, when one of the few open conflicts in the area emerged, between mining and agricultural land use in the wetlands of Cabeceiras-Tietê catchment in 2002, the Municipality of Mogi das Cruzes asked a group of geologists to elaborate maps of the mining potential of the area as a definitive solution to the conflict. FEHIDRO funds specific scientific studies aiming to provide better or more detailed information and management plans are often conceived as scientific reports. This makes it particularly difficult for less informed representatives of civil society to participate.

Real involvement of stakeholders is even more difficult given that their main concerns relate more to securing land title and better housing conditions, household welfare, health, education, security and controlling violence, rather than to water preservation. Communities are afraid that they will be expelled from protected areas and most of the proposed solutions have difficulty in integrating their specific interests. Because the needs of the local population are so acute and diverse, the proposed solutions also find it hard to take into account the future development of the area, as well as solving on-going problems. As in the French Local Water Commissions or participatory management of collective schemes (Latour and Le-Bourhis, 1995; Le Gal *et al.,* 2000), the challenge is to facilitate exchange and integrate people's knowledge and representations, to understand different interests, and to facilitate the incorporation of possible futures in the collective discussion.

Research to facilitate dialogue

In the Brazilian Negowat project, we set out to develop methodologies and specific discussion tools to improve exchanges and support discussions. More specifically, we aimed to test the use of computerised role-playing games to support discussions on land and water management in two sub-catchments of the São Paulo Metropolitan Region: Guarapiranga and Cabeceiras.

In both areas, our methodology aimed to build a joint understanding of the issues in hand in a conceptual model that represented the social and biophysical dynamics involved. To deepen our understanding of the issues, we undertook a series of baseline thematic field studies. This led to the development of two specific intervention and discussion processes:

- *Teraguas* deals with land use and occupation at local levels and its impact on water resources quality.
- *AguAloca* focuses on water allocation and quality management at catchment level and its implications for agriculture.

Both processes developed specific tools and interventions, including computerised games and stakeholder workshops.

We wanted not only to test and develop tools and methodologies that facilitate discussion and knowledge sharing related to land and water management in peri-urban areas, but at the same time promote disciplinary integration and exchange of knowledge between scientists in different thematic areas and local stakeholders. The Negowat team itself brought together an array of disciplines and actors from the public, private and civil-society domains, namely:
- research centres from two universities: the Institute of Advanced Studies of the University of São Paulo (IEA-USP), the post-graduate programme in Environmental Science (PROCAM-USP), the Faculty of Public Science (FSP-USP), the Polytechnic Complex Technology Laboratory (LTI-POLI-USP), and the Institute of Economy of the University of Campinas (NEA-IE-Unicamp),
- three laboratories from a state research institution on agriculture: the Institute of Agricultural Economy of the Agência Paulistana de Agronegócios e Technologias (IEA-APTA), the Agronomical Institute of Campinas (IAC-APTA) and the Fisheries Institute (Instituto da Pesca) of IP-APTA,
- one private water management research institute (AIIGEA),
- one NGO (Institute PÓLIS).

This diversity proved useful in supporting social learning not only among stakeholders, but also among ourselves.

Role-playing games

Brazil has experience with role-playing games built on the legacy of Paulo Freire (Freire, 1992), especially with psycho-socio-drama in the area of social intervention and local stakeholder capacity building. In the area of water management or environmental management of the urban fringe, the Negowat team identified various experiences that used role-playing games for capacity building. These games help to make the different interests of actors more explicit, and help participants from different backgrounds to experiment with negotiation processes (Ducrot *et al.*, 2006).
- 'Governance' games focusing on the discussion process have been developed and played to train high level-civil servants in planning and implementing negotiation processes in the field of public policy. Their elaboration necessitates a careful assessment of the role of power relationships in the control of information, institutions and natural resources.
- Various environmental education games have been developed and played to train local stakeholders on the use of new legislations and tools. The objective is often to train users in the best way to manage the environment.

• 'Companion Modelling' (ComMod) simulation games focus on the interaction between actors and resources (Collectif Commod, in press). This was the approach that inspired the games we developed and played in São Paulo.

Box 4.1 Companion modelling

Companion modelling (ComMod) is an approach based on social simulation in various forms (computer simulations, role-playing games) to understand and strengthen the collective decision-making process of stakeholders sharing a common resource. Simulation models integrate various stakeholders' points of view and develop them as platforms for collective learning. Different stakeholders, scientists included, work out a common vision on resource management that can lead to new indicators, shared monitoring procedures, information systems and concrete alternatives for action.

The resulting three-stage cyclical process (see figure below) can be repeated as many times as needed:

• Field studies and research bring in relevant information and hypotheses for modelling and raise questions the model can help resolve.

• Modelling converts current knowledge into a formal tool that can be used as a simulator.

• Simulations, conducted according to an experimental protocol (either a computer model or role-playing game), challenge earlier understandings of the system and raise new questions for a new batch of field studies.
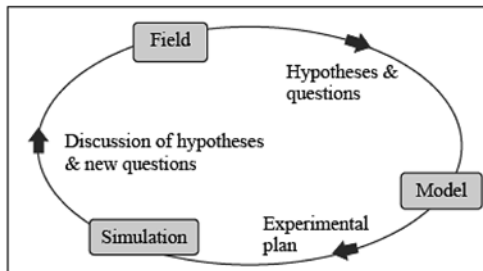
Adapted from: www.commod.org

A Companion Modelling process approach makes the social, institutional and biophysical components of a situation explicit, builds joint representations, supported (in our case) by role-playing games and discussions on possible steps and approaches to solve the situation. More specifically a ComMod approach aims to:

• facilitate a better understanding of the roles various parties can play, and moves towards more common objectives (sustainable settlement in the *mananciais* area),

• discuss different ways of interacting and negotiating to enhance the effectiveness of negotiations over the medium term,

• introduce and discuss opportunities that the law enables, which rely on participation and collaborative work, and help participants jointly to identify ways to address problems in the short run.

This work took place in two sub-catchments.

1 - Juqueri - Cantareira
2 - Cotia - Guarapiranga
3 - Penha - Pinheiros
4 - Cabeceiras
5 - Billings - Tamanduatai
6 - Jusante - Pinheiros Pirapora

Figure 4.3 Location of the different sub-catchments and the municipality of São Paulo within the Metropolitan Region of São Paulo (external non-shaded part) and the Alto Tietê catchment (shaded part and sub area 1)
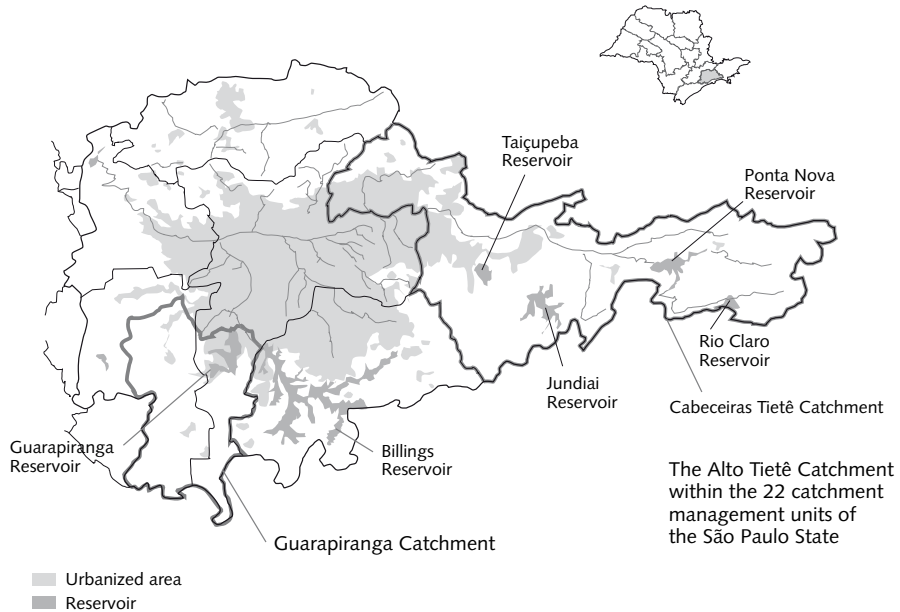
Figure 4.4 The Alto Tietê Catchment and the two sub-catchments selected by the Negowat project

Cotia-Guarapiranga

The sub-catchment of Cotia-Guarapiranga, an area of 905 km², covers seven different municipalities. It includes the Guarapiranga Reservoir which provides 15% of the domestic water supply for the metropolitan area and with a direct catchment area of 643 km². Home to 3.8 million people, this is the most densely populated catchment in São Paulo (4,275 inhabitants/km²) and one of the most severely affected by urbanisation. About 15% of the total catchment area is considered urban. The reservoir has suffered from high organic pollution rates since the 1970s mainly due to inadequate sanitation and wastewater collection in illegal settlements. To rehabilitate the reservoir, improve the quality of water and reduce treatment costs for water supply, an important investment programme, the *Programa Guarapiranga*, was implemented with the support of the International Development Bank in 1990. This programme was in itself quite innovative from an environmental, urban governance and institutional point of view (Marcondes, 1999; Bellenzani, 2000). In contrast to regional planning, it promoted inter-sectoral cooperation and discussion in a new form of integrated intervention at municipal level (Porto, 1999). However, it also gave priority to structural activities over participation, capacity building and support of economic activities. As an inevitable result, the programme did not manage to reduce water pollution in the catchment in the face of population pressure. However, it did allow the testing of some tools that were later included in the adapted legislation on *mananciais* and it promoted effective sectoral cooperation in the discussion of tools and legislation (Gondolo, 1996). It made it possible to elaborate one of the first models to simulate the impact of land use change on water quality (Mqual[14]) and to develop the first specific legislation for catchment management, the Specific Law of Guarapiranga[15]. After years of discussion, the law was finally approved by the state legislative in 2005 and is included in the new water framework.

After preliminary discussion with the Cotia-Guarapiranga Sub-Committee, we decided to focus our attention on raising awareness of the challenges in implementing the Guarapiranga law at local level in order to deal with the tensions between urbanisation, sanitation infrastructure development and control of water quality.

The objective became to elaborate a methodology, including discussion tools and role-playing games, that would allow different actors (representative of local communities, water firms, local municipalities, land markets, business and small rural owners) to make overtures to each other and initiate negotiations

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14   Mqual model is a model that simulates the water quality of the Guarapiranga Reservoir depending on the land use and settlement patterns of the micro-catchments composing the Guarapiranga Catchment. It was developed during a previous development project and was used to define quality objectives for catchment management as part of Negowat research.

15   *Lei Específica de Guarapiranga*

and discussions on local urbanisation planning and development in a protected watershed. In response, we developed a specific process, Teraguas[16], in which we developed and played a computerised game, called Ter'Aguas.

The Cabeceiras-Tietê

The Cabeceiras-Tietê Catchment is the biggest sub-catchment of the Alto Tietê. This 1,694 km² watershed covers nine municipalities where 1.8 million people live at high-density: 1,101 inhabitants per km². It includes the headwaters where the Tietê River rises. In total, 64% is protected as a spring catchment area. The catchment provides 10% of domestic water supply for the metropolitan area thanks to two interconnected systems: the Rio Claro system and the Alto Tietê production system or SPAT (*Sistema Produtor do Alto Tietê*). The SPAT includes 3 reservoirs that were initially built for flood control purposes. Two other reservoirs are currently being filled to increase water production. This is the only metropolitan catchment where the agricultural sector is significant and is represented on the committee. A total of 8,000 ha is under irrigation, mostly by individually pumped surface water sources, while 20,200 ha are cultivated each year, mainly for horticultural crops. This cultivation requires an estimated abstraction of 2.56 m³/s (Porto *et al.*, 2003). Because there is such a high water demand in the city, the place of agriculture is now being questioned. Water quality in this system is better than in other catchment areas, but the quality of the water in the reservoir of Taiçubeba is steadily decreasing. There is no consensus about whether this could be due to the inflow of low quality water from another reservoir (Sendacz *et al.*, 2005).

In this catchment, the Negowat project team decided to study multiple-use conflicts over water allocation, water quality management at catchment level, and the implications for agriculture in the catchment. It led to the development of a game, AguAloca, a series of workshops with farmers and a proposal for capacity building that could not completely be implemented during the game process.

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16   Teraguas refers to the intervention process and Ter'Aguas to the game.

Table 4.2 Summary of the two Negowat processes in São Paulo

	Teraguas Process	*Agualoca Process*
Area of test	Guarapiranga sub-catchment	Cabeceiras-Tietê sub-catchment
Objectives	Discussion about land use planning and water infrastructure development.	Discussion on water allocation management in peri-urban area, taking into account agriculture.
Scales	Municipality/ Settlements	Catchment
Dynamics represented	Land market, land uses and urbanisation dynamics in protected area of *Mananciais* and impact on water resources quality.	Allocation of water between multiple users (inclusively small-scale agriculture) and impact of quality/quantity of resources where there a multiple reservoirs
Intervention level	Micro local: communities Local: municipalities	Micro-local: small scale farmers Regional: sub-committee

Building games together with stakeholders

In São Paulo, the elaboration of the games was a key opportunity to integrate knowledge between scientists around a common question. Thus, rather than a simple exercise of tool development, we treated this development explicitly as a modelling process, to specify and make explicit the representations about interactions between actors and the resources in a given spatial territory. This required specifying and confronting how different participants perceive and represent the various social and biophysical dynamics, as well as selecting a type of representation that would make sense to all participants and include all potential players. To achieve this, we followed four steps:
(1) learning about the games,
(2) elaborating the models underlying the games,
(3) developing the materials and computer application,
(4) testing and validating the games together with users.

Learning about games

The first step was to learn more about the proposed methods, especially role-playing games for natural resources management. Some Brazilian experiences were assessed and compared (Ducrot *et al.*, 2006). A theoretical computerised role-playing game called JogoMan was elaborated to train partners in the development of computerised role-playing games (Adamatti *et al.*, 2004; Adamatti *et al.*, 2005) and in how to implement and monitor such games (Camargo, 2006).

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Box 4.2 JogoMan

JogoMan is a computerised game that simulates the functioning of a peri-urban catchment area facing rapid water resource quality degradation due to urbanisation and inadequate sanitation arrangements. The game includes two or three territorial municipalities, and thus two or three mayors, (instead of just one as in Ter'Aguas) and 7 to 15 private landowners depending on the version of the game. Land owners can only choose between four types of land use (forest, agriculture, industry and settlement/urbanisation). Population dynamics are much simpler than in Ter'Aguas, and there is a specific role for migrants looking for cheap housing, which does not exist in Ter'Aguas. The spatial basis is abstract and very simplified.

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The modelling process and testing the game with students underscored the need to specify more exactly some of the processes and strategies. Scientists in the field of hydrology, agricultural economics, and social sciences carried out specific research studies. The results led to a series of thematic reports and papers. It also contributed to the elaboration of a general conceptual framework we built through a series of internal workshops. Regular interactions with the Bolivian team provided other important opportunities for partners to discuss the team's theoretical, methodological framework as well as the institutional, political and environmental dynamics of the peri-urban catchments in each country. In spite, or maybe even because of, the differences between situations in Brazil and Bolivia, these interactions helped the Brazilian team to identify better the specificities of the Brazilian dynamics and of their conceptual basis. We used the results of the studies and meetings to develop the Ter'Aguas and AguAloca games.

Elaborating the models underlying the games

For each process (Teraguas and Agualoca), a work group was responsible for developing an underlying model that could represent the interactions between the social and biophysical dynamics, and that real actors could use as a virtual negotiation platform. The underlying model of each game specifies the relationship between the resources, their dynamics and the actors, and it indicates the different 'spheres of action and decision making' for each actor. These include tasks, indicators and the information necessary to make decisions, the main relationships with other actors, their frame of reference in terms of time and space, their main concerns regarding natural resources management, and the reciprocal interactions between actors and the resources. To build it, we used the methodology 'actors-resources-interaction' proposed by the Companion Modelling group.

For both of these two main games Negowat decided to formalise the natural dynamics with the help of IT, which resulted in a computer-based game, designed with Cormas (Common-Pool Resources and Multi-Agent Systems) multi-agent software (see http://cormas.cirad.fr) (Bousquet *et al.*, 1998). As explored in Box 4.3, the use of computers in role-playing games has various advantages and drawbacks. It was particularly useful in the cases studied in Brazil to represent water flows and changes in water quality that otherwise would be difficult to represent.
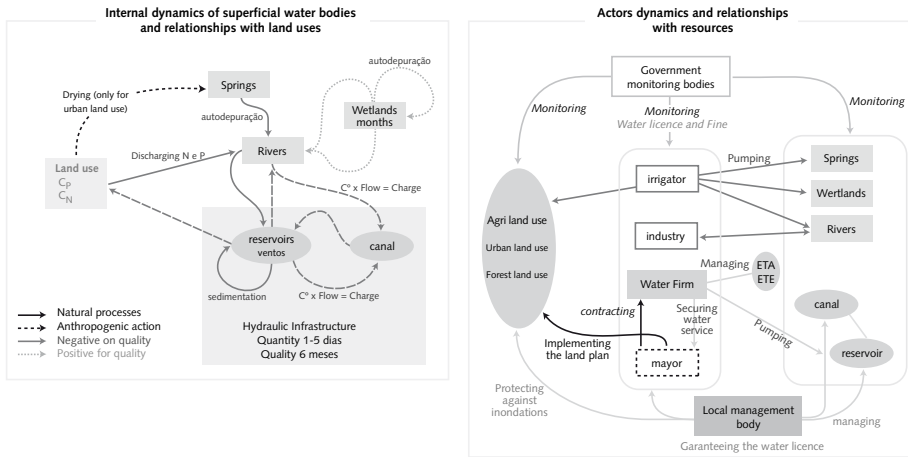
Figure 4.5 Part of the collectively built model underlying the AguAloca game

The groups that elaborated these models were composed of scientists involved in the Negowat project. To take better account of other representation and knowledge, we involved other key stakeholders. For the Ter'Aguas game, we held a series of eight workshops about urbanisation and environmental issues with a small group of representatives from local communities. For the AguAloca game, we presented and discussed the assumptions underlying the game and its model with representatives of the sub-committee in two meetings. We had further direct discussions with some of the representatives to specify relevant strategies and indicators.

Developing the game materials and computer applications

As a next step, we developed the game materials (board, roles, rules, cards) based on the underlying model. We needed to specify the time and space units we would use, which roles there were, what activities are associated with each role, on the basis of the actions and decision-making process identified for each actor and the information and indicator needed. After that the game materials (board, cards etc) were designed. In the case of ComMod (Companion Modelling) games, the spatial aspect (playing with a map) is very important as it not only serves to help players to internalise their role but it also supports the environmental dynamics (water flows, transformation of land use) and changes.

Testing and validating the games

The first test, conducted with members of the team and graduate and postgraduate students in environmental management was aimed purely at assessing whether the game could be played (clarity of materials, etc.) and whether it was dynamic and enjoyable enough to play. The student tests highlighted a need to simplify the Ter'Aguas game materials, notably to change the territory from 900 ha territory to 180 ha.

Box 4.3 Computerised game versus non-computerised game

Computerised games facilitate the realisation of complex tasks and calculations, such as rapid assessment of resources dynamics, or economic balances. They can represent complex resources dynamics, for example water flows or pollution diffusion. The computer makes it easy to monitor and review a game session, as one can keep track of all the different steps and decision-making elements. This can facilitate discussion during debriefing, or allow players to explore how different strategic choices could lead to different developments.

Computerised games also have weaknesses. They can to some users seem like "a black box" for users that gives magic answers, and they lack flexibility as options and possible solutions are limited by the alternatives into the computer model. Understanding and filling the interface between players and computers can also pose problems.

We can think of solutions to remedy such problems, for example, a first turn when all calculations are done by hand (to avoid the black box effect), or by collective elaboration of the game to be sure that everyone understands its contents. One could also introduce "on the spot" innovative solutions in a computerised session but this requires very good knowledge of the detailed content of the software and underlying rules. Such drawbacks can sometimes be compensated for by adequate facilitation.

Non-computer-based games are not necessarily easier to play. What makes the difference is:

• the true-to-life quality of the game in relation to the decision-making process,
• the enjoyability of the game (calculation by hand can be too slow or less interesting than a computerised game),
• the facilitation support,
• collective preparatory work before the game.

The key test is the validation of the underlying model by users. To this end, a small group of stakeholders well known to the game developers, played the games, each taking their own real-life role. This test aimed to validate the general and individual representation of each role, the indicators, and the rules of interaction. The focus group from Parelheiros helped us test two games: the non-computer game JogoPol (Box 4.4) and the Ter'Aguas game. The validation of the Ter'Aguas game not only gathered representatives from the district (the focus group itself) but also representatives of the Municipality, the water company and the local business sector. A first discussion group with representatives from Parelheiros region (Municipality of São Paulo) helped us develop the game itself and validate the representation of reality.

Box 4.4 JogoPol, a non-computerised game that did not prove so useful

The JogoPol game is a non-computerised game that rests on the same underlying model as Ter'Aguas but uses coloured balls to represent pollution and colour cards to represent land use (3 types of land use, compared with 15 in Ter'Aguas). It was designed to be played by local actors and so avoided the need for players to have to read and write. However, the manipulation of the balls made this game particularly slow, not so easy to play and not dynamic enough. As a result, the game was not considered good enough to facilitate discussion and multi-stakeholder interaction.

In these first workshops, local dwellers tended to focus on the most visible part of the problem (for example, garbage in rivers, rat infestation). Even when the links between health and pollution were acknowledged, many related it only to these obvious pollution sources rather than to the diffuse domestic pollution which our baseline assessment showed to be the main problem. It also emerged from the workshops that the local residents distrust the Government, Municipality and water company, demand better living standards and strongly desire to be better informed about legal issues that would allow people to regularise their situations.

The comments of these players, who were also real life participants in these issues, led the team to modify the representation of districts and to incorporate new functions that were not initially included, such as the drilling of artesian wells. Also, in order to involve the players in a more collective dynamic, the collective discussion that originally occurred after the first turn was reallocated to the beginning of the game.

Role-playing games for capacity building: the Teraguas process

To involve all the different real-life actors, the Negowat team proposed a multi-step methodology (see Box 4.5), including playing the game with representatives of the Municipality, local residents and the water firm. The Teraguas process is therefore shorthand for a sequence of workshops, including a session to play the Ter'Aguas game.

We implemented the process in its full extent in two districts (Figure 4.6): in Parelheiros, where the objective was strengthening the capacity of local stakeholders in negotiations related to urban infrastructure development, especially sanitation, and in the northern part of Embu-Guaçu with the objective of preparing local stakeholders to participate in a local-level municipal planning process.

Box 4.5 The Ter'Aguas game

Ter'Aguas is a computerised role-playing game used to simulate negotiations related to land use planning in a peri-urban municipality. It is based upon the Specific Law of Guarapiranga. Six types of actors are represented: a municipality mayor in charge of the development of urban infrastructure (roads, school, health centre etc); a water company in charge of the development of water and sanitation infrastructure; four district representatives defending the interests of local dwellers (different types of district in terms of access, type of settlement, homogeneity, proximity to rivers); two small farmers in the surroundings of the district; two big landowners with speculative and electoral strategies; and one weekend house owner who also defends environmental issues in the catchment.

The players take decisions concerning investment strategies in urban infrastructure or water and sanitation, subvention and taxes on land, buying and selling plots, developing property, land-use activity, licensing land uses and activities, and allocating land to migrating families in the area. The computer simulation rapidly assesses the impact of land-use changes on reservoir water quality (with the help of an adapted version of the Mqual model), on the cash assets of players, social indicators (employment) in the municipality and eventually the settlement of migrating families. After a round of decision-making, all players gather to try to find a more collective planning strategy and try to implement it the following round. The interactions can focus on strategies for urbanisation, investment in urban infrastructure (sanitation, piping, wells, roads, etc), land-use planning and land market dynamics.
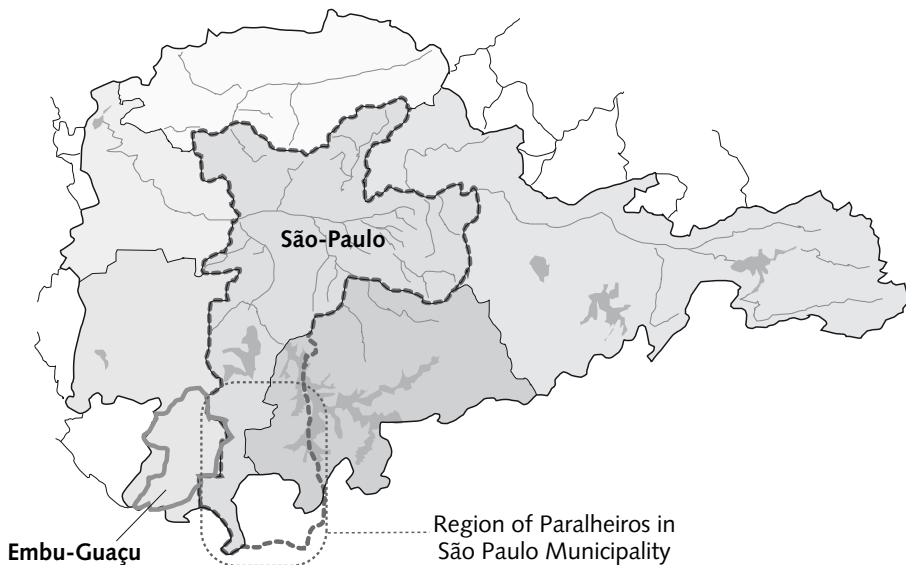
Figure 4.6 Location of Parelheiros and Embu-Guaçu

Box 4.6 Methodology for Teraguas

A series of 7 activities held during 4 or 5 workshops:

• Map the relationships between resources (land, water, housing, urban infrastructure) in each settlement and compare settlements to identify similarities and differences.

• Reconstruct the development of settlements and the history of the present situation in order to introduce the dynamics of resource relationships.

• Reconstruct a simplified version of the mechanisms of dynamics (for example land market or land use) (This activity was only implemented once).

• Map the actors, responsibilities and activities (legal or illegal) relating to resources.

• Rapidly stage a situation close to the issue, adapting the game situation (role description) from a pre-existing game, *Desafios das Aguas*, in order to introduce multi-party negotiations.

• Play the Ter'Aguas games followed by a debriefing. This helped to connect all previous elements, provide a dynamic view of the situation at regional level, and experiment with new attitudes and solutions.

• Carry out action planning or negotiation planning related to the selected issues. This helped stakeholders to prepare a specific action or negotiation and to identify further information needs, mobilisation needs, actors, etc.

The Teraguas process in São Paulo was intended to support the *rapprochement* of various stakeholders interested in the local planning and development process in a protected peri-urban catchment area. It was designed to build the capacities of local stakeholders in related negotiation processes and to help them assess some possible alternative local and shared solutions and to contribute to water quality preservation in the *mananciais*, taking advantage of the possibilities offered by the new law.

We found there to be almost no tradition of participatory interventions in these peri-urban areas and little previous communication between representatives of government and research institutions. In each case, residents said that the Negowat intervention was the first direct contact with research they had the opportunity to become involved with. The real-life role of residents' representatives is generally limited to listening to presentations of plans or explanations from the water company or the municipality, while the Government's approach is often one of paternalism. Local municipalities lack the financial and human resources to hold in-depth discussions with local communities. Local residents' associations, for their part, have little interaction with one another, and instead compete strongly to get greater material advantages from the municipality. They tend to develop a political discourse that is not well grounded in reality. In such a context, promoting a real dialogue between these actors on a complex issue was particularly challenging.

Table 4.3 Summary of Teraguas process and Ter'Aguas game

	Number of test games (Ter'Aguas game on its own)	Complete Teraguas process
Focus Group Parelheiros	2	
Embu-Guaçu (Municipal land planning)		1
Parelheiros settlements (Conflict on sanitation)		1
Guarapiranga Catchment Sub-Committee	1	

In this social context, a game like Ter'Aguas provides a unique opportunity for local representatives to meet other actors. However, it was difficult for them to distance themselves from their every-day reality and to get into the game in the presence of these other actors. During the first part of the test, the district representatives took this opportunity of meeting high-level representatives of the SABESP water company and the Municipality to express real-life demands and needs, using their traditional way of interaction, and this put an end to the first round of the game itself. They started to understand that other interests and purposes may surface in a second round of the game but unfortunately, there was not enough time to complete it in the same session.

They decided to play on another occasion, asking for a simplified version of the maps. When the second test was done one month later, not everybody who had participated in the first game was again able to be there, while there were also new players. This time we purposely inverted the roles. This was interesting for players who had already played the game, but was resented by new players who found it hard to play their non real-life parts. The game did, however, lead to rich discussions about legalisation and negotiation processes and permitted players to discuss the attitudes and behaviour of parties during negotiations.

The members of the Guarapiranga Sub-Catchment Committee also played the game, mainly with representatives of municipalities, government (Environment and Housing), water companies and the main environmental NGO. Two local representatives came from an urban part of the catchment (São Paulo). As the sub-committee had been involved in the elaboration of the detailed contents of the Specific Law of Guarapiranga over the previous six months, we expected the game to be an opportunity to test the implementation of this law. Because the members of the committee were supposed to have excellent knowledge of the complex situations and mechanisms involved we inverted the roles. The two representatives of local communities (along with other people) were assigned a role as mayor and water company manager. People from government institutions

represented the local representatives. The game was very dynamic and eventful but the discussions were very different from what we had observed in the other games. They focused on an agreement with the business sector, played by an NGO representative with a very strong personality, who never mentioned the land regulation issue, which had been the main focus of discussions in other games. In this game, the players attributed difficulties in land planning to lack of control and monitoring, but made no collective effort to organise themselves to take care of monitoring or to use economic, social or investment mechanisms to shape the urbanisation process.

Local planning in the Municipality of Embu-Guaçu

We proposed to representatives of the Embu-Guaçu Municipality that they use the Teraguas methodology to strengthen the capacity of local leaders to engage in a new municipal planning process. Unfortunately, we were unable to develop these activities before the 'participatory' discussions started as part of the planning process. Thus, the Teraguas process took place in parallel with (and after) these consultations. We took care to plan the Teraguas activities, five meetings over two and a half months, so that they did not clash with the six meetings the Municipality organised on the Municipal master plan. It must be said that the more formal consultation process was not successful. Few representatives attended the public consultation carried out by the municipality. Lack of interest, combined with lack of information in what was supposed to be a planning process and a municipal organisation that was not really adapted to involvement of the public can explain why this participation was so weak.

We decided, together with the Municipality, to work in the northern part of the Municipality, in a remote area that has to contend with an influx of illegal settlements from the adjacent M'Boi Mirim area of the Municipality of São Paulo, close to the reservoir. We could not identify any residents' organisations. The Municipality suggested we work with health agents who act as intermediaries for activities in this area. Health agents are part of the municipal health movement that aims to decentralise health services in each settlement recruiting and training local people.

The health agents indeed showed a keen interest in water management issues, especially in access to clean water and sanitation as these are closely related to health. They had had little previous opportunity to discuss the origins of pollution or the related problems and dynamics, even if they sensed it was important for their interaction with local communities. Two local NGOs also joined the group but other movements or organisations did not participate.

The last meeting was devoted to a presentation of the main elements of the Municipal master plan, its relationship with the specific law of Guarapiranga and the opportunities it might offer in term of legalising settlements and access to infrastructure.

The water company, SABESP, was not represented during the game but the Municipality participated as did a former representative of the planning service and representatives of the agricultural services. The game was playful and dynamic and the agents who had participated in earlier workshops did not report any difficulties in playing or understanding the game.

A first assessment indicated that participants in previous workshops benefited from collective learning about what negotiation means in terms of mutual benefits, understanding different interests, the need to come to the table with some prepared proposals for solutions and, finally, how to integrate a more global vision of development issues with the interests of people living in the settlements.

The group of health agents managed a more successful interaction with the authorities, which is very necessary as they struggle to upgrade services and improve the quality of life in their settlements. In the real world, the Municipality and public authority are very difficult to get hold of, while the Municipality finds it hard to implement a really participatory process to elaborate the master plan. The interest of the health agents was not limited to the content we provided (knowledge and information concerning the relationship between land use and occupation, spring protection, water management, information on the legislation); they also engaged with the methodology. Subsequently, the supervisor of the health officers asked us to provide formal guidelines for the method, so that they could adapt them in their work on health issues with local people.

Negotiating infrastructure development in the district of Parelheiros

At the request of Parelheiros, a district on the southern tip of São Paulo City, (pop. 200,000), we developed an intervention to help resolve a conflict over sanitation infrastructure. Three settlements in the area had recently gained access to drinking water thanks to a new decentralised water system based upon an artesian well and managed by SABESP. This system was constructed after a judicial order that the settlements were entitled to water services, as they had been legalised twenty years ago. However, no sanitation service had been planned and SABESP and the district authorities were willing to promote the use of septic tanks in order to avoid pollution. The slum dwellers resisted this option as being expensive, technically not suitable and more difficult to manage than a sanitation network that is perceived as the 'normal' sanitation option in a place. In the context of this disagreement, the Municipality asked the project team to help out, believing that a communication exercise could facilitate the implementation of the technical solution they proposed. Although this was not open conflict as has happened in Bolivia, there were strong tensions and a complete lack of trust between the settlements and the Municipality.

A sequence of four meetings was held, one every Saturday, mainly with district representatives, members of the settlement organisation and some individuals, making a core group of at least 10; and sometimes up to 17 people. Although

the involvement and competence of individual representatives was recognised, many participants lamented a lack of connection between residents and their representatives, and a lack of involvement by residents in any collective action on their immediate interests. The Municipality was represented in only two meetings, including the Ter'Aguas game. A couple of people were afraid that the meetings would be followed by their expulsion, a major fear of people in the area who are insecure about their land title and are more or less aware of settling illegally in a protected environmental area.

It was not possible to find detailed alternative solutions to improve sanitation and the related negotiation process, but during the last session, some interesting proposals started to be discussed. All participants understood the possibility of collective solutions, for example by creating partnerships between SABESP, the Municipality and the communities to share the investment costs of individual sceptic tanks, and eventually the maintenance costs as well. The process also allowed participants to reflect on and discuss how they interact with the local authority, and to point out possible ways to elaborate collective solutions. It shed new light on stakeholder attitudes and modes of negotiation and gave them the opportunity to discuss various aspects of negotiation: 'free riding' (by people who benefit from negotiations without playing any role in achieving it), monitoring an agreement, handling and using information in argumentation, assessing one's role and responsibilities, and the constraints of different parties. The process was also an important moment for *rapprochement* between opposing parties.

First lessons learned from the Teraguas process

It has not been possible to implement a complete assessment of the sequence of work before the end of the project, so we are presenting only our preliminary views.

The sequence of work was organised so that local representatives might change the way they interact with other actors and present a more global view of the issue of land and water at local level. The first step, a description of district development and problems, was important for representatives, as it gave them a platform to express and clarify their grievances and complaints. It helped them to understand the similarities between their problems and those of other stakeholders and to initiate a discussion about how housing development and land and water resources are interrelated. The subsequent steps helped them to link and better understand the role of different actors, of which they have had a very fragmented view. We chose to introduce negotiation through a small and simplified dramatisation that does not require any specific support, just a rapid description of roles. It helped the players to think about the contents of a negotiation and which attitudes can help or hurt negotiations. For example, settlers often tend to be passive when confronted with a paternalistic attitude on the part of authorities. This has often led settlers to accept any answer without clear justification or argumentation, and to abort discussions, especially since their own argumentation is generally not well constructed or informed. This

simplified drama also helped to prepare them for a more complex simulation when they face representatives of other parties, whom they are not used to meeting on such an equal footing.

The Ter'Aguas game makes the links between actors' decision-making processes and resource dynamics (housing development, pollution....) and simulates collective action. As in the previous workshops, the Ter'Aguas game was dynamic, playful and constructive. This happy result was not necessarily what we expected, as the workings of a computerised game are far from simple. To make things as easy as possible, we made it possible for the players to concentrate on decision-making and strategy elaboration while project facilitators took care of filling out the instruction sheet. This proved to be a good way to work with the players, even those with very basic education, and allowed a dynamic game to progress in spite of the apparent complexity. The complexity is in fact relative, as the game deals with normal, every-day activities of the players. Once the rules were clear and players made the connection with their own situation, they quickly identified themselves with their role and activities. The participants did not report any difficulties that could not be overcome after the first (learning) round, apart from one or two people who needed two rounds. However, the game clearly would not have been so successful without the previous workshops.

Our first assessment indicated that the game helped players to make sense of their situations and discuss how their decisions affect resources and the lives of other players. It helped them to better understand the roles, responsibilities, interests and positions of other players and to open up avenues to non-traditional modes of interaction. The final step would have been to use what had been learned during this process to elaborate new negotiation strategies on specific issues. Sadly, we could not accompany this group further in the full development and implementation of these strategies within the project's time frame. The key problem was to mobilise other actors, especially relevant representatives of the Municipality, of agriculture and especially of landowners. Many municipalities in the area have few human resources; it proved very difficult to mobilise them for our game. A paternalistic attitude on the part of some representatives obviously prevents real involvement in this kind of group dynamic.

Our methodology helped to build capacity among local representatives in the process of negotiation about infrastructure development around a protected spring catchment. But the process also showed up many problems that may stand in the way of constructive collective action. Existing organisations are weak, not well structured and attract little support from local people. In areas characterised by migration and high mobility, there is often no formal organisation and leadership remains weak. The population is often not closely involved in collective action, either because of a lack of a sense of community or as a result of engrained attitudes toward authorities. Actions to 'upgrade' the district are often the concern of just one or two people. If they are linked to local political interests, this only gives rise to further internal conflict. Some of these politics are

clearly related to local private interests. Representatives report a general lack of information about or interest in the spring catchment area. We would need to use other methodologies to raise awareness among local dwellers and mobilise their representatives.

For us, one of the most interesting results was the difference between the games played with 'real actors' and those played with the Sub-Catchment Committee representatives. Land legalisation was not tackled even once as an issue in the Committee, while most of the discussions with the real actors were about this issue. We found it significant that there was a clear orientation to seek external control and monitoring functions to control planning. During the discussion, the players said that if they did not succeed in controlling urbanisation, it was because there was no role in the game representing 'environmental police' in charge of monitoring settlements in the area. We had purposely declined to create such a role in the game to see if the players were able to organise this monitoring and control collectively (say, by making one player responsible for this) or would leave it to the free market (land speculation). The first immediate reaction of players in the game however was to look for a 'master' controller, which seems to suggest that they did not see urbanisation as a collective problem but as something external that you cannot possibly control. This seems to reflect a rather static, instrumental and top-down view of governance, in which planning is not an objective or a process, but an instrument. This could be illustrative of the distance between lawmakers and everyday reality, and the institutional actors' difficulties in integrating the dynamics of urbanisation, which they know about at theoretical level but find hard to put into practice. The committee also appeared to be badly prepared for the new specific law: even its designers had difficulties in working with it to tackle urbanisation and pollution control.

In summary, the Teraguas process was implemented twice in the Guarapiranga catchment. Thus the game was played four times with local actors (twice as part of the Teraguas process and twice as a test for validation of the game). It was played once with the Sub-Committee of Guarapiranga. But Teraguas deals only with local planning issues. We also tested the type of approach with management of water at catchment level by developing a specific process named AguAloca in another peri-urban watershed (the Cabeiceras Tietê Basin).

The AguAloca process
The second process developed by Negowat called AguAloca (Box 4.7) aimed to help stakeholders to take the water quality aspect of catchment management into account, and to contribute to a dialogue for a better integration of agricultural activities in catchment development and policy in another area, the Cabeiceras Tietê Catchment. We organised two main activities. We worked with farmers on the relationship between farming and the environment (especially water) and started a discussion about good practice for water quantity and quality. We also worked with members of the sub-committee, playing role-playing games to integrate water quality and quantity issues at catchment level.

Supporting better involvement of farmers with water issues

We organised workshops to strengthen the ability of the farmers´ organisation to deal with the looming water crisis and to support collective management. We focused on multi-functional land use in agriculture as a potential strategy for the Alto Tietê Cabeceiras Committee management policy. The workshops sought to present this new perspective and to initiate a participatory appraisal of three technical issues: rationalising water use for irrigation, best practice on applying agricultural inputs, and pollution control. Finally, we set out to craft a farmer organisation willing to propose a programme to promote 'environmentally friendly agriculture' in the water committee, and to promote gradual change towards technological 'greening'.

We selected four areas where there was already an existing micro-catchment project. A community leader was made responsible for organising the local structure and for inviting farmers to the workshops. Economic studies on market conditions and the economic viability of ten production systems had previously been carried out, and these findings were presented at our workshop to stimulate farmers to broaden their perspectives on local activities, and potential benefits and constraints. With an average of 15 farmers in each workshop, we discussed how to develop a local water-friendly eco-label and a social control system for guaranteeing quality. For technical information on agrochemicals we could refer to a course they had previously engaged in and to the best practice handbook promoted by the Associação Nacional de Defensivos Agrícolas (ANDEF). However, it soon became clear that we also needed training days, specifically on irrigation system management. On the basis of these workshops, a set of rules and procedures was defined based on existing or easily adopted practices. A final meeting was planned to integrate each micro-catchment proposal into a regional set. An invitation was made to the water committee to bring it up to speed about this proposal.

Taking an action-research perspective, we aimed to show that agriculture could play an important environmental role in preserving adequate conditions for water production. We set up a series of participatory workshops to involve small-scale farmers and evaluate their interest in introducing the necessary technological changes to promote agriculture as an environmental service in a participatory way. In the workshops, we presented a set of suggestions to stimulate discussion and summarised ideas on cards which were discussed until a consensus was formed. At the end of each meeting a list of common rules and procedures was affixed to the wall, and was read out and approved by the whole group. The experience showed that it is eminently possible to integrate small-scale farmers into the process and also how necessary it is to develop proper conditions for technological change. These conditions include training field days, legal land-use issues, access to proper financial resources, technical issues and others. As the workshop progressed, we saw an increase in the number of small-scale farmers in the workshops and we saw an increasing willingness for people to present their perspectives.

We needed to adapt our strategy, however. The initial proposal was to stimulate interest in the water issue by appealing to the economic interests of small-scale farmers. However, economic evaluation of different production systems proved a hard task, due to the complexity of these systems and the lack of any interesting new information that they did not already know intuitively. Far from the workshops stimulating the farmers, we witnessed the number of participants dwindle steadily. In one case, one activity even led to a conflict with some farmers who were involved in purchasing local products for supermarkets. As a consequence, one group decided not to participate in any further workshops, although they changed their minds when draft rules and procedures that had been discussed by other groups became available. On the plus side, the discussion of environmental issues and the possibility of attracting customers with the help of an eco-label was highly appreciated. This was the first time that such a proposal had been put to the farmers.

Together with farmer representatives, we built a water-scarcity scenario supported by information about per capita water availability in the Metropolitan Region of São Paulo. This demonstrated the region's strategic role in increasing availability within the watershed and its dependency on neighbouring watersheds. The role of farmers as potential guardian of water resources was discussed as a basis for improving land and water management practices. At the time of writing, the negotiation process had not yet started and the product of these efforts was dependent on water committee interest and financial support.

Helping committee representatives integrate quality at catchment management level with a game

While one group worked with farmer committees, agricultural and rural specialists on the Negowat team became involved in discussions promoted by the Guarapiranga Sub-Catchment Committee, to detail the rural management aspects of the Specific Law for Guarapiranga. Internal differences within public agencies had led to the development of a revised proposal which led some municipalities in turn to propose a third alternative. At the time of writing, the sub-committee was trying to merge two proposals.

As this was unfolding, we developed the AguAloca game to help the Cabeceiras-Tietê Catchment Committee strengthen individual and collective knowledge about the physical and social processes that affect water quantity and quality at catchment scale, and to contribute to a discussion about the role and place of agriculture in the catchment development.

The game represents the relation between quantity and quality of water resources at catchment scale. In a peri-urban headwater catchment, this relationship is the result of the water system management at catchment or wider scale (management of dams and transfers of water); the local actions of each stakeholder (irrigated agriculture, industry); and the management of local land use. It was important to represent the relationship between these different elements and, after some

deliberation, we opted for a computer-based representation (simulation model). We needed a model that could represent both dimensions (quantity and quality) at catchment scale as well as at the level of individual users.

Here, it gets a little technical. Generally, water allocation models show arcs and nodes that represent flows (rivers, channels) and specific points (confluences, pumping stations, dams). Some key stakeholders of the Cabeceiras-Tietê Sub-Catchment are used to an allocation model called AQUANET (Porto *et al.*, 2003) developed to support the management of the complex system of dams of the Alto Tietê catchment, so we decided to take inspiration for our allocation model from this tool. There are also various other kinds of water quality models dealing with different issues: diffuse pollution, contribution of tributaries, dam pollution. In our case, the purpose was to show in an insightful way the mechanisms that occur in the Cabeceiras-Tietê Sub-Catchment. We decided to focus on the concentration of phosphorus in water bodies, as this is the key limiting factor for eutrophication in Brazil (Salas e Martino, 1991, cited in Von Sperling, 1996). The catchment was first divided into ten sub-catchments. Each sub-catchment module calculates a phosphorus contribution from its land use following the coefficient of an existing simulation model (Mqual of Guarapiranga) and transmits it to a specific node of the allocation model. Then the model calculates the exponential decrease of the concentration of the phosphorus following the AQUANET model quality functions. In the model, dams are specific nodes that use the Vollenweider model[17] to predict their phosphorus concentration (Von Sperling, 1996; Jørgensen, 2000).

The way we represented the system had various limits. In particular only three land uses are represented. Moreover, it does not show the complexity of dam water quality, as in the model the effects of phosphorus remain constant while in real life they are normally proportional to the intensity of precipitation. Nevertheless, this skeleton proved sufficient to demonstrate within a game the main trends of the relationships between water quantity and quality at catchment scale, including phosphorus coming from dams, phosphorus contributions from urban areas (with or without sewage collection), and upstream-downstream transport of pollution loads. In this way, the impact of decision-making by all key actors can be taken into account in a negotiation process.

As the project team developed the game, we also developed our own capacity. The elaboration of the underlying model enabled us to synthesise different Negowat lines of work. This contributed to a better understanding of the complex water dynamics (quantitative and qualitative) in a peri-urban headwater catchment, such that the non-water specialists in the team could also work with it. Some

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17   The Vollenweider model is an empirical model developed (indeed by Vollenweider) in 1969 to assess the phosphorus concentration in a reservoir as a function of (1) the phosphorus charge generated by the land use in the related drainage area of the reservoir, (2) retention time in the reservoir (Jørgensen, 2000; Von Sperling, 1996).

issues were however left out because of time scale (impact of cold fronts on dam quality) or because of the complexity of the process (fish farming).

We tried to make the game a virtual discussion platform, and many players appreciated that the game made complex issues and dynamics much easier to understand.

Playing the AguAloca game

To test and validate the game, we first played with a group of key participants in the sub-committee. This validated the basic principles, but we decided to reorganise the timing of the collective discussion and to simplify the rules, as players reported difficulties internalising so much information.

After these adjustments, we played the AguAloca game with SABESP engineers and representatives of local municipalities, with representatives of the Alto Tietê Water Agency and three times with students. A game was planned with the technical planning unit of the Sub-Committee of Cabeceiras Tietê.

Box 4.7 The AguAloca Game

The AguAloca game is a computer-based role-playing game, developed with the multi-agent software Cormas. It aims to simulate negotiations related to water allocation and its impact on water resource quality at catchment level.

The environmental setting was based upon the Alto Tietê Cabeceiras Sub-Catchment. This peri-urban Catchment includes multiple and competitive uses of water influenced by the vicinity of the Metropolitan Region. The game contains two municipalities (one typically peri-urban and the other still very rural, a strong irrigated agriculture sector, and industrial activity, with a complex hydraulic management system (3 dams, 2 transfer canals) which aims to protect a downstream metropolitan region from flooding and to supply domestic water to the metropolitan region.

Five types of actor are represented within the game, which requires six players. The two mayors of the municipalities have to guarantee access to water services for their inhabitants. One operates the water services system while the other grants a concession to the company in charge of the Metropolitan water supply. The water company has to supply water to the whole Metropolitan Region. The farmers' delegate has to defend irrigation interests while the industry delegate operates two paper manufacturing plants. The Catchment Water Department has to operate the complex hydraulic system respecting the users' water rights.

The players make their decisions every six months just before the rainy season or the dry season, taking into account production objectives, pumping processes, and effluent treatment processes. The model quickly translates these decisions into water demand (quality and quantity), water effluent (quality and quantity) and water satisfaction, i.e. whether demand is met (quality and quantity).

A first analysis underlined that the game has good potential to include agriculture at the centre of a discussion, either as an activity affected by water management at catchment level or as a potentially polluting activity. A lot depends on the involvement of the 'farmers' representative' role. At each session we also held discussions about the role and place of farming in catchment management or in infrastructure development in more rural areas. We discovered that many stakeholders are uninformed about agricultural activities.

Analysis of the sessions also indicated that games do contribute new and concrete insights into what is meant by 'integrated or shared water management' or 'collective action related to water management'. They drew out the underlying interactions between different activities at catchment level and allowed the players to understand better the interests of other stakeholders. They also increased players' knowledge about how the quantity and quality of water resources are interrelated at catchment level. This is particularly true for stakeholders who arrived with a strong interest in water management, which they initially always expressed in terms of quantity. As their knowledge increased, some players started to investigate the biophysical model. For example, one player in charge of the management hydraulic system tried to mix his water allocation model skills with the quality option model so as to dilute effluent. Other examples were industries that decided not to treat their effluents in order to see the impact on water quality downstream, or the participant playing the farmer representative, who tried to promote rural sanitation in order to assess the potential impact on water quality. This especially caught the interest of some technicians from the SABESP team in charge of the drinking water plant in Taiçubepa, who requested a detailed conversation with the Negowat water quality specialist to help them better understand the underlying dynamics and how they could incorporate these principles into their real life daily practice.

The game also led some players to investigate the relationships between water management and urban planning. However, the highly simplified representation of land use and population dynamics in the AguAloca game (compared to the more sophisticated representation in Ter'Aguas) led to some frustration on the part of the planners. Another source of frustration stemmed from their rather mechanical vision of land planning and urbanisation control. Once an agreed zoning policy was in place, municipal players expected the (simulated) 'people' to act exactly according to planning. But the software does not necessarily take into account the zoning planners had selected – and neither do real people. It would be interesting to follow an AguAloca game session with a Ter'Aguas game to discuss the issue of land planning in more detail.

The game not only turned out to be particularly enjoyable and mobilising, many participants also emphasised the quality of the support it provides for discussions about catchment issues. It particularly helps to raise awareness of the role and management of technical information in catchment management. It also helps to identify the real difficulties most participants have in negotiations and clearly shows the need for capacity building in negotiating skills. The game never led to

a clear collective solution or a clear outcome to negotiations, except in the single case of the game played at the Alto Tietê Water Agency, where the players came up with the idea of creating a monetary fund. They had been debating for several months how to achieve cost recovery and proposed to introduce the fund to trigger negotiations. Every stakeholder in the game started with a financial stake. After the players had identified solutions to problems and agreed on priorities, the fund was allocated to different stakeholders by collective agreement.

These two parallel initiatives (the AguAloca game and the farmers' workshops) led to a greater understanding of water quantity and quality issues, both within the sub-committee and amongst irrigators. We have not yet been able to implement a game gathering farmer representatives and other actors in order to promote a real dialogue between the different sectors involved in water management at catchment level. The development of capacity building activities on negotiation skills for sub-committee members would add value. This was planned but not implemented for lack of time.

Table 4.4 Summary of the AguAloca game

	Number of games played by Focus Group of the Sub-Committee of Cabeceiras-Tietê	Number of games played by SABESP Engineers	Members of the Water Agency of the Alto Tietê Water Basin Committee
Testing and validation session	1	1	
Game on its own		1	1

Moving forward

We assessed both the Ter'Aguas and Agualoca games with questionnaires, before the game (to assess player expectations) during it (to capture the dynamics of the game), and after (to verify the learning process and elicit suggestions). What did we learn from these evaluations?

Both games proved to be effective in mobilising discussions, but cannot be played without mediators or facilitators. The players cannot simply play on their own, but need at least one practice turn to understand the richness of all available elements (graphs, supporting material, etc). The players found both games interesting, very close to reality, sometimes enjoyable and effective for learning and capacity building in both technical and negotiation aspects.

Because knowledge is divided between players, it takes time for a real collective interaction process to begin. Alliances, negotiations and the formation of interest groups do emerge during the sessions. Discussions can be considered proactive even

if some conflicts appear in some simulations. Even with a good representation of real-life situations and good virtual reality in the game, it is difficult to capture all the complexities of peri-urban São Paulo, which derives from simultaneous dynamic interactions concerning water and land or quantity and quality issues. Depending on how the game is played, very different solutions can emerge. In some Ter'Aguas sessions the social issues (illegal settlements, unemployment, etc.) were given more importance, while in others the emphasis was on access to public water and sanitation. It also became clear that holding preparatory workshops was a precondition for successful games, enabling the actors to understand that other forms of interaction were possible and even interesting.

A particularly interesting effect of this participatory modelling approach was that it enabled a collective learning process within the research group. The group brought together people from different backgrounds – academic researchers, those with expertise in supporting public sector decision-makers, specialists in action research with local actors or on local development. Unsurprisingly, each researcher assessed the potential and limitations of the methodology in light of their background. Some researchers tended to value the computer-based tools or exchanges of technical information, while others focused on the elaboration process or the sequence of interaction with the actors. Collective interactions allowed each scientist to verify their interpretation, derived from their research and pedagogical background, practices and experiences.

There is always a risk that the IT aspects of the game will remain a mysterious 'black box' for some players. Interestingly, this was much more of a problem within the Negowat team (as the computer implementation was the work of only two members, a modeller and an IT specialist) than for the players themselves. Local actors did not directly participate in elaborating the underlying models, so their knowledge was only indirectly incorporated into the model. A simplified version of this modelling was made with local actors in the Teraguas sequence, but it was not possible to confront the representation of the local actors with that of the institutional actors or researchers in the same meeting. Frankly, one wonders if this would have been possible at all given the difference of information and training between those groups, and whether the power relationships would even make it possible for local actors to express themselves fully in the same way as other participants.

Box 4.8 Some quotes from role-playing game participants

"A princípio fiquei meio confusa, a situação é muito difícil… tínhamos muita coisa para fazer… me senti uma péssima prefeita… me senti sem saída… tentamos resolver os problemas não atentando para o que se passava … fomos regularizando os bairros e não nos preocupamos com a água… e percebemos que a responsabilidade é muito grande…"

"At the beginning, I was rather confused. The situation is really difficult. We had a lot of things to do. I felt I was a very bad mayor. I felt I had no way out. We tried to solve the problems without a proper grasp on what was going on. We were legalising settlements without focusing on water issues. We realised our responsibilities were very great."

(Community representative, in the role of Mayor, Ter'Aguas game, 26 August 2006)

"Tive que cobrar a prefeitura, me negaram um monte de coisas, os donos de terra dificultaram bastante para a gente… foi muito complicado, a situação é ruim…"

"I had to revindicate things to the Municipality, they were refusing me a lot of things, landowners made also things rather difficult for us. It was very complicated, the situation is really bad."

(Health agent, playing a community representative, about difficulties in getting improvements in the settlements, Ter'Aguas game, 26 August 2006)

"Foi difícil pois havia sempre uma barreira, a gente insistia para a prefeitura regularizar os lotes, pois nós precisávamos da água, e tinha sempre uma barreira… fiz o papel de intermediária entre a prefeitura e os proprietários e consegui com os proprietários alguma coisa… com a prefeitura não..."

"It was difficult because there always were obstacles. We were insisting that the municipality legalise our plots, because we needed water and there was always a problem. I played the role of intermediary between the Municipality and the landowner, and I managed to get something from the land owner… but nothing from the municipality…"

(Health agent playing a community representative, Ter'Aguas game, 26 August 2006)

"Gente, eu me senti tão importante… `se eu tivesse lá dentro mesmo eu seria capaz de tudo`… colocamos rede de água, de esgoto… fizemos as coisas de acordo com a necessidade das pessoas, na medida certa, não prejudicamos as pessoas… adequamos as possibilidades às realidades das pessoas… acho que convenci as pessoas, elas vão fazer as fossas… com mais duas aulas dessa para frente eu vou ficar `tinindo`…"

"Man, I felt so important. If I really were with [SABESP], I could do anything! We put the water network in, the sanitation network. We did things according to the needs of the people, as required, we had no bias against anyone. We adapted our actions to the reality of the people. I think I convinced people, they are going to build a septic tank… Two more courses like this and I will be expert at it!"

(Community leader on her experience playing a water company manager, Ter'Aguas game, 26 August 2006.)

"Com a SABESP, no dia-a-dia, nós temos problemas, mandam a gente de um para outro..."

"With SABESP, on a daily basis, we have problems, they are always sending us to different people."

(Municipal representative, playing the mayor, talking about real-life relations with SABESP)

"A sociedade civil deveria chegar mais organisada, com os interesses colocados de forma clara, com prioridades estabelecidas... as associações normalmente vem pedindo coisas particulares do bairro e não coisas comuns a vários bairros".

"Civil society should arrive better organised, with their interests clearly stated, getting their priorities straight… Normally associations demand specific things for their settlement, not common improvements for various settlements".

The Brazilian Negowat project tried to overcome the limits of 'traditional' environmental education processes and open up avenues that would change the mode of interaction between actors. It was of course too much to expect that such a change could occur in a short span of time, but a first evaluation of the methodology has indicated that it does contribute to change. It promotes individual learning and an understanding of the dynamics and interests, and widens the perspectives and potential for action on the part of different actors on various issues, including attitudes, relationships and possible solutions.

We carried through two complete Teraguas processes in the final four months of the project. It was not an easy process as participatory activities depended on our capacity to mobilise actors. We needed to have the support of the Municipality, as one of the objectives is to promote dialogue with the public sector. Moreover, it proved very difficult to mobilise specific sectors such as rural landowners (farmers, weekend home owners, absentee private landowners). We needed to develop specific sectoral activities, such as the workshops dedicated to agricultural issues and the environment to mobilise some farmers before we could initiate a more collective process in Cabeiceras Tietê Catchment. Had we applied such a dedicated approach to other sectors, it would probably have been easier to get them on board as well.

Most professionals in the Municipalities and public sector have little experience with participatory processes involving local stakeholders. The discrepancies between the game played with 'real' local actors and sub-committee representatives is probably illustrative of this gap. Their full involvement in a complete sequence of work is therefore difficult. A further problem was that local stakeholders were only available on Saturdays while institutional actors were not easy to mobilise on that day. As local organisations remained weak in this protected catchment area, identifying and mobilising representatives was also a problem. In many areas, there would be a need to build the capacity of local leadership and support the development of local organisations *before* engaging in a process like ours. The Teraguas process was not designed to mobilise the participation of local people for a specific collective action, but to increase the capacity of local representatives of slum dwellers and the public sector on new forms of more participative interaction about land and water issues. While Teraguas is a very apt method to prepare community leaders for negotiation on the implementation of new infrastructure or local plans, it is not very suitable for mobilising grassroot community members. Specific methodologies need to be developed when the basic means of community participation need to be stimulated.

The methodology clearly made a strong contribution to the mobilisation, mutual *rapprochement* and preparation of serious discussion or negotiation processes around the issues on the table. This type of activity can be particularly interesting when related to a specific development project (for example infrastructure). In existing multi-stakeholder platforms such as catchment committees, the

methodology could be a helpful way to introduce more complex simulation modelling and scenarios, using models validated and calibrated using the real life situation. After a simulation exercise based on a virtual and simplified exercise, some members from the Cabeceiras-Tietê catchment indeed asked for the organisation of discussions around an adapted simulation model more closely resembling the way the actual catchment functions. Many simulation models or geographic databases are justified by a desire to develop negotiation support tools. However, such tools rarely achieve their objective and are seldom effective in supporting multi-party discussions – either for lack of trust in the models or data, or because of a lack of understanding, because the scenarios do not really support collective work or because the approach is not well geared to mobilising non-specialists. Our methodology succeeded in introducing simulation to all parties, regardless of their level of awareness or capacity.

Other activities, such as training in negotiation skills, may become necessary. Even sub-committee members theoretically involved in negotiation processes had difficulties in performing well in a negotiation process. The original idea was to develop such training along with the AguAloca game, but unfortunately, we could not achieve this in the allocated time. Nevertheless, the project team has already been asked to integrate the tools into a formal training course on water management at catchment level. Some inputs will also be used in a web course about negotiation. It is also planned to integrate this into a in post-graduate course on environmental issues.

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CHAPTER 5

Conclusions: what did we achieve, and what did we learn?

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That poorly planned or unplanned urbanisation processes have dramatic effects on land use, agriculture and livelihoods in peri-urban areas, we have seen in the previous chapters. In Cochabamba, the encroachment on traditional irrigation systems is threatening the future of agricultural production close to the city and increasing flooding risk for both urban and agricultural land. In São Paulo, where urbanisation is driven by uncontrolled land speculation, regulation follows land speculators rather than the other way around. New areas are invaded and settlements developed, and only then does pressure develop to provide services to residents. Good service provision to planned new settlements could alleviate pressures, but is often lacking. While land speculation mechanisms were a handle to organise urban expansion and land planning in the City of Curitiba, land regulation laws that have aimed to protect water resources have been unsuccessful to date. In Chennai, land grabbing, high levels of water extraction, and dumping of solid, liquid and biomedical wastes in the peri-urban environment have endangered agriculture. As a result, peoples' livelihoods are threatened and many have been forced to migrate permanently or temporarily. Some people are being pulled into attractive urban employment in cities, but many are pushed by increasing ecological stress and are effectively environmental refugees. Women in particular are more vulnerable, for they are not only losing their traditional agricultural employment but are also not as 'free' as men to seek casual urban employment, so that women find it harder to adapt to the changing environment.

A range of avenues to cope with such problems (both structural and ad-hoc) has emerged in response to urbanisation, the pressures to provide water services for urban and peri-urban residents, and the lapses, gaps or failures of traditional water service providers to adequately serve these communities. These responses have both positive and negative characteristics. In peri-urban Cochabamba, perhaps 500 water committees provide relatively good services at low cost to 400,000 people – more than are served by the Municipal company in the city centre. But lack of support makes sustainable improvements in the quality of service very difficult. Until recently there has been a total lack of official recognition of such committees as a valid service model.

In urban and peri-urban Chennai, water markets have developed based upon the extensive use of groundwater from peri-urban villages (much of it purchased from private farmers), and large-scale transport by truck to the city. There has also been a mushrooming of profit-oriented private sector companies to supply bottled drinking water, given the failure of alternative systems to provide water of adequate quality. These (unconventional) approaches have many unfortunate impacts including, in the case of peri-urban groundwater abstraction, the depletion of aquifers in peri-urban areas, road deaths and sea water intrusion. Water supply is less of a problem in upstream areas of peri-urban São Paulo where water is more easily accessible from perennial rivers in headwater catchments and the provider, SABESP provides a reasonable service in most areas. But in many cases communities have to access the water by illegal means. Water pollution remains a formidable challenge, as does frequent flooding due to inadequate urban drainage facilities and the proliferation of 'hard surfaces'. Access to clean water also remains a formidable problem in Chennai, and for that matter in many parts of India, where people prefer to spend huge amounts on water rather than on treating health problems which could occur due to the consumption of contaminated water. This should not be construed as a 'willingness to pay' for water, but rather as payment under duress.

Furthermore, those solutions respond more to a need for water supply and do not address sanitation and wastewater management problems. Poor sanitation has severe environmental health and environmental impacts which do not receive enough attention in any of the three cities. In peri-urban areas, pollution from untreated wastewater, and also from industrial processes and the remaining agriculture, has a major impact on water quality. In peri-urban Cochabamba, a major project (MACOTI) to develop sanitation (and water) ran into problems reflecting the lack of connection between unconventional water supply systems and a conventional sanitation project, and severe problems over a lack of participation and institutional design issues. There was a failure properly to consider decentralised approaches and alternative solutions, and neglect of important issues including users of wastewater for irrigation. The institutional vacuum in peri-urban Chennai leads to over-exploitation of water resources but also to a failure to control polluting industries. And in São Paulo, poor collection and lack of treatment of domestic wastewater leads to pollution of vital drinking water sources (the main drinking water supply reservoir) and high treatment costs. A failure to provide infrastructure is linked to the high cost and because settlements are illegal and irregular. There is also a lack of coordination between municipalities, service providers and regulators and frequently a lack of innovation. Only recently have alternative, decentralised approaches to treatment been considered. Of course, lack of formal recognition of illegal settlements makes difficult any kind of service provision. People may also not prioritise sanitation over other services that are seen as even more vital e.g. transport, health, education and security. Further complicating the situation, water quality is neglected (and the knowledge base weak) compared to water quantity management.

Peri-urban zones are therefore areas of local institutional weakness. In these areas, rural organisations are often seen to be weakening, while urban-orientated organisations are not yet existent, or are weak and struggling to fulfil new roles. In peri-urban Cochabamba, community level structures are active because of traditions and decentralisation processes that support the lower tier of management (OTBs), but municipalities lack capacity and are struggling to support activities at this level. In São Paulo, peri-urban municipalities are weak and lack resources, as in the headwater catchment areas many economic development options are prohibited by environmental protection laws. These parts of the city are also home to the poorest communities. While a sense of community and organisation may develop in established migrant areas, this cohesion is absent in neighbouring fringe regions, where settlements are new and heterogeneous and not infrequently lacking in effective organisation and community leadership. In Chennai, while in theory village panchayats (an elected body) can control development, in practice they are weak in the face of strong business interests. They suffer from bullying by a strong centre, while other urban and peri-urban authorities compete to encourage urbanisation through attracting investment in industry.

We found in the three case study processes, that researcher-initiated and supported negotiation processes can contribute to the search for less painful, less conflictive or more inclusive urbanisation. In each of the cities, it was possible to observe positive results of processes initiated or supported by the Negowat project. Minds and attitudes were changed in São Paulo when people saw that it is possible to interact across institutions, possible to negotiate and coordinate, and feasible to collaborate between public sector, local civil society and local business. In discussing collaborative solutions to water and sanitation service problems in peri-urban areas, rather than waiting for the public sector to deliver traditional approaches, new ideas emerged like decentralised sanitation and wastewater treatment options (including septic tanks) and for the first time these ideas are on the agenda. The agricultural sector is also getting more involved in river basin committees as a result of the project activities.

The Negowat project looked to start new participatory, inclusive and integrated processes or to support existing ones. Planning urbanisation should not only be about providing new services to expanding urban areas but managing land and water across the rural, peri-urban continuum and include the management of environmental services. It should not exclude those who are most deeply affected, only because they are not well-organised or 'illegal'.

So, where do you start?

Finding the right entry point for such processes is critical to a successful transformation process. For this, we have to unearth, understand and analyse stakeholder demands together with stakeholders and reach a very good understanding of local governance. In São Paulo there are river basin committees trying to tackle these issues, but where there is no multi-stakeholder process yet,

you can't draw one out of a hat! Stakeholders may feel they have too much to lose, or that the opportunity costs of participating are too great. The challenge is to think carefully from the very different perspectives of different stakeholders, so as not to privilege a particular way of thinking from the start. This means having a broad enough agenda to interest all kinds of concerns. These processes may not even start from a water focus, but possibly from a health, land use, or road safety focus. Moreover, the process needs to be taken on with considerable time and energy, banking on the skills of both stakeholders and facilitator to overcome foreseeable and emerging impasses. When stakeholder processes also showed up failures in government implementation and gaps in legislation, as happened in our work, we looked for collective strategies to bridge these gaps.

In Cochabamba, we soon found that – despite our best intentions and capacities – some issues were just too difficult to address, such as management of surface water resources. Here, farmers feel they have everything to lose and not much to gain from such discussions. They had, therefore, no interest in becoming involved in a dialogue that might threaten their rights. They were unwilling, and perhaps also unable, to discuss water resource allocation at catchment level. There wasn't either a strong interest on the part of the Municipality to work on urbanisation control. But on other issues related to more local ways of dealing with impacts of urbanisation, there was a possibility to work towards win-win possibilities through dialogue.

In Chennai, there was a stark problem. Day by day, there is massive transport of water from peri-urban villages into the mega city, while local groundwater stocks are depleted. The viewpoints of the Metropolitan Water Board, TWAD Board and rural communities clashed, and they lacked proper, comprehensive baseline information to work from. For this reason, the project team in Chennai first engaged in a collective fact-finding process, as well as a conflict and stakeholder analysis. We found that proper long-term planning, laws and investment would solve many problems. But a lack of vision, lack of implementation of laws and poor execution of projects stand in the way of sustainable reforms. The stakeholder dialogue created some heat in raising awareness and bringing people to account. It keeps key decision-makers on their toes and makes it more difficult for them to do a bad job.

In São Paulo, sub-catchment committees wanted us to train people at local level in implementing 'good practices' laid out for them in the laws. However, the composition of the committees is highly heterogeneous – some members have university training, others lack education, which makes it hard for them to engage in technical debates. Opportunity costs differ widely: some will be reimbursed by their institutions, others pay their own way and forego income from their livelihood in order to attend the meetings. Our workshops with residents, likewise, showed that interest was often triggered by immediate concerns, such as fear of being expelled from their settlements, and residents did not coordinate their strategies with other stakeholder groups. We created a dialogue at local level with local societies to find common ground in implementing laws.

Building something new or building on what's there?

The 1990s saw a lot of institution building: a drive to build multi-stakeholder platforms by Negowat could easily be met with the same criticism as many initiatives of that time, that it treats local communities as *tabula rasa* while neglecting existing institutions. Of course, it is preferable to support existing institutional processes, and we looked for them. But it turns out that in peri-urban areas these often simply don't exist. In such cases, it may be desirable to create new spaces rather than have a gaping institutional hole. In a democratic governance context, people have the option of going to court or seeking judicial redress in case of mismanagement, but when this fails…where do they go?

Multi-stakeholder platforms, as we saw in the introduction, are often promoted as a form of alternative dispute resolution. In Cochabamba, for example, there was no institutional space to work on water resources (on groundwater and surface water resources management) at catchment level, so we created our own, facilitating a more local bottom-up process linked to specific conflicts and demands. In Chennai, we found there may well be a need for a Peri-Urban Area Development Agency (similar to Chennai Metropolitan Development Authority) with more stakeholder participation and strategies to involve the government. In São Paulo, basin committees and agencies were in place. It was a legitimate entry point, but challenging because institutions are highly formalised and engaged poorly with peri-urban areas. They found it especially hard to overcome the problem of scale, from catchment to local. This showed the need to develop and work with methods and tools across these scales. The Teraguas methodology, including the game, can be useful at different scales in bringing out a wide range of issues linked with water and sanitation, from septic tanks to land speculation.

Learning or fighting?

Writings on multi-stakeholder platforms are usually predicated on the idea that at root, there is no 'us' and 'them'. The problem is 'us' and the interdependencies between actors in causing or perpetuating the problem and facilitating solutions are acknowledged. Of course, not all stakeholders recognise this interdependence, or are equally implicated: interdependence does not mean equality. The dialogues in Negowat are indeed based on this idea and yielded exciting results, but also had elements of empowerment for specific groups. It turned out the farmer and peri-urban resident groups indeed appreciated our methodology for capacity-building for engaging in interactions with authorities. However, multi-stakeholder dialogue should be combined with training and strategies to level the playing field (see also Edmunds and Wollenberg, 2001).

We find that multi-stakeholder processes should involve a mix of social learning and a good deal of negotiation between stakeholders, recognising that a power-centred approach is likely to be central to most decision making. Social learning taps into existing but at times limited goodwill on the part of stakeholders. Sometimes there is a real possibility of finding win-win solutions, sharing information, developing joint visions, but as soon as there are competing claims

or values, and people have to make concessions, there have to be real, tough negotiations. When key information is missing, joint fact-finding like in Chennai is extremely instructive for everyone involved. Still, sharing information only takes you so far.

There is often a concern that conflict and open stand-offs can get in the way of constructive learning and mutual adjustment processes. But conflict does not always have to be destructive– it makes it very clear what the basics of the situation are and what the stakes are. Causing a stir can lead to an unexpected outcome and precipitate change. The Chennai process created a veritable stir, so that politicians became aware of processes and demanded crucial papers and data at the top government level. The media picked up on the movement to rehabilitate disused tanks (reservoirs) and published a series of reports. This brought new groups of stakeholders together around the impacts of water extraction in peri-urban areas, and promoted the issue up the agenda. Peri-urban communities are now more aware of their rights and strategies to protect resources against abstraction and pollution. Our role-playing games in Cochabamba and São Paulo may not have had a similar concrete impact, but they got people together, made them reflect on the broader situation and built trust and confidence. It put issues on the agenda that otherwise would have been suppressed or not adequately addressed. Sustaining such impacts is a key challenge.

In this context, it is useful to distinguish between vertical and horizontal stakeholder coordination (Warner, 2006). In the case of the blocked canals in Cochabamba, the multi-stakeholder dialogue did stimulate processes of horizontal negotiation (between stakeholders at the same level), but it proved more difficult to get stakeholders in the vertical axis (different levels of authority) to engage in the *mesa técnica.* We used role-playing games in which players shifted positions (i.e. put themselves in the other's shoes) and in so doing, opened new perspectives on the role of canals (typical social learning). In drinking water committees, women were specifically empowered (usually they have no say in management).

Just sharing information can be useful but has limitations. MSDs don't usually have the power to change anything significant, e.g. the MACOTI *mesa técnica* in Cochabamba could achieve a certain amount but decisions were not in fact implemented even when a new group that had supported the process took power in the Municipality. We thus encountered a mix of social learning processes inspired by Habermas' vision of communicative action (learning) and a power-based approach (fighting) (see also Faysse, 2006; and Verhallen, Warner and Santbergen, 2007).

In São Paulo, the Teraguas process (social learning) brought some empowerment, bringing agricultural voices into communities and supporting the enactment of new operational laws and policies to implement the progressive Specific Law

developed by the sub-committee in Guarapiringa. Fascinatingly, near the end of the process, a sub-group of government people represented on the sub-committee decided to write their own proposal, as did the Municipality, so that in the end three different implementation laws were sent to the legislature!

In Chennai's peri-urban villages, women have powerful self-help groups and these tackled sand mining and water transport, staging protests and demonstrations to protect peri-urban wetlands. Through multi-stakeholder dialogue, we arrived at a fair estimate of the cost of tank regeneration which could then be presented to government to make a case for funding. A citizens' water forum, representing citizen groups, but with informal government participation, formed in Chennai and is still active. Citizens also became involved in strategies for demand management, water harvesting and recycling as a means of conserving the resource base, and roundly opposed desalination as a proposed way of augmenting supplies.

Monitoring and evaluation

How do you monitor and evaluate the performance of multi-stakeholder processes? This is an enormous challenge, on which we admittedly made somewhat limited progress and which needs to be prioritised in any practical follow-up work. It brings specific difficulties, because a multi-stakeholder process is not necessarily on a trajectory moving towards a clear *target* and output, but rather about improving quality of the *processes*, interaction and so on. Although we had pretty good monitoring and evaluation processes, it is fair to say we would have liked to have benefited from more process documentation. However, this is expensive and needs special skills. Fast turnover of team members or partners may also make it hard to sustain monitoring and project documentation. Finally, monitoring and evaluation is not always very attractive to funders.

What positive results do we have on monitoring the multi-stakeholder dialogues? In São Paulo, the evaluation of the games especially focused on the individual learning process: we asked participants to fill out the same short questionnaires at the beginning and end of the game. Questions still remain such as: Who should monitor, and against what objectives? Should they always be shared between the team and stakeholders? In São Paulo, the assessment of the usefulness of games so far has been on an individual basis. We aim to achieve more open learning processes with the committee, so we will ask the river basin councils to evaluate jointly with us in subsequent work. In Cochabamba, we did make some detailed assessment of processes and use of tools (e.g. role-playing games). While we were fairly weak on measuring qualitative changes, we conducted insightful ex post interviews to elicit players´ opinions on the game sessions. In Chennai, the Negowat process triggered an interesting external dynamic as the media reporting of the Chennai process enabled a wholly different debate outside the scope of the immediate stakeholders.

Facilitation and follow-up

While MSPs are an alluring alternative for dispute resolution and visioning, developing, sustaining and scaling up, they bring their own complexities. You need a good facilitator (where do you find these?), to build legitimacy with the participants (how do you do this?), and to secure the active participation of both grassroots and governmental stakeholders (how do you ensure this)? Stakeholder processes tend to take (much) longer than planned, which doesn't fit well with pre-agreed project structures. They need to be structured and ideally continued with local funding beyond the project's agreed time window. You actually have to think right from the start how to make it possible for the project to be followed up if successful.

MSPs take a great deal of time and patience, and dialogue has its ups and downs. We should expect this and not be too easily discouraged by a long gestation period. Final outcomes are uncertain, difficult to predict and judge, but especially in unstructured peri-urban areas there may not be better alternatives. At a certain stage we need to hand over the process to the stakeholders themselves, or to a local facilitator. Can NGOs play this role? Do they have adequate competence to organise multi-stakeholder dialogue in a sustained manner?

In Cochabamba, the team could build legitimacy because it worked in partnership with grassroots actors and local authorities, building legitimacy in the process. The NGO, Ceres, has high professional standards and took a positive view of the project as it involved action research. But there was little local history of research interventions, so we encountered a huge demand for support from resident groups, groups of farmers, etc. The project had mixed experiences, because of the fragility and lack of training and skills that NGOs may run up against (Ceres in Bolivia, Guide in Chennai). In São Paulo, the team successfully enticed the NGO (Institute PÓLIS) to take up a role in facilitation.

There can be a huge gulf between scientific researchers and local users when they engage in dialogue. In Chennai, the Madras Institute of Development Studies, an academic research institute, acted as facilitators to bridge the gap between research and action by making crucial data available. Multi-stakeholder dialogues need a lot of information that is relevant to their situation, and ways to make this information accessible, and to manipulate information. Because water and sanitation is a rather technical issue, successful multi-stakeholder platforms are of necessity some form of 'co-production' between researchers and practitioners.

Facilitation takes a lot of resources, and does not bring the kind of academic credits that, for example, a peer-reviewed publication does, so there can be a lack of money to fund these types of activities beyond research initiatives. The crux is therefore to look early on for non-academic sources to fund a budget to pay for good, independent, skilled facilitators. It may help to make good use of media and communication to increase exposure and impact. It is however clear that research cannot be about making a full-time intervention, but rather about

introducing, testing and adapting fresh approaches to facilitation and negotiation jointly with stakeholders such that others can help scale it up and make it more permanent and sustainable.

Games or scenarios?

When problems or conflicts are highly entrenched in the present, it may not be so useful to seek integrated, participatory approaches to solve immediate problems or disputes for today, but rather to develop a joint vision for the future and to work backwards from a desired future scenario.

Work with scenarios requires a subtle balance: facilitators need to simplify and unpack the parameters of the situation such that they are easy for stakeholders to work with, but not to oversimplify complex and dynamic processes. In Cochabamba, we worked with water committees on alternative scenarios (e.g. with and without willingness to pay) to arrive at a better water price setting. The work with Excel sheets and hand-held calculators was appreciated by many in the committees that worked with us. Excel spreadsheets are pretty complex, but we found they were not too abstract if preceded by an in-depth preparation phase with the usual 'newsprint' paper board. Scenario analysis on costs and tariffs of water committees enable communities to have a better understanding of cost structures and opened up acceptance of alternatives. However, no matter how successful the sessions, there remains a huge practical challenge for committees to change real-life tariff structures. The water resource audit in Chennai helped assess and challenge the 'conventional' data and wisdom, while mapping tanks and channels with GIS to bring together new information and make it available.

Due to the intense social interaction they inevitably generate between stakeholder-players, role-playing games are a powerful method to build bridges between stakeholders with different levels of knowledge, and to understand different stakes and how people see problems. Role-playing games have proven a useful way to build capacity on drinking water committee management in a participatory manner, and open up visions on the multiple use of irrigation canals. Simulation models and games in São Paulo opened up dynamics and links between natural and social processes. The participatory element in jointly building a simulation led to a better understanding of dynamics. Playing games then led to more concrete and well articulated demands for information. Different role-playing games can be appropriate, with the situation in each case becoming one element in the process. It is important to take care that the game is played at the right time – and to allow enough time to interpret it. That may well be the most important part of the process.

The playful, enjoyable aspect of games is certainly highly important in building trust and relationships needed to bring about the kind of 'reframing' process that opens up new problem perspectives and avenues towards solutions (Schön & Rein, 1994). In Cochabamba, people developed the concept of 'multiple use' of canals for irrigation and drainage. Urban residents now help farmers to clean

canals. Our work on drinking water committees in Cochabamba, helped put water supply by communities higher on the agenda of the Government. Likewise, we promoted capacity building for stakeholder groups and a sub-committee in São Paulo.

But for games to enable a 'reframing' of problems, you need to make sure the game and game setting are conducive to creating some distance from every-day routines. In this sense, the sessions on canals in Cochabamba worked less well when the role-playing game was too close to reality, so that stakeholders tended to go back to the same conflict discourse they used in every-day interaction in disputes. The way we arrived at role-playing games in São Paulo was rather heavy in terms of design and implementation. But we found the collective design process across disciplines, representing different stakeholders highly valuable. It provided an opportunity for people to step out of people's usual roles, situations and then come back.

Role-playing games: A process of trial and error

Of course, the Negowat processes in Cochabamba, São Paulo and Chennai cannot pretend to have the power to redirect urbanisation processes. The political and economic forces behind urbanisation are unstoppable. However, it is possible to do better, and to mitigate the impacts, both on people and on the urban water cycle, and to support policies and practices that lead towards more sustainable solutions.

In sum, Negowat proved an opportunity to try different approaches to get people to negotiate and communicate in a trial-and-error process. People consented to do simulations, participate in training and fact-finding sessions and play games, and both we and they learned in the process. While admittedly not all approaches turned out to be equally successful, we bridged many gaps between research, documentation, advocacy and implementation, at least at pilot scale. We hope this book will inspire others to add to these efforts, in these cities and beyond.

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