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Water investment in Mexico City: contradictory elements preventing investment efficiency

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Abstract

The complex connections between environmental and socio-economic variables in the water sector system involve not only ecological changes such as climate change but also a need for changes in socio-economic arenas to reduce the impacts of climate change. It is necessary not only to acknowledge the elements of change but also to understand the constraints preventing change in specific cases. The challenges faced by the water sector in Mexico City, as the world's second largest urban agglomeration with its fast growing population, limited external water sources, depleted aquifers and increased disaster risks, call for urgent measures to resolve the inefficiencies found in the traditional approach to water investment.

This paper explores how far the multiple objectives of different actors involved in water projects are balanced to attain integrated water management. The *Santa Catarina* Water Supply Project, which is in a highly contentious area because of the limited availability of drinking water, is presented as a case study. The analysis shows that the multiple objectives of the different actors involved, together with an institutional structure that perpetuates a traditional engineering approach, constrain the effective and efficient delivery of water projects.

The institutional analysis development framework (Ostrom, 2006) is used to analyse the arena of investment decision-making in water for Mexico City. Following the notion of institutional arrangements as "*incentives and deterrents*" (Ostrom, 1976), eight contradictory elements are proposed to illustrate the process by which institutional arrangements, implemented by specific actors with the intention of producing specific outcomes, are inefficient in delivering the expected outcomes, and can even produce negative ones when interacting with other existing formal and informal arrangements determined by other actors. These elements explain both the resilience of the system, which has so far prevented its collapse, and the magnitude of a growing problem that demands change.

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1 Introduction

Water supply in Mexico City entails many challenges that could be met if contradictions constraining the efficiency of investment in water supply projects could be solved. This paper presents a series of contradictory elements identified in water supply projects investment. These elements are institutional arrangements implemented by specific actors with the intention of producing specific outcomes, which turn inefficient in delivering the expected outcomes, and can even produce negative ones when interacting with other existing formal and informal arrangements determined by other actors.

The *Santa Catarina* Water Supply Project (SCWSP) (SACM, 2009) was selected as a case study to show how actors' objectives can constrain the achievement of project's efficiency, since their interactions create formal and informal institutional arrangements to advance particular interests that reflect the bargaining power of the different actors involved, which result in institutional constraints that in turn constrain the actors, because "*changes in the institutional arrangements for delivering urban goods and services create incentives and deterrents*" (Ostrom, 1976:7). This is illustrated with eight elements that explain the challenges facing sustainable water management in Mexico City in general, and the failure of the SCWSP to achieve the original objective of increasing the water supply to inhabitants of *Santa Catarina* to 112.43 l/inhabitant/day (SACM, 2009) in particular.

Mexico City's population and geography determine the complexity faced by the water sector. Its origins date from the fourteenth century, when indigenous people founded the city on small islets in a lake. Hydraulic development has become necessary since then because of the risk of flooding. Further challenges (water supply, sewerage and sanitation demand) have emerged with the city's growth, most considerably in the twentieth century when the metropolitan area spread beyond the Federal District (DF) to what is known as Mexico City Metropolitan Area (MCMA). In 2005, 8.7 million inhabitants lived in the 16 boroughs of DF, and 10.5 million in 59 municipalities of the State of Mexico and 1 municipality of Hidalgo (INEGI, 2005). This is the world's second largest

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urban agglomeration (UN, 2005). Pumping water supply to and within the city entails around 20 million pesos a day (Burns, 2009). Mexico City's water supply amounts to 33.8 $m^3 s^{-1}$; however, 35 percent is lost through network leakages and informal connections, with an estimated delivery of 22.3 $m^3 s^{-1}$ to users, with further losses due to household leakages (SACM, 2007). Not only water but also energy is being lost.

One of the areas perceived most problematic in the matter of water supply is the borough of *Iztapalapa*. This is due not only to its being the borough with the highest population, the third lowest GDP, the second highest population without access to water and the highest population without access to sanitation in Mexico City (SEDECO/SIEGE, 2000; INEGI, 2005; CNA, 2008); but also to the political involvement of its population and the media coverage, since the large population carries a large number of votes. *Iztapalapa* has the longest primary and secondary water supply networks; however, they are insufficient to meet demand. The population of the *Santa Catarina* and *San Lorenzo* zones had a mean consumption of 58.43 l/inhabitant/day in 2006 (SACM, 2009), and though the SCWSP aimed at reducing scarcity by increasing supply in 54 l/inhabitant/day to the area, water supply services still do not meet users needs in terms of quantity and quality. Intermittent water supply and provision through water trucks continue as normal practice. Since the urban poor are the most vulnerable to climate change, this situation will be aggravated by droughts and an estimated increase in water consumption rates of 20 percent from 2000 to 2015 (WB, 2011).

The SCWSP was developed by *Sistema de Aguas de la Ciudad de Mexico* (SACM), a deconcentrated (rather than decentralised) organ of the government of DF that is responsible for water management in the 16 boroughs of DF. SACM's funding comes from local and federal governments, who can subsequently contract national and international debt.

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2 Materials and methods

This research follows Saravanan's (2008) distinction between actors, stakeholders and agents according to their involvement in the decision-making arena. The term "stakeholder" corresponds to the broad group of water users or managers with particular interests in the decision-making arena impacting water resources; stakeholders with legitimate interests, information-processing and strategising capabilities who actively interact with one another are known as "actors"; an "agent" is an actor with discursive power and transformative capacity.

A map of the stakeholders/actors/agents involved and their main objectives, constraints and interactions was used to explore the complexity of the water sector system. Focus groups, semi-structured interviews, documents provided by interviewees and actors' public statements provided the input data for the stakeholder analysis (Grimble and Wellard, 1997; Chevalier, 2001).

Selection of the interviewees depended primarily on the available official channels for contacting water management organisations and the willingness of individuals representing those organisations to participate in the research. Other relevant stakeholders were contacted through interviewee intervention (the snowball technique). Only the choice of individuals for interview from the user and community categories was random. In the case of relevant stakeholders who did not agree to participate in the research, their objectives, constraints and interactions were inferred through content analysis of their public statements and actions.

Qualitative data analysis was conducted using a codification informed by the institutional analysis development framework (Ostrom, 2006). This included distinguishing between stakeholders, actors and agents; the identification of positions, outcomes, action-outcome linkages, control exercised by participants, information and costs and benefits assigned to outcomes; and the identification of linkages to contextual factors (culture, physical attributes and rules).

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3 Results and discussion

Eight elements are used to explain the interacting formal and informal institutional arrangements that prevent efficiency of water supply projects investments in Mexico City, as it is the case of the SCWSP. These elements show not only the constraints to the sustainable development of Mexico City's water sector, but also the working arrangements that have prevented the collapse of such a complex system. They are discussed below.

3.1 Short vs. long term investment decisions

Investing in short term has an impact in long term investments. Water infrastructure development has been undertaken in separate rather than complementary stages following a long-term strategy. Mexico City's water supply has not increased at the same rate as its population.

The last large infrastructure project undertaken to solve Mexico City's water crisis, the *Cutzamala* System, was constructed in the 1980s as part of an integral strategy to overcome the city's water crises in the 1970s. The federal strategy (long term project) consisted of exporting water from four river basins (*Lerma-Chapala-Santiago*, *Balsas*, *Tuxpan* and Eastern) to the Valley of Mexico basin in the medium to long term (SARH, 1985), and exploiting the internal aquifer through the construction of wells in the city in the short term. Social and political opposition, as well as a change of administrations, determined that only one part of the strategy was undertaken: namely, the construction of wells and the import of water from the western basin (the *Cutzamala* System of the *Lerma-Chapala-Santiago* basin).

It is important to consider that the social and environmental costs of such a strategy might have been significant, and although it would have been an integral strategy from the point of view of Mexico City, a regional development strategy at the national level to tackle the overpopulation of the capital city would have been more beneficial. It is also important to consider the context of the strategy, since in the 1970s the DF was

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completely dependent on the federal government and Mexico was ruled by a single party. If the strategy could not bloom in an environment with such space to manoeuvre on the part of the federal government it is even less likely to succeed in the current context, in which multiple parties rule in the federal government, the DF and the surrounding states, and there is increased internal demand from the external basins.

This is a case of path dependence that has led to the overexploitation of the internal aquifer, since the "short term" strategy (that is, wells) provides 55 % of the total water supply to Mexico City (Horna and Cota Ozuna, 2004). Staff members of the water utility's Sub-direction of Planning and Investment recognise that the main criterion for undertaking a project is urgency. And, as in the 1980s, short-term projects are undertaken, absorbing most of the budget for new infrastructure development. Thus each short-term investment decision puts the water utility onto a path that diverges from one of social, economic and environmental sustainability, with its corresponding financial, environmental, social and political costs.

3.2 Investment, operation and maintenance cost considerations

Project's success entails covering investment and operation and maintenance costs; covering the first and failing to cover the latter impacts it. The water utility divides its budget between infrastructure investment and operation and maintenance costs. Although both costs are included in the project evaluation (293.1 million pesos for investment and 211.5 million pesos for operation and maintenance costs, SACM, 2009), operation and maintenance costs are assumed not to be a burden at later stages of the project without considering cost recovery risks. This is explained by the fact that the water utility is not a single unit but an organisation with multiple departments. The Executive Direction of Planning and Investment is interested in justifying costs in relation to potential benefits in order to be eligible for federal resources to cover the investment costs, but once the project is constructed the operation and maintenance costs become the responsibility of the Executive Direction of Operation, which has to bear the costs with a limited budget due to the lack of cost recovery.

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Financial sustainability is a concern of the water utility as a whole, but to achieve it, it must be sought at all levels. The SCWSP illustrates how the principle has not become operational, since the project's financial sustainability was not considered in the original evaluation (SACM, 2009). The projects' impact is limited to its first years as new infrastructure, but as failure to invest in operation and maintenance reduces its efficiency, it is necessary to cover such costs to avoid losing the initial benefits of the investment. It might be efficient to invest 293 million pesos in a project supplying water for 15 yr (SACM, 2009), but not so in a project only lasting 2 yr.

3.3 Multiple financial sources

More money can allow investing but also squandering. Federal grants have an income effect on the total budget of the public utility. Public finance theory indicates that the substitution effect is the only effect that causes inefficiency (Stiglitz, 2000); however, when the water utility budget is increased by the federal grant the water utility can spend the equivalent on other project types, both efficiently and inefficiently. It is in the latter case that an unintended outcome can result.

The national water authority provides grants to the water utility through the Programme for Water Supply, Sewerage and Sanitation in Urban Zones (APAZU) for infrastructure development and the Programme of Rights Devolution (PRODDER) for improvement of efficiency and existing infrastructure. In financial programming it is necessary to have different funding sources to meet different expenditure needs; however, this can also provide an incentive for inefficiency, since the money that the local authority receives reduces the burden on its total budget and allows it to spend the same amount, not only on desirable service improvement but also in inefficient areas, such as projects that do not meet the sustainability criteria of the national government, private banks or international financial institutions. In such a case, the existence of multiple financial sources becomes a deterrent rather than an incentive.

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3.4 Water problems stemming from spatial planning problems

Contradictions in spatial planning can impact the water sector. The physical difficulty in providing water supply to *Santa Catarina*'s inhabitants stems from the community's origin as several informal settlements. Land use planning has been over-ridden by over-population and organised pressure groups exchanging land tenure for political support. The conditionality of household connections upon land tenure regularisation has been legislated. However, the enforcement of the legislation has varied across administrative periods. In some cases, this enforcement has been considered unfair to people's needs, and pressure from borough authorities to overcome the conditionality has been effective. This can follow a legitimate interest in people's needs (as a public servant with experience in water infrastructure working in the borough of *Iztapalapa* claims) or patronage by political figures.

Solo et al. (1993) condemn the policy by which service is denied to informal settlements in an attempt to avoid further such settlements, citing the inefficacy and negative social development that result from prohibiting zoning planning policies. Urban dwellers move to a place that shows more advantages than its previous location or when they have lost the means to afford a former better place to live. *Santa Catarina* inhabitants choose to live there despite the restricted water supply, but also in hope that their pressure will change the policies. The history of policy change depending on administration changes is an incentive to them.

3.5 Lack of participation

The SCWSP is supposed to solve the problem of intermittent and insufficient water supply suffered by the inhabitants of *Santa Catarina*, who, however, have no voice in defining the best solution to the problem. There is lack of participatory decision-making in project planning and development. This stems from a two-sided problem. First, the top-down approach does not allow the inclusion of stakeholders such as project beneficiaries and communities. When project developers (water utility engineers) and

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constructors meet with communities and beneficiaries, they commit themselves to give notice of any action that could cause inconvenience; however, their perception is that as soon as people know about the project they will oppose it, demonstrate and slow down or even prevent the construction process, thus public disclosure of the project is avoided. Second, most beneficiaries are unwilling to get involved. They justify this with claims about their lack of knowledge and the responsibility of "the government" as a whole or the water utility engineers in particular to provide solutions to their water problems.

Inhabitants usually oppose the works because of the dust, traffic and delays in road recovery that they entail, but potential beneficiaries are willing to accept some of these inconveniences if the work will reduce a bigger problem such as the lack of water supply, and if constructors commit to minimising such inconvenience. The case of communities is different, since they do not benefit from such works, and their opposition grows when they also suffer intermittent and insufficient water supply. This is why participatory approaches and integral water supply programmes and projects should be used as means of achieving sustainable water management objectives.

3.6 Decentralisation and financial self-sufficiency

Decentralisation is key to water management, but it cannot be achieved without financial self-sufficiency. The water utility is not decentralised. It is a deconcentrated organ of the central public administration of local government. Deconcentration implies hierarchical subordination with top-down delegation of specific administrative functions; limited decision-making power and budgetary autonomy; and lack of own patrimony and juridical personality (LOAPF, 1998). The income and expenditure balance of the water utility shows that it is subsidised by the local government budget. Bureaucrats in the water utility urge for decentralisation. Although this would mean that the water utility would have its own budget, it would face an unsustainable deficit since currently the revenues are insufficient to cover its expenditure.

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Decentralisation has been found to have a positive impact on infrastructure expenditure at the national and subnational levels, and in the case of the water utility, transferring responsibility for its budget would represent an incentive. However, previous local and national government institutional capacity support would be necessary in order to avoid it becoming a transferred burden, as Wilder and Lankao (2006) have observed in several case studies in Mexico.

3.7 Water supply does not mean perennial water supply

There is a contradiction between targets and indicators. Governmental indicators – as well as international indicators such as the MDGs – focus on water supply network coverage; however, indicators of service delivery receive less attention. *Santa Catarina*'s inhabitants may be considered to be covered by the 98.38 percent water supply coverage of *Iztapalapa*; however, the water supply network consists of pipes that do not carry water. In this case, service delivery indicators are more relevant.

The intermittent water supply does not match the existing water metering systems. Interviewed users complain about air metered as water, resulting in high fees for people who are in fact using little water because they simply do not receive it. SACM has not introduced products available in the market to avoid this.

Supplying water to the *Santa Catarina* mountain areas entails physical constraints to the water supply network; however, a better design taking people's needs into account might reduce the inconveniences of the intermittent service (Vairavamoorthy et al., 2007). Pahl-Wostl (2005) suggests the possibility of substituting expensive centralised systems with household-level technology. Again, a participatory approach is necessary at the early stages of project design.

3.8 Differentiated tariffs systems

Projects like the SCWSP aiming to increase water supply efficiency entail costs that are expected to be recovered with the increase in efficiency; thus, failure to achieve service

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efficiency implies unrecovered costs. Supplying water to *Santa Catarina*'s inhabitants, either through the network or via alternative means, entails costs. However, the local government has cancelled the bills to users with intermittent service. The construction of the SCWSP would not change this, since the project would not increase the water supply to an acceptable level of service (beyond the 150 l/inhabitant/day threshold, SACM, 2009). As long as the inhabitants continue to receive an intermittent service they will pay nothing. The government's cancellation of bills can be interpreted both as an incentive for the water utility to reach the 150 l/inhabitant/day threshold and as a financial constraint to the general budget due to lack of cost recovery.

The distinction between payers and allowed non-payers also implies transaction costs, since it requires coordination between the water utility and the local government's Secretary of Finance. Coordination between the intermittent service from the water utility and payment remission from the local Secretary of Finance is not immediate, as interviewees from remitted areas claimed to be charged despite the remission and intermittent service. Users are charged annually, while service in an area can change from constant to intermittent and vice versa throughout the year.

3.9 Actors' awareness of existing institutional arrangements

Actors have implemented strategies with outcomes that, although not optimal, are acceptable from their point of view. This results from their lack of knowledge of the complexity of the water sector, since their involvement in the water decision-making arena usually involves only two- or three-party interactions. A platform exhibiting the current interactions of objectives and constraints with their respective outcomes, as well as possible cooperation scenarios, could not only facilitate the diffusion of information but also promote the cooperation and participation of excluded (decision-making) actors. This platform could be funded by a governmental programme (Starkl et al., 2009) on capacity development in the water sector, or by international cooperation (Koudstaal et al., 2011); however, an external party should manage it. Information is power, and true participation involves power sharing. Given the current power structure in the water

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decision-making arena it is necessary that an external actor, i.e. a civil society organisation, academic, negotiation expert, etc., procures information input from all actors and facilitates negotiations among them. Previously excluded actors gaining access to information and participating in the decision-making arena will then become agents of change.

4 Conclusions

The interaction of actors' objectives and constraints leads to potential conflicts, but these can be settled through formal and informal institutional arrangements. However, these arrangements have a contradictory nature allowing the perpetuation of water infrastructure investment paths that have proved complicated, inefficient and unsustainable. This illustrates the impasse of Mexico City's water sector: the resilience of a system that has prevented collapse until now, but also the magnitude of a growing problem that calls for change.

The vulnerability to climate change of Mexico City's water sector urgently requires an integrated strategy in which elements preventing change are acknowledged in their context. This must include all actors' objectives and constraints, with not only the formal but also the informal institutional arrangements framing their interaction. The participation of all actors involved is necessary to increase the project's success. The input of different actors can enrich solutions to common problems, as long as the dialogue transcends the current lack of interaction among all the actors affected in the water decision-making arena. Actors need to stop focusing on specific elements of the system and start adopting a systems approach to tackle their problems. This research may serve as a starting point for an information and cooperation platform that can lead to further research on the emergence of agents of change in Mexico City's water sector.

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