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Facilitating Negotiations Over Land And Water Conflicts In Latin- American Peri-Urban Upstream Catchment: Combining Agent-Based Modelling With Role Playing Game
PROJECT NEGOWAT.

Is there a future for locally-managed domestic water supply systems in peri-urban Cochabamba, Bolivia? **Analysis of performance and some possible scenarios**

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Is there a future for locally-managed domestic water supply systems in peri-urban Cochabamba, Bolivia? Analysis of performance and some possible scenarios

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***Abstract** — Locally-managed water supply systems are common in Bolivia. Although these are acknowledged to some extent by national policies of decentralisation and local government, locally-managed water supply systems do not fit neatly into national policies and plans for water and sanitation, especially at the peri-urban interface. In urban and peri-urban areas the current policy is to develop large centrally-managed water and sanitation utilities. A new water and sanitation project based upon these policies is currently being planned in the municipalities of Tiquipaya and Colcapirhua, close to the city of Cochabamba. This project will clearly result in major changes for locally-managed water supply systems in the area, if they survive at all over the long-term. This paper considers the performance of existing locally-managed water supply systems, based upon a study of 28 systems, and their potential outlook. Possible future scenarios for such community-managed systems are relevant to other peri-urban areas in Bolivia and elsewhere.*

1. Introduction

Locally-managed water supply systems are common in Bolivia, especially in rural and peri-urban areas. According to the *Viceministerio de Saneamiento Básicos* (2004), over half (54%) of water supply systems in the country are managed by committees and a further 25% by cooperatives, while only 11% of (mainly larger) systems are operated by municipalities¹. Although to some extent acknowledged by national policies of decentralisation and local government, these locally-managed water supply systems do not fit neatly into national policies and plans for water and sanitation, especially at the peri-urban interface. In order to improve services in urban and peri-urban areas, the policy encapsulated in *Plan Bolivia* (Ministerio de Servicios y Otras Públicas, undated) and the *Plan Nacional de Saneamiento Básico 2001-2010* (Ministerio de Vivienda y Servicios Básicos, 2001) is to develop large centrally-managed water and sanitation utilities with high levels of externally financed investment (and cost recovery from consumers).

1.1 - Management scales for water and sanitation services

Until the mid-1990's, provision of drinking water and sewerage services in Bolivia was largely a central government responsibility. Following a reform process and institutional changes in the sector, responsibility for service delivery was transferred to municipalities and a national level regulation function was created in the *Superintendencia de Saneamiento Basico* (SISAB) in 1999. The reform of the sector was aimed to improve coverage, and in urban areas, to reduce public expenditure through the promotion of private sector participation and investment in order to release public funds for the rural areas². In the *Plan Nacional de Saneamiento Básico 2001-2010* the following categories of locations were identified:

1. 10% are run by other kinds of organisation including private companies 1%, Mancomunidades 1% and others 8%
2. "If concessions are awarded in Cochabamba, Santa Cruz, Sucre and Tarija, rural public investment could be doubled without increasing resources for the sector." (World Bank, 1999: 157).

- Metropolitan (the largest cities: La Paz, Cochabamba, Santa Cruz)
- Major cities (Sucre, Oruro, Tarija, Potosí, Montero)
- Intermediate cities (25 urban centres with a population between 10.000– 100.000)
- Small towns (65 towns with a population between 2.000-10.000)
- Rural (areas where population centres have less than 2.000 inhabitants)

The policy considers as rural only those areas where the population (in settlements) is less than 2.000 inhabitants. This categorisation has an important impact on the way money is allocated. Peri-urban areas, which by definition are hard to categorise because they occur at the rapidly changing boundary between urban and rural areas, were not specifically recognised. However, as discussed in this paper, the peri-urban areas present some special challenges for the development of water and sanitation services and are potentially areas of contestation and conflict over development policies and plans.

1.2 - New policies

The *Plan Nacional de Saneamiento Básico (BSNP) 2001-2010* attempts not only to improve coverage of water and sanitation, but also to guarantee sustainability of services and to control negative environmental impacts. In relation to improving sustainability, a diagnosis of the sector showed that while coverage in urban areas had reached 90%³, sustainability of services “*is still very fragile... only 48% are guaranteed potable water and a continuous and reliable service*”⁴ (BSNP, 2001: 13).

In order to help reach the long term objective of sustainable services (and investments) *Plan Bolivia* (2002 – 2007), amongst other measures, proposes to align infrastructure development with institutional development and community participation, as well as to promote the integration of services⁵ to generate economies of scale and improve the efficiency and economic feasibility of supply companies (Plan Bolivia, 2002). It is important to mention that in this plan the emphasis in metropolitan and major cities is on increasing wastewater treatment, while in intermediate cities and small towns it is on increasing sewerage coverage, and in small towns and rural areas, the policy emphasises increasing domestic water coverage.

One central component of the strategy proposed in *Plan Bolivia* is to introduce “*efficient and sustainable management models through financial incentives to entities that associate to form municipal joint companies, regional or metropolitan companies*” (Plan Bolivia; 2002: 28). These associations are aimed to integrate small and dispersed systems, consolidating service markets, leading to economies of scale, and facilitating technical assistance. In the long term it is intended to promote Private Sector Participation or Public Private Partnerships in services management and investment in the urban areas (mainly metropolitan and major cities).

In both policy documents (*BSNP; 2001 – 2010 and Plan Bolivia; 2002 – 2007*) - except for sporadic allusions - there are no references to a reality where, not only in the rural areas⁶ but also in peri-urban and some urban zones, a large number of locally-managed organisations are very important as service providers. There is a clear gap in policy, and lack of support, to these community-managed systems. This is illustrated by the widespread assumption that improving sustainability is partly analogous with getting people to pay more for water and sanitation services, undervaluing the huge non-monetary contributions that many communities make in developing, operating and maintaining these systems.

3. According to *Plan Bolivia* coverage only reaches 85% in urban areas.

4. “*still there are serious deficiencies in the quality of the services due to the insufficient capacity for producing water, the high level of losses, few hours of service and deficient quality of the water provided, mainly in peri urban zones, small towns and rural areas*”. (Plan Bolivia: sector agua y saneamiento; 2002: 9)

5. According to the statistical projections given in the Plan by the year 2010, 72% of the population will live in the urban areas (49% in the metropolitan cities) and only 28% will live in the rural areas (BSNP, 2001:).

6. According to a World Bank report in 1999 there were three types of institutional arrangements to provide the service in the country: private concession (La Paz – El Alto), cooperatives (320 mainly in Santa Cruz and Tarija) and autonomous municipal water companies (many of them with a concession regulated by the Superintendence of Basic Services by now). Besides, this report mentions that in rural areas, “*water and sanitation committees (called CAPYS) are being established to administer, operate and maintain rural supply and sanitation systems*” (World Bank; 1999:140)

In the municipalities of Tiquipaya and Colcapirhua on the urban fringe of the city of Cochabamba, there are 90 domestic water committees currently operating in the 'peri-urban' valley area. These systems were often initiated by the inhabitants themselves, in the absence of government or municipal services. The very future of these systems is challenged by recent policies, which in this location, have been key in the framing of a major planned water and sanitation development project (the MACOTI project) that envisages the creation of a new metropolitan service area spanning the two municipalities. This project has been hugely controversial, with many concerns raised and demonstrations held, including local objections to: a lack of information and consultation, a perceived loss of control and community involvement, concerns about elements amounting to privatisation, the high cost of the project and associated loans, and the high water and sewerage charges that could be levied as a result. This paper considers the current performance of the locally-managed water supply systems in Tiquipaya and Colcapirhua, and their possible future, against the background of the proposed MACOTI water and sanitation project.

2. Methodology

The current performance of 28 locally-managed water supply systems in Tiquipaya (22 systems) and Colcapirhua (6 systems) was assessed through a survey of system representatives in 2003, and other related research by the Centro Andino para la Gestión y Uso de Agua (Centro-AGUA). The paper was based upon a survey carried out in 2003 of 28 locally-managed water supply systems in Tiquipaya and Colcapirhua. The survey interviewed system representatives e.g. presidents or vice-presidents of OTBs or of domestic water committees. The sample of 28 systems (out of a total of 90 systems) was largely based upon availability and willingness of people to contribute to the study, and was not random. Since water and sanitation was a seriously contested issue, some people and organisations were not willing to be interviewed. It is important to recognise that results only reflect the views of system representatives, and because performance was such a contested issue, responses were also influenced by the context of contestation. Where possible we refer to results of other studies, and further household-based surveys will also examine the perceptions of users.

Out of the 28 systems studied, 15 are managed by the Territorial Based Organisations (OTBs)⁷ and 13 by *comités de agua potable* (drinking water committees) that function independently from the OTBs (but they still tend to have strong links). All of these organisations tend to be community-based and voluntarily-run, but they are also supported by the municipalities and other external agencies. Some of the systems are now also federated⁸. Most systems serve between 50-300 households and the average number of connections was 203 households (Figure 1). Typically the systems manage a groundwater source (borewell or spring) with an overhead water storage tank and a piped network delivering water to households (24 of the 28 systems studied utilised wells or springs). In Colcapirhua, wells are the only source although surface water (one sixth of the flow of the Rio Khora) is also utilised in Tiquipaya. In many cases, an organization has access to more than one well or spring.

Households tend to have a yard or in-house connection to the network (Table 1). In Tiquipaya 65-81% (depending on which figures are used) and in Colcapirhua 74-91% of people have a household connection to a piped water supply with yard or in-house supply. Most households in Tiquipaya rely upon on-site sanitation (68% households have septic tanks or cess pits). With the exception of the system serving the centre of Tiquipaya, local water systems have not been involved in the provision of sewerage services to

7. Territorial Based Organizations (OTBs) were established by the Popular Participation Law as the only recognized local actor in questions related to development issues. Each OTB is entitled to an annual fund from the local municipality for community development projects, which they plan and submit to the municipality for approval. Communities elect a president for their OTB, who in turn, elects a representative for their district to be part of a Vigilance Committee. The Vigilance Committee is responsible for supervising the municipality's administration (the execution of projects, administration of resources, etc.).

8. In 2003 an association (*Asociacion de Comites de Agua Potable y Alcantarillado Tiquipaya* or ASOCATI) was established in Tiquipaya to "defend the drinking water systems" and several drinking water committees are members. The main objectives are: to provide the associated members with drinking water, to develop and improve the service, and to prevent privatisation of the water sources that belong to the committees. An important point is that it has been decided that ASOCATI does not have the right to intervene in the internal management of the committees which remain autonomous.

date in this area. In the more urbanized Colcapirhua, around 40% of the inhabitants have access to a sewerage system (one managed by the Municipality and the other one by a Water Committee).

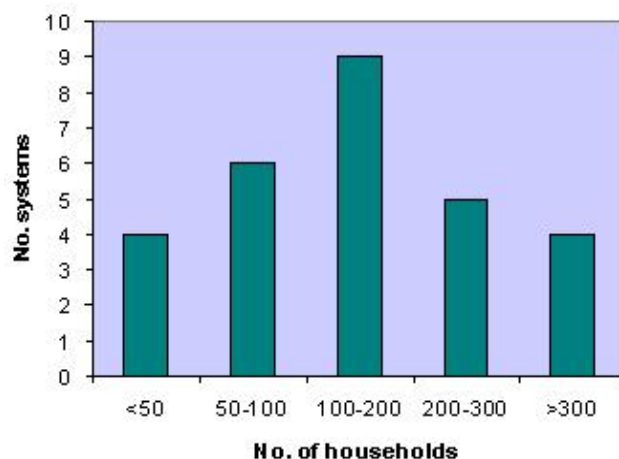


Figure 1. Scale of locally-managed systems

3. Results: the performance of locally-managed domestic water supply systems

Although some households remain unserved (with a house or yard tap), domestic water supply coverage (and sanitation) indicators for Tiquipaya and Colcapirhua are reasonably good and improving. However, coverage indicators are of limited value by themselves since water supply systems may be unreliable, or water quality may be poor. Possible additional indicators of the performance of domestic water services include:

- the quantity of water consumed (litres per capita per day or $\text{m}^3/\text{household}/\text{month}$),
- the quality of water supplied (whether minimum standards are met), and
- availability (number of hours of service per day)

Next, we consider how the existing locally-managed domestic water supply systems in Tiquipaya perform against these criteria.

3.1 - Quantity

The quantity of water supplied by locally-managed domestic water systems is relatively high compared to national and international standards (e.g. WHO target of 50 lpcd). Based upon estimates at the system level, consumption exceeds $10 \text{ m}^3/\text{month}$ per household (equivalent to 80 lpcd) in about 85% systems (Figure 2). Most systems, over half, supply between $10\text{--}15 \text{ m}^3/\text{month}$ (equivalent to between 80–120 lpcd). Of the 28 system managers interviewed, 18 reported that the quantity of water supply was good, and a further 9 said that the supply was fine.

Other studies have estimated similarly high levels of domestic water use. A survey of 19 households in four areas of Tiquipaya showed domestic water consumption averaged 141 lpcd (Duran et al., 2004). Woudstra (2003) studied domestic water consumption at the system level for four water supply systems in Tiquipaya and neighbouring Colcapirhua (Morococala, Santa Isabel, Huanuni, and Holanda), and found average consumption was 94, 94, 204 and 110 lpcd, or an average of 125 lpcd across the four systems (assuming an average household size of 4.1 persons). In a much small study of only four households in Tiquipaya, Hillion (2003, see also Bustamante et al., 2004) reported domestic water use averaging 74 lpcd.

Though the general picture is one of sufficient quantity, several committees who use surface water face problems of water quantity, and these are likely to increase given fast rates of population growth.

3.2 - Quality

Responses by system managers asked to describe the quality of water supplied to users were not as positive as for water quantity, but nevertheless most of the managers reported that ‘ok’ or ‘good’ quality water was supplied by 26 of the 28 systems (Figure 3). Planning data and sample analysis for

the MACOTI project also indicated that water quality of groundwater sources in Tiquipaya is relatively good, but not in neighbouring Colcapirhua (and the southern part of Tiquipaya) where there are problems with iron, manganese (leading to pipe blockages and extra costs as well as possible health hazards) and microbial contamination. According to EPSA data, in Tiquipaya 26 out of 27 systems reported that water is “clear” and only 1 reported it to be “turbid”. In Colcapirhua, 31 systems out of 51 reported that water is “clear” and 20 out of 51 reported it to be “turbid”.

Table 1. Key indicators

| Parameter | Tiquipaya |
|--|---|
| Population, Tiquipaya | 37791 (71% urban, 29% rural) |
| Population growth rate, Tiquipaya | 11.23% |
| No of households, Tiquipaya | 8123/8216 (urban 5829) |
| Average household size, Tiquipaya | 4.45 |
| Average annual income, per person, | US\$1448 (Source: UDAPE) |
| Poverty, Tiquipaya? (urban) | 55% below poverty line of Bs 3330 (US\$426) annual income per person (Source: EPSA) |
| <i>Water sources, Tiquipaya</i> | |
| Piped water to house (yard tap or in- | 5319 (65%) |
| Public standpost | 932 (11%) |
| Tanker | 375 (5%) |
| Well | 935 (11%) |
| River or spring | 509 (6%) |
| Other | 146 (2%) |
| <i>Sanitation</i> | |
| Households with sewerage, Tiquipaya | 809 (14%) |
| Households with septic tank, Tiquipaya | 1805 (31%) |
| Households with cess pit, Tiquipaya | 2135 (37%) |

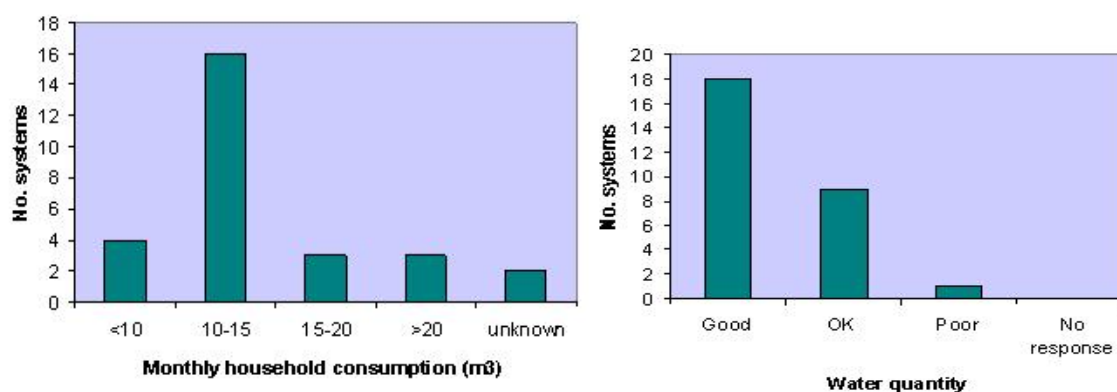


Figure 2. Water quantity performance a) average estimated household consumption b) response to interviews with system managers.

Generally good quality of water supplied by locally-managed groundwater systems in Tiquipaya was also reported by Woudstra (2003). Some samples from groundwater sources exceeded safe limits for iron in Colcapirhua, and some microbial contamination was also observed, but at much lower levels than samples derived from surface sources. The water quality of systems that abstract from surface water sources is much more problematic, with consistently high levels of microbial and parasitic contamination reported due to the limited treatment facilities available. At taps supplied by these sources, total coliforms of 100-2000 UFC/100ml (or more) were observed by Woudstra (2003).

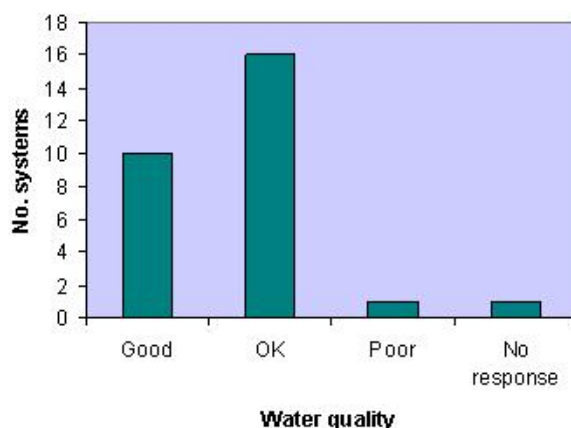


Figure 3. Water quality performance from response to interviews.

3.3 Availability of service

The availability or reliability of the service provided by locally-managed systems is also good. Over 50% systems supply water for 24 hours a day (Figure 4). As well as being convenient, provision of a 24 hour water supply is likely to lead to improved water quality since the risk of contamination of piped water supplies is greatest when systems run dry and lose pressure. A further 25% of the systems supply water for at least 12 hours each day. In contrast, water supplies from the centrally-managed system in the city of Cochabamba (SEMAPA) are often only available in some of the service areas for a few hours every two days.

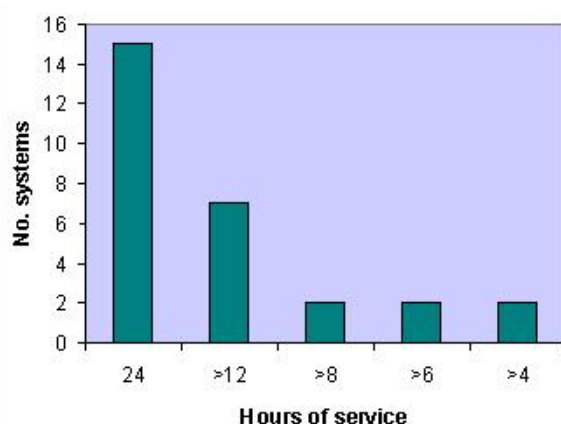


Figure 4. Number of hours of service provided.

Overall, locally-managed systems appear to perform well on average when assessed against criteria of quantity, quality, and availability. Next we examine the costs to users of locally-managed water services. Do these systems provide an affordable service?

3.4 Water charges and tariffs levied by locally-managed water supply systems

Domestic water charges levied by the locally-managed water supply systems include a joining or connection fee, and a monthly tariff. The connection fees are very high, compared to incomes. Most systems charge between US\$300 and 400, and some charge more than US\$600⁹ (Figure 5). This is a major barrier to services for poorer households (according to Table 1, 55% people have an annual income below US\$426).

9. In June 2004, 1 Boliviano= US\$ 7.8

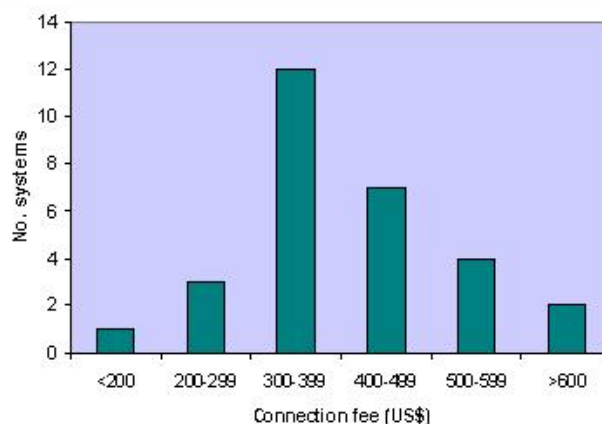


Figure 5. Connection fees charged by locally-managed systems.

Just as connection fees are hugely variable between different systems, there are a large number of different tariff systems and levels. Some systems use a simple fixed monthly tariff (10 of 28 systems studied), others use a volumetric tariff with a fixed charge per cubic metre of water used (12 systems), and some have stepped tariffs with higher volumetric charges above a certain threshold (2 systems). Some tariffs are also a combination of a fixed monthly charge and a further fee that depends upon volumetric consumption (3 systems).

Individual consumption levels of 80 and 140 lpcd are equivalent to 10 and 17.5 m³/month respectively for a family (with an average household size in Tiquipaya of 4.1 persons). The cost of 10 m³/month varies between 3-20 Bolivianos across the different systems with an average cost of 10.2 Bolivianos (Figure 6). The cost of 17.5 m³/month is between 3-35 Bolivianos with an average of 15.9 Bolivianos. A good rule of thumb is that the locally-managed systems on average tended to provide water for around 1 Boliviano per m³ (or US\$ 0.13/m³) in 2004. This is low and relatively affordable when compared to other piped water supply systems in Bolivia. The average tariffs in other metropolitan areas are US\$0.46 where there are concessions in place and US\$ 0.25 in other cities (Ministerio de Vivienda y Servicios Básicos, 2001)¹⁰. Costs of tankered water are even higher, around 10 Bolivianos per m³ (or US\$ 1.3/m³).

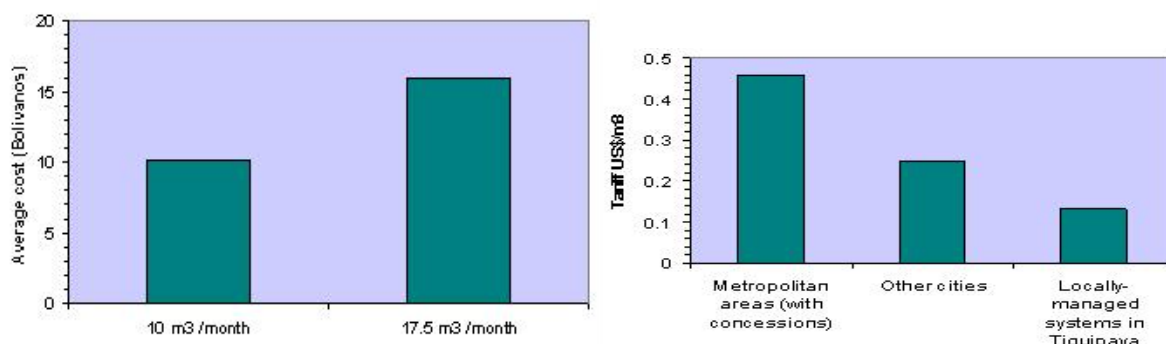


Figure 6. a) Water tariffs of locally-managed systems in Tiquipaya for different levels of consumption, and b) comparison with tariffs of alternative systems

But an important question is how much people can afford to pay for water (and sanitation) services. The average annual income per person in Quillacollo (the Province in which Tiquipaya and Colcapirhua are located) is US\$1448 but incomes are almost certainly lower in parts of Tiquipaya and Colcapirhua when the urban area of Quillacollo is excluded. According to EPSA Macoti project documents, 55% of the population fall below a poverty line of Bs 3330 annual income per person

10. According to a recent study of the *Viceministerio de Saneamiento Básicos* in 2003 the average fee (across 86 mainly urban EPSAs) was 0.35 \$us/m³

(US\$426) with an average income of only Bs 2160 (US\$276). Government guidelines propose that water and sewerage services should be within 3-5% of peoples' income which is equivalent to Bs 5-9 (US\$0.6-1.2) per person per month for these poorer families. Currently users of the locally-managed water systems pay an estimated Bs 3.9 (US\$0.5) per person per month (Bs 15.9 or US\$2.0 per household) if they use 140 lpcd or 17.5 m³/ month per household (a relatively high level of use) i.e. less than 3% of income.

Of course, tariffs are only an indicator of the cost of water to users. They do not shed much light upon the financial sustainability of systems that depends, amongst other factors, upon whether fees are collected efficiently, and whether the collected revenues cover total costs. The low water tariffs for users served by the locally-managed systems in Tiquipaya and Colcapirhua do not include the additional costs that are paid for through municipal expenditure for example. According to the *Plan Nacional de Saneamiento Básico*, municipalities have been investing an average of 10% of their resources in the water and sanitation sector over recent years.

Clearly, at the user level, the locally-managed systems provide a low-cost service to existing members, however the high connection fees are a major barrier to new consumers. Next, we examine the actual uses of domestic water by consumers in Tiquipaya. This is important in order to help understand the type of water service that consumers want and are prepared to pay for: is this a high quality and low volume supply, or do people have more complex requirements?

3.5 Uses of domestic water in Tiquipaya

Domestic water supplied through the pipes of the locally-managed water systems is not only used for basic uses like personal sanitation, drinking, cooking, washing and cleaning, but also for productive activities like keeping animals (cattle, pigs etc.) and cultivating gardens (*huertas*) as well as environmental and recreational uses such as cultivating lawns and flower gardens. Many of the residents of Tiquipaya are involved in small-scale agriculture. In most cases this is not the major household activity, but provides a vital additional source of food or income for families. Almost half of the water supplied by domestic systems in Tiquipaya is probably used for such productive activities. Total use of domestic water for a sample of 19 households in four different parts of Tiquipaya was 141 lpcd, of which 72 lpcd was used for basic needs and 54 lpcd for productive activities especially keeping animals and *huertas* (Figure 7; Duran *et al.*, 2004). Consumption of water for drinking and cooking, where water quality is most critical, was estimated in the same survey to be around 4 lpcd, or less than 3% of total domestic water use.

The challenge faced in supplying domestic water through a single piped network is how to meet drinking water quality standards at an acceptable cost, while still supplying sufficient water for other activities that are dependent upon domestic supplies. The economies of scale in water treatment may be sufficient to justify the supply of treated water for all domestic uses, regardless of the fact that 97% of this water does not need to be of drinking water quality. However, if the costs of treatment are high, alternative supply systems should be considered to ensure that all the needs of domestic users are met, such as alternative sources for high and low quality water supplies. Household level treatment, especially boiling of water, is a further alternative.

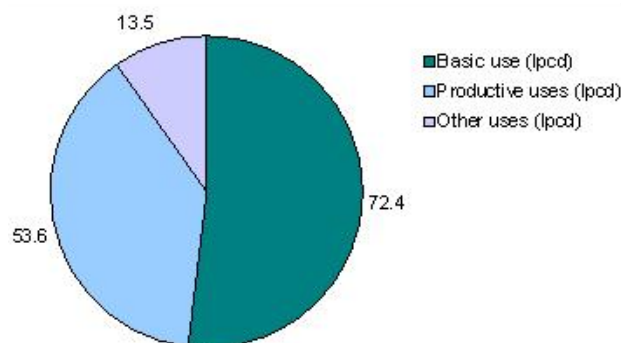


Figure 7. Basic, productive, and other uses of domestic water in Tiquipaya (after Duran *et al.*, 2004)

3.6 Community participation, ownership and rights

Discussions with system representatives indicated a high level of community participation in the development of systems, and a strong sense of local ownership. Only 13% of the water sources studied were developed (digging a well, building an intake etc.) without the direct contribution of the local people, and all the rest were either entirely financed by community (34%) or developed in collaboration (47%) with external organisations or institutions (such as the water utility in Cochabamba SEMAPA, NGOs, or the *Fondo de Inversion Social* etc.). In all the systems, infrastructure (piped networks) was built with the participation of users, who contributed with labour and cash in most cases (24 systems), only labour in two systems and only with cash in the remaining two cases.

This direct participation and contribution to the construction of the systems by local people explains why they consider themselves as being “right holders” and not just “users” of systems. To be a right holder implies that people are entitled not only to receive a service but also to make decisions about management of the system. In 68% of the cases studied, the representatives considered that the community (through the OTB or drinking water committee) ‘owns’ the water source while in 19% cases this is shared with other communities. Only in 13% of the cases were the assets considered to belong to some other institution or organization. However only in 28% of the cases was there a legal document to prove these property rights, while in 43% cases there exists some kind of documents but with an unclear legal value. In a further 21% cases there is no documentation. In relation to the infrastructure, with the exception of only one system the representatives consider that the infrastructure belongs to the community that uses it, although only three of the systems have a document that proves this ownership and only two have that document legalized.

The rights earned by the direct participation of the people are usually implicit and clearly understood within the local organisations, and although they constitute an important basis to understand how decisions are made in relation to the systems, they are not widely recognised by other organisations or formalised in law.

3.7 - The MACOTI project

In September 2001, the Municipalities of Tiquipaya and Colcapirhua agreed to constitute a joint organization (*Mancomunidad*) to develop a project that would improve the sewerage coverage in the valley area. A month later, a Technical Agency was established and work started to design a primary sewer network that would connect the secondary networks of both municipalities, and a treatment plant. To finance the project, negotiations with the Regional Development National Fund (FNDR) were initiated, but to meet the criteria set for access to loans, a “water supply systems improvement and expansion” component was included in the project. FNDR also set as a condition for granting the loan that an *Entidad Prestadora de Servicios de Agua* (or EPSA - decentralized and autonomous management institution) should be constituted to manage services. This original design of the MACOTI project attempted to connect 32.000 households to the domestic water network, and 10.000 households to the sewage system, increasing the reticulated sewerage coverage from 11% to 95% across the whole area. The total estimated cost of the project was \$US 4.5 million towards which FNDR was going to grant a loan for 80% and the municipalities were expected to contribute the remaining 20%.

At the beginning of 2003, the loan contract with FNDR was signed. Later the same year however, in June, a conflict emerged. The drinking water committees and the local irrigation systems’ association (ASIRITIC) protested against what they perceived as the encroachment of the planned system over their rights. After some negotiations and the acceptance from the side of the government not to intervene in the autonomous management of the drinking water committees (agreeing to provide only bulk water to the systems that have a demand for it), the debate shifted to the sanitation component of the project (technical design, financial and institutional arrangements for a sewerage system and wastewater treatment) and the future provision of bulk potable water by the MACOTI to the drinking water committees. As yet, these issues are unresolved. Very recently a round-table (*Mesa Tecnica*) has been established to debate the issues in a more structured way and this could lead to meaningful changes in the original design of the project.

In relation to domestic water, as mentioned previously, the project now proposes to supply bulk water to the locally-managed water systems. It is further proposed that this supply will be made at a cost of 1 Boliviano/m³ (*pers. comm.*, Promotores del proyecto MACOTI, 2004) which is about the same as the current charges these systems make to users (i.e. there is no margin to cover additional costs of the systems and the implication is that tariffs charged to users would need to rise to cover any additional distribution and revenue collection costs of the locally-managed systems). This figure is not based upon production costs, but is based upon assumption that systems will use 50 litres per second of bulk water (about half of the current estimated level of consumption) resulting in a largely beneficial financial balance for the MACOTI project on the domestic water side. This will help to finance the sewerage part of the project, which may well cost more than is currently estimated due to optimistic projection of the number of connections (6000 in Tiquipaya) and where revenue collection problems can be expected (if not linked to domestic water supply which can be cut off in cases of non-payment). The proposed charges for sewerage are 14 Bs/month (1.8 \$us/month) with a US\$100 joining fee (Promotores del proyecto MACOTI, 2004).

Each locally-managed domestic water system will, according to the current discourse, be free to decide whether they want to buy water from the MACOTI system. But importantly, there are no agreements or contracts in place that specify how much water will be purchased by the locally-managed systems and the price of bulk water. This leaves the MACOTI project vulnerable to the risk that locally-managed systems do not purchase additional bulk supplies, and that locally-managed systems will be exposed to significant political pressures to purchase water that has to be sold in order to collect revenue and repay loans.

In such an uncertain context, some locally-managed domestic water systems have managed to get extra untreated water supplies directly from the Cochabamba-based SEMAPA water company. These Committees already started negotiating with SEMAPA the purchase of treated water in the future, at a lower cost. This would also enable these systems to maintain their independence from the MACOTI project.

4. Discussion: Possible future scenarios for locally-managed water supply systems

The future of locally-managed water supply systems in Tiquipaya and Colcapirhua is uncertain. In the future these systems may be expected to handle bulk water supplies from the MACOTI project, return some revenue to the MACOTI project, and operate alongside or integrated with sewerage services. More positively, new bulk water supply infrastructure may improve the availability of water resources and security of supply. This section of the paper considers some of the many factors and issues that may determine the future shape of these organisations and water (and sanitation) services in the municipalities over the next 10-20 years.

4.1 - Issues driving change

A number of key issues can be identified that are likely to shape the future of water supply in Tiquipaya and Colcapirhua, and especially the fate of locally-managed domestic water supply systems.

a) Urbanisation and changing patterns of demand

Urbanisation is likely to lead to changes in users' demand, i.e. the type of service they want and are prepared to pay for, as well as overall demand linked to the rate of population change. As areas become more urban it is possible that people will increasingly shift towards in-house consumption, using less water for small-scale cropping, livestock and home-based enterprises. This may also lead to a shift in perception where users will be more sensitive to issues of quality and water availability (i.e. number of hours of service) than of quantity. It must be noted that, while some zones will soon be completely urbanized, others will remain largely rural over the next 10-20 years.

b) Legal changes

In 2000, new national legislation was passed (Ley N° 2066 *de Servicios de Agua Potable y Alcantarillado Sanitario*). The details of implementation of this new law are still under discussion. However, it seems certain that the law will impose a clearer – and stricter – framework for the

functioning of locally-managed domestic water supply systems, covering (a) the legal status of organisations involved in the provision of services; (b) quality of service, (c) tariff structures and (d) accounting requirements. Some water committees may be able to adhere to these stricter conditions, others not, at least without considerable external support. Many of these committees lack technical capacity to ensure potable water at the tap, and administrative capacity to meet the new requirements. Several institutions could provide support: an association of water committees; NGOs; or a municipal-led organisation, including for instance, the MACOTI project.

c) Implementation of the MACOTI project

A key issue will be the impact of the MACOTI project on the locally-managed domestic water supply systems, and the future relationship between the two. This project has already been considerably modified and the actual details of implementation are likely to further change, particularly since they are still being contested and negotiated.

- How will the project impact upon municipality investment in locally-managed domestic water supply systems? Since the MACOTI project is going to be costly and the project plans to sell potable water to all the Water Committees in Tiquipaya and Colcapirhua, the municipalities may stop funding rehabilitation of existing wells or drilling of new ones, arguing that the Committees should rather buy water from the MACOTI project.
- Will locally-managed systems retain flexibility? The competitive advantage of locally-managed systems (administrative management at low cost based on voluntary efforts, and a locally-adapted service) may be undermined by requirements to purchase more expensive bulk water supplies, and the reduced room for local manoeuvre in setting tariffs and managing type of water supply (quality, quantity etc.).
- What will happen to tariffs charged to users? There are likely to be increasing pressures to increase tariffs from current levels, because of the higher costs of treated water supply compared to existing locally-managed sources, and the need to cross-subsidise sewerage costs. It is possible that more systems will adopt metering and volumetric-based pricing structures, and combined with higher prices, this may result in reduced overall consumption and especially reduced use of domestic water for small-scale productive activities.
- How will sewerage charges be collected? After paying a US\$ 100 connection fee to the MACOTI project for connection to the sewerage system, it is unclear how sewerage charges will be collected. Conventionally, revenue for water and sanitation systems are collected together, and non-payment of bills could lead to disconnection of water supply. However, any role of the locally-managed water supply systems in sanitation is uncertain.
- How will the MACOTI project impact upon groundwater quality? On the one hand, the provision of sewerage may reduce contamination of groundwater leading to improved quality of water from locally-managed sources. On the other hand, availability of good quality bulk water supplies may remove incentives to protect local groundwater supplies and to control pollution.
- Will water supplied by the MACOTI project be of better quality? There is no guarantee that the water provided in bulk will really be of potable quality, due to possible poor operation and maintenance of water treatment facilities (as experienced elsewhere). It is possible that while the quality of water from local sources or the bulk supply is good, that contamination of reticulated supplies from poorly maintained sewerage infrastructure and piped water supply networks will lead to worse water quality at the tap. The locally-managed systems may also choose to mix water from the bulk supply with their own groundwater sources (optimising water quantity rather than quality and minimising costs).

d) Political and economic changes

In order to ensure revenues, the municipality may use powers (for example, by withholding investment) and political processes to force locally-managed systems to purchase water from the bulk MACOTI supply, and in the absence of contracts between the bulk water provider and the locally-managed systems, at prices they determine. Locally-managed systems may be continually undermined by 'forces' that are not committed to decentralisation and autonomy of management, and who have to ensure revenue flows to repay project investment. To spread the cost of loan repayments, there may be pressure to ensure that all systems are incorporated. Any deterioration in the general macro-political and economic environment may also lead to reduced willingness and ability of consumers to pay higher water fees.

4.2 - Possible scenarios

In Table 2, issues that are likely to impact upon water (and sanitation) services in Tiquipaya and Colcapirhua are summarised under four possible scenarios:

a) Scenario 1. Continue with the existing situation

Under this scenario the locally-managed domestic water systems continue to function autonomously; possible if the MACOTI is not implemented or only partially implemented, and if systems continue to operate without purchasing bulk water. In District 5 of Tiquipaya for example, the community have opted out of the MACOTI project and plan to develop alternative sewerage provision.

b) Scenario 2. MACOTI provides bulk water to the committees

Under this scenario, locally-managed domestic water supply systems will need to vary water tariffs in order to repay bulk water charges, develop administrative systems to handle bulk water payments, and modify infrastructure (such as storage facilities).

c) Scenario 3. MACOTI integrates all the committees under its management

If locally-managed domestic water supply systems are unable to cope with a variety of pressures and changes, and receive inadequate financial, management and technical support, it is possible that services will be taken over by an expanding centrally-managed utility (as is planned to handle new connections in currently unserved areas)

d) Scenario 4. The Committees associate themselves to provide services in the area

If more integrated operations are desired, and economies of scale exist, locally-managed domestic water supply systems could increasingly federate, potentially increasing their ability to seek external support where required.

In practice, of course, the future for locally-managed domestic water supply systems in Tiquipaya and Colcapirhua is likely to be complex mix of these (and other) scenarios, both within and between different systems and with variable impacts across the area. There is a high level of diversity within the locally-managed domestic water supply systems, and especially great differences in the capacity of the different systems in order to respond to the challenges faced. Other particular differences include whether the areas served are more urban or more rural, the type of water source (groundwater or surface) and the type of organization.

5. Conclusions

- A study of locally-managed domestic water supply systems in peri-urban Tiquipaya and Colcapirhua near Cochabamba, Bolivia revealed a diverse pattern of community-managed water committees and cooperatives providing services. Variations between systems include differences in source of water, legal arrangements, quality of services, and tariffs, and not least, the ability of the systems to cope with change.
- Though several of the locally-managed domestic water systems face management, water quantity, or water quality, the overall picture is one of a service that is reasonably good, and certainly not worse than the nearby large and centrally managed SEMAPA company that serves Cochabamba.
- Several actors in Tiquipaya and Colcapirhua have contested the arrangements for the proposed new water and sanitation project (MACOTI) which has already led to changes in project design such as the proposals to supply bulk potable water to existing small systems. This project, along with other pressures such as the requirements of new legislation, is likely to lead to major changes for locally-managed water supply systems over the next 10-20 years.
- A consultation process, with official government support, that is currently underway to revise the planned MACOTI project (*Mesa Técnica*) is an opportunity to further this debate.
- Tiquipaya and Colcapirhua are not isolated examples, and given the importance of locally-managed domestic water supply systems in Bolivia, what happens in the future will be important for the future of domestic water supply institutions in other peri-urban areas of the country.

Table 2. Possible future scenarios for locally-managed domestic water supply systems in Tiquipaya and Colcapirhua

| Issues | Financial sustainability | Performance of the service | | | Management |
|--|---|--|---|--|--|
| Scenarios (over 10-20 years) | | Quantity | Quality | Availability & access | |
| Scenario 1 Continue with the existing situation | Systems will still require external (financial and other) support to upgrade infrastructure as current low levels of water fees leave little room for new investment. | Existing high levels of service likely to be sustained although gradually eroded by pressures due to increasing population. | Need to address concerns over groundwater pollution, and lack of/poor treatment of surface sources. | Some people remain unserved by piped networks. High connection fees are barrier to poorer households. | Support required to meet new legislative requirements. |
| Scenario 2 EPSA - MACOTI provides bulk water to the committees | Dependent on whether committees are effective in collecting revenue (at higher tariffs levels) and repaying charges. Water charges likely to increase due to higher costs of bulk water. Committees currently successful at collecting low tariffs may prove unsuccessful in collecting revenues at relatively high tariffs for both water supply and sewerage. If levels of unpaid fees are high, pressures may increase to replace voluntary bodies with a centralised and professionally-staffed revenue collection service. | More security of supply (more options for both local and bulk supply) potentially leading to higher water consumption. However, higher tariffs (to pay higher bulk water costs) may lead to reduced consumption. | Uncertain. Potential that bulk Macoti water will be mixed with local sources. | Macoti project likely to increase access in currently unserved areas. | |
| Scenario 3 EPSA – MACOTI integrates all the committees under its management | May lead to economies of scale and efficiencies, but advantages of (low-cost) local management will be lost and water fees likely to increase to cover extra administrative costs. Sustainability will depend upon willingness and ability of users to pay higher water fees. | Potential abandonment of local sources could lead to increased reliance on few bulk sources, and dependence on the effectiveness of centralised-management affecting the volume and number of hours of supply. | Potential to introduce more treatment utilising economies of scale. But performance of treatment facilities often poor, and quality potentially worse than locally-managed groundwater sources. | Questionable whether good performance of hours of service will be matched by a centrally-run system. Very dependent on management. | |
| Scenario 4 The Committees associate themselves to provide services in the area | May strengthen ability of committees to access external financial support for new investment, and to improve financial management. | | | Could develop solutions to address unserved areas, such as supporting development of new systems. | |

- A key recommendation is that specific policies and support mechanisms (including investment in capacity building) are required to support locally-managed domestic water supply systems. Recognising and tapping the contributions of local communities may often lead to greater efficiencies, and be more sustainable, than large and centrally-planned systems.

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