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Sustainability analysis of water supply systems in Cochabamba, Bolivia

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After the decentralisation, water supply systems in several municipalities of Cochabamba department, Bolivia are being managed by different local institutions. The main aim of this study was to make a comparative evaluation of the sustainability of three water supply systems in Cochabamba, Quillacollo and Tiquipaya municipalities of Cochabamba. Based on the results of extensive field data collection and sustainability scoring system developed, technical, financial, social, institutional, and environmental aspects of these three water supply systems were analysed. Sustainability analysis showed that SEMAPA Cochabamba has the highest score in all sustainability aspects followed by COAPAT Tiquipaya and EMAPAQUI Quillacolo. Furthermore, the technical aspect is the weakest in all the three water supply systems. Lessons learnt from this study could be used to improve the sustainability of water supply systems in these municipalities and would be helpful to analyse water supply situations in other municipalities in Bolivia.

Introduction

Cochabamba, the third biggest department in Bolivia consists of 31 municipalities. Each of these 31 municipalities is managing their water supply systems quite differently. There are no well accepted policies for implementation and O&M of water supply systems. There are different types of systems for water provision like piped water supply (public and private), water vendors, and wells (public and private). Private water supply services are well known for their high connection fees, deficient management, and corruption but in places where the public supplier can not reach, they are the last solution for water supply. Public water suppliers in Cochabamba are mostly inefficient and inadequate planning has led to deficient water services and the annoyance of the inhabitants. Therefore, there is an urgent need to improve the existing water supply situation in Cochabamba. For that it is essential to analyze the existing situation and the factors affecting sustainability of the water supply systems. This study focussed on three major municipalities of Cochabamba namely; i) Cochabamba, which is the biggest and has the most complete water supply system managed by a private company; ii) Quillacollo, which has a dependent (semi – decentralized) water system company but of smaller-scale and; iii) Tiquipaya, which has decentralized water supply managed by the [illegible] these three types of institutional arrangements are typical for water supply sector in Bolivia.

Water supply situation in three selected municipalities of Cochabamba

The city of Cochabamba and the surrounding neighbourhoods towards Sacaba and Quillacollo have populations of about 600,000 inhabitants (about half the total population for the province of Cochabamba). The municipal water supply company SEMAPA has been providing water services in Cochabamba since 1967. Only about 53% of the urban population have access to drinking water from the municipal system. Quillacollo city at present has 104,206 inhabitants with a growth rate of 4.86%. EMAPAQUI is a decentralised water supplier (under the municipality) which manages the central system that supplies water to the old town and nearby zones. The central water supply system in Tiquipaya is managed by the water

committee COAPAT, which is supplying water to 1250 households and also manages local sewer system. Table 1 summarises the main characteristics of water supply systems in three municipalities surveyed.

Table 1. Characteristics of existing water supply systems in three municipalities of Cochabamba

	Cochabamba	Quillacollo	Tiquipaya
Population	599,302	124,374	58,095
Coverage by municipal system %	52.6%	52.1%	60%
Responsible agency	SEMAPA	EMAPAQUI	COAPAT
Institutional situation	Decentralized (private)	Semi-decentralized	Decentralized (community managed)
Number of connections	56,148	3,875	1,250
Water source	Surface water (40%) & groundwater (60%)	Groundwater (100%)	Surface water (90%) and groundwater (10%)
Treatment	Conventional treatment (complete)	Disinfection only	Conventional treatment (partial)
Billing method	Computerized	Manual	Manual

Source: SEMAPA (2005); EMAPAQ (2005); COAPAT(2005)

Methodology

The evaluation of water supply systems in three selected municipalities of Cochabamba, Bolivia was based on desk study of relevant literature and field assessment of performance of water supply systems in the country and factors affecting sustainability.

Questionnaire development and field data collection

Based on the literature review, water supply system performance and sustainability aspects evaluation criteria were developed. The sustainability evaluation was based on five main sustainability aspects namely: i) financial, (ii) technical, (iii) institutional, (iv) social, and (v) environmental. Each sustainability aspect was analysed using several criteria (questions) related to that aspect. Four sets of questionnaires were developed to collect data from four different categories of main stakeholders: (i) households (consumers), (ii) water supply companies, (iii) private water providers, and (iv) government institutions. Furthermore, a checklist was prepared to guide the interviews with key personnel in the sector. Details of the questionnaires, checklist and field data collected from each municipality are presented in Qunitanilla (2006). Questionnaires and interview checklists developed were used and different stakeholders were interviewed to get information on different aspects of the sustainability of water supply systems. In total 100 households were surveyed in each of the three municipalities. Additionally three main water supply companies, private water providers and several government agencies were visited and 10 key people were interviewed.

Data analysis

For the purpose of quantifying the field data, a 6-level scoring system ranging from 0 to 1 (with a step of 0.2) was used for each criterion (question) of a given sustainability aspect. The score for a sustainability aspect was calculated as the average of scores of all questions related to that aspect. For the household surveys the sustainability scores for each system was the average of the scores of 100 households.

Main results

Two different approaches were used to evaluate different sustainability aspects of water supply systems; (a) evaluation based on household surveys and (ii) evaluation based on response from other stakeholders.

Evaluation based on household surveys

Technical, financial, institutional, social, and environmental aspects of the water supply systems were evaluated based on questionnaire-led survey of 100 households in each municipality. Typical technical sustainability criteria and average scores, and the overall sustainability scores of three water supply systems are presented in Table 2 and 3 respectively.

Table 2. Technical sustainability scores of three water supply system based on household surveys

Sustainability criteria	Water quality	Water quantity	Water pressure	Frequency of supply	Duration of supply	Overall Technical
SEMAPA Cochabamba	0.66	0.51	0.62	0.64	0.45	0.58
EMAPAQUI Quillacollo	0.55	0.49	0.51	0.61	0.50	0.53
COAPAT Tiquipaya	0.62	0.66	0.61	0.60	0.50	0.60

Household surveys in three municipalities revealed that there is a large variation in quality and quantity of water supplied, water pressure, and frequency and duration of supply. Water supplied ranges from 30 to 160 litres per capita per day; supply duration is 1 to 5 hours and frequency of supply is 1 to 4 times a week. Water tariff, revenue collection system and collection efficiency of three water supply systems vary considerably. SEMAPA Cochabamba has computerized billing and collection system whereas other water providers EMAPAQUI and COAPAT have manual system. SEMAPA has metered supply and volumetric tariff whereas the other two have no meters and use monthly flat tariffs. In all the three systems the cost of connection are relatively high (> 200 US$) and this is even higher for private water providers (> 500 US$).

Table 3. Sustainability scores of three water supply system based on household surveys

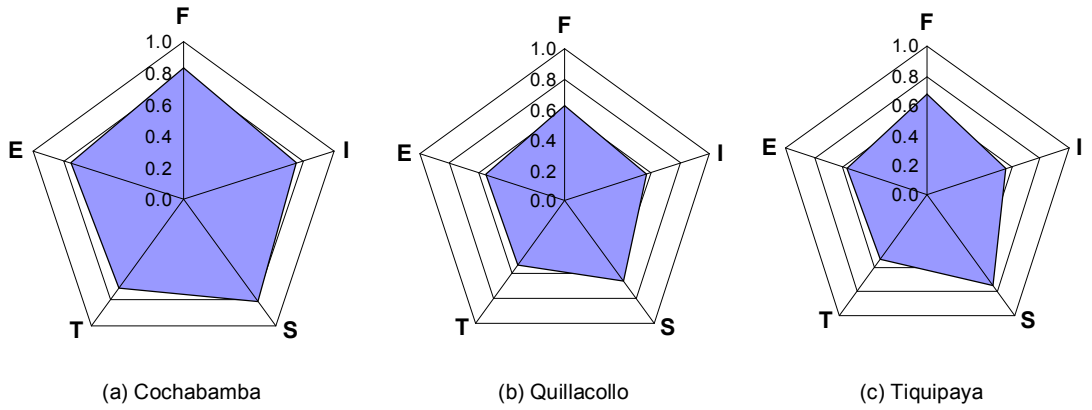
	Financial	Institutional	Social	Technical	Environmental
SEMAPA Cochabamba	0.82	0.56	0.75	0.58	0.75
EMAPAQUI Quillacollo	0.33	0.65	0.69	0.53	0.70
COAPAT Tiquipaya	0.64	0.59	0.87	0.60	0.65

Evaluation based on interviews with other stakeholders

Based on the field survey questionnaires the average sustainability scores for each of the sustainability aspects were evaluated separately after assigning weightage to different questions under each category. The sustainability scores thus obtained are presented in Table 4 and the sustainability diamonds are presented in Figure 1. Data analysis showed that SEMAPA has the highest scores on all sustainability aspects followed by COAPAT and EMAPAQUI. In spite of receiving a lot of financial input from government and external agencies, SEMAPA was not able to improve the coverage significantly in the past years. There is a lack of trained staff in smaller water providers like EMAPAQUI and COAPAT. However COAPAT demonstrated that despite of being a small water provider and not having trained staff, a good leadership may result in good management and good relations with the customers. Private water supply companies in Cochabamba are driven by financial interests only and not by customer satisfaction and the quality of service provided. They do not take into account the health risks related to selling poor quality water and a pronounced level of corruption is present in most of these private water providers. Furthermore, in general, there is a lack of basic environmental awareness; no attention has been paid to surface water and groundwater resources protection in these three municipalities. In the smaller (private) water providers the negligence of environment and water quality aspects is even higher.

Table 4. Sustainability scores of three water supply system based on stakeholder interviews

	Financial	Institutional	Social	Technical	Environmental
SEMAPA Cochabamba	0.84	0.75	0.80	0.70	0.75
EMAPAQUI Quillacollo	0.63	0.57	0.65	0.53	0.55
COAPAT Tiquipaya	0.68	0.56	0.75	0.53	0.57



(a) Cochabamba (b) Quillacollo (c) Tiquipaya

(F= Financial, I = Institutional, S=Social, T = Technical, E = Environmental Sustainability)

Figure 1. Sustainability diamonds for three water supply systems

Conclusions

- Household surveys showed that the technical aspects of water supply systems in three municipalities, in terms of quality and quantity, water pressure, frequency of supply, duration of supply, differ significantly. There are also large variations in these factors in different areas of each municipality.
- There is a considerable difference in the water tariff and collection system among three systems. In spite of a high level of willingness to pay the water bill shown by customers during field survey, the smaller water companies (Quillacollo, Tiquipaya) still have relatively lower collection efficiency (50-60%).
- Of the three water supply institutions, SEMAPA has the highest sustainability scores on all aspects followed by COAPAT and EMAPAQUI. The technical aspect is the weakest one for all the suppliers.
- The study revealed that the smaller the size of water supply company, the higher the attention to the customers and the higher the belongingness of the customers to the company e.g. COAPAT. For bigger companies like EMAPAQUI and SEMAPA customer care and satisfaction was lower as less attention was paid by the companies on these aspects.
- Technical and environmental aspects of all the three water supply systems should be improved considerably for their sustainability.

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