PERGAMON

Natural Resources Forum 24 (2000) 263–271

Natural Resources
FORUM

www.elsevier.com/locate/natresfor

The small-scale water provider in Paraguay: bringing private sector efficiency to water resource use and the provision of drinking water to the poor

Peter W. Loach[a], Silvio Melgarejo[b], Manuel Lombardo[c]

[a]*Program Manager, Cooperative Housing Foundation, El Salvador E-mail: ploach.chf@es.com.sv (P.W. Loach)*
[b]*President, Camara Paraguaya de Agua (CAPA)*
[c]*Secretary-General, CAPA .*

Abstract

This article provides a case study of small-scale private sector provision of water supply in Paraguay, where the Government has sought sector policy reforms that would encourage private investment in drinking water supply. Ironically, while the Government has focused almost entirely on garnering the interest of large private international water companies, much smaller local firms have already made significant investments in drinking water services for the poor, all without any participation or encouragement from the Government..

Outside Paraguay's two major cities, Asunción and Ciudad del Este, large numbers of aguateros currently provide piped potable water to lower-income people. Though the aguateros have little legal footing — they are in many respects informal and unregulated — they have constructed as much as one third of all the new drinking water connections in these two cities over the past 20 years.

The small-scale water systems in Paraguay offer a model of financial, economic, and water-use efficiency. This article asserts that an abundance of groundwater resources, cheap access to electricity for pumping, and a spirit of informal investment, among other variables, has spawned widespread use of this approach.

This article documents and analyzes the features of these independent small-scale water providers in Paraguay and the efficiency they bring to the use of water resources in meeting drinking water demands among the poor. It also cautions against policies that may trample on such entrepreneurial spirit in the name of State-managed privatization. © *2000 United Nations. Published by Elsevier Science Ltd. All rights reserved.*

Keywords: Rural water supply; Paraguay; Private sector; Small-scale providers

1. Introduction

During the last three decades, the amount of investments in the provision of potable water in Latin America has increased dramatically. During the 1980s alone, the so-called Water Decade (the International Drinking Water Supply and Sanitation Decade), international donors and national governments allocated billions of dollars to consolidate and expand the coverage of drinking water throughout the region. While much progress has been made, significant portions of Latin American society remain without a dependable and safe water supply.

The pace of rural to urban migration in Latin America has outstripped most public services already constrained by systemic inefficiencies. Dysfunctional shelter and land markets and inadequate policy and investment responses leave few options for the poor but to settle in often physically risky and unserviced areas surrounding Latin America's major cities. Drinking water usually arrives by truck or through illegal connections to public distribution systems. In these marginalized areas, service quality is low and unit charges often much higher than those paid by residents in more formal areas of the city.

In response, multilateral and bilateral agencies in recent years have sought to encourage governments to adopt private sector approaches to drinking water provision. Some public water utilities have employed service contracts

PII: S0165-0203(00)00025-8

with private firms to increase the efficiency of daily operations. Others have reached agreements with national and international firms through management contracts, lease contracts, concessions, or the outright selling of assets, among other arrangements, to improve efficiency and expand services and foster private capital investments in delivery systems.

Paraguay too has begun seeking sector policy reforms that would encourage private investment in drinking water supply. With assistance from multilateral donors, the Government of Paraguay has drafted legislation to establish a more independent sector regulatory system and open the door for the negotiation of contracts and concessions with private firms.

Ironically, while Paraguay makes arrangements to garner the interest of private international water companies, much smaller local firms have already made significant investments in drinking water services for the poor, all without any participation or encouragement from the Government. In fact, recent government policy developments may actually impede or eliminate these small-time providers, reducing coverage in low-income areas and making more complicated the job that any international firm would face. This article documents and analyzes the features of these independent small-scale water providers in Paraguay and the efficiency they bring to the use of water resources in meeting drinking water demands among the poor. It also cautions against policies that may trample on such entrepreneurial spirit in the name of State-managed privatization.

2. Brief description of the Paraguay case

2.1. National context

Paraguay is divided geographically into two distinct areas: the Eastern Region and the Chaco desert. With about 98% of the country's population of 5.2 million (1998), the Eastern Region is the focus of economic activity. Per capita income was estimated at about $1760 in 1998 (compared with $3940 for the Latin American region) and population growth is about 2.5% a year. Paraguay's economy is highly dependent on agriculture and a large informal commercial sector. About 25% of GDP and 40% of employment come from the agriculture sector, while a large share of undocumented, informal economic activity remains outside the measured economy. This includes unregistered border trade, which may exceed official GDP in volume (World Bank, 2000b).

When compared to other Latin American countries with equal levels of per capita income, Paraguay boasts a relatively more equal income distribution and lower levels of poverty. According to recent poverty assessments by the World Bank, about 20% of the population in the Eastern Region live below the poverty line, and only about 3% live in extreme poverty. More moderate poverty levels seem to be an outgrowth of lower land pressures, high levels of primary education, relatively high economic openness, and a low tax burden. Nonetheless, due to historically low social spending, access to secondary education is low, as is coverage of basic health care and water and sanitation services.

Approximately 45% of Paraguay's population still live in rural areas, compared with only 25% for the Latin American region as a whole. Another 8% reside in towns with less than 25,000 inhabitants. Nonetheless, high population growth and the effective end of its agricultural frontier have produced an increasingly rapid urbanization trend. The growth of cities, particularly the capital, Asunción, and Paraguay's second largest urban area, Ciudad del Este, has put even more pressure on government-supported drinking water and sanitation service providers.

2.2. Drinking water coverage

Paraguay has one of the lowest levels of water and sanitation coverage in Latin America. The Government of Paraguay estimates that in 1998, 70.7% of urban and 14% of rural residents had access to a piped potable water supply. This compares to averages in Latin America of 81% and 39%, respectively. Provision of sewerage services is even lower: about 27% for urban areas compared to 53% in the Latin America region.[1]

Relatively low levels of formal drinking water service coverage have not resulted from a lack of water resources. Paraguay sits in the basins of the Paraná, Paraguay and Pilcomayo rivers, which provide abundant surface water. They also feed extensive groundwater systems in the Eastern Region that supply water for domestic consumption and irrigation. Except for the Chaco Region in the northwest, Paraguay enjoys generous rainfall. In the Eastern Region, the annual average is 1270 mm, although the average on the Paraná Plateau can be 250–380 mm higher. Variations by subregion can be considerable from one year to the next. Asunción has recorded 2080 mm in one year, and 560 mm in another. Puerto Bertoni on the Paraná Plateau has recorded as much as 3300 mm and as little as 790 mm. Such rainfall levels, combined with relatively low population density and a use of less irrigation-intensive agricultural methods, limit pressures on water resources.

2.3. The formal water supply sector

The formal public water and sanitation sector has been arbitrarily divided in two groups: communities with more than 4000 people, which are serviced by the State-run Corporation for Sanitary Works (CORPOSANA); and settlements with a population less than 4000, which fall under the jurisdiction of the National Environmental Sanitation Service (SENASA), an agency of the Ministry of Health. CORPOSANA maintains roughly 220,000

[1] Ministry of Health statistics and national census data.

connections nationwide, while SENASA manages approximately 120,000 connections through approximately 600 community water committees.

The two water utilities have different institutional, organizational, legal, and managerial characteristics. SENASA's projects focus on community participation with some cost recovery of initial investments and full user financing of operation and maintenance costs. Its dispersed and small-scale rural and suburban water supply systems tend to rely almost exclusively on groundwater sources, and accordingly, have relatively low unit costs. SENASA creates local sanitation committees, or *Juntas*, within communities. These Juntas own the assets of the system and must fully administer, operate and maintain them under SENASA's regulation. Following SENASA's completion of the system design and cost structure, it assists the community in constructing the works and initiating the service. Of the investment costs, SENASA donates 40–60%, usually financed by multilateral loans to the central government. The Junta then borrows 15–30% under soft terms from SENASA, and the remainder is contributed by the community in the form of labour, materials, and/or cash.

CORPOSANA, on the other hand, does not generally involve local governments or users in the selection, construction, operation, or maintenance of systems, and tariffs do not meet either construction or operational costs. CORPOSANA's principal sources of water in serving greater Asunción and Ciudad del Este, wherein most of its users reside, come from the Paraguay and Paraná rivers, respectively. Waters are extracted from these sources, treated, and transmitted, in some cases a number of kilometres, to principal distribution systems. In recently proposed investments to expand the supply system in Asunción, to be financed largely by international donors, the total cost per new connection, relying on lengthy transmission, has been calculated to range from $1800–$2800. CORPOSANA's operational indicators also demonstrate very weak cost recovery, poor administration, and high rates of commercial and physical water losses (a combined total of 40% in 1993), all of which have contributed to the public utility's financial instability, a heavy reliance on central government infusions of cash financed by multilateral loans, and less efficient use of available water resources.[2]

2.4. Independent, small-scale approaches to water service

Considering the availability of groundwater resources and the prevalence of informal economic activities in Paraguay, it should not be surprising to find a proliferation of small-scale, private water providers filling the gap of coverage left by public utilities. In most departments of the Eastern Region, it is the custom to extract water from shallow wells (typically 4–15 m deep) or from greater depths (80–150 m). In the case of the latter, sealed and often artesian aquifers are found, with water quality and flow very dependable. With a far-reaching national electricity grid supplied cheaply by the Itaipú hydroelectric project, use of electric pumps to access these aquifers is widespread and affordable.

In fact, around the outskirts of Asunción and Ciudad del Este there are somewhere between 350 and 600 independent *aguateros* currently providing piped potable water through roughly 115,000 connections to 600,000 people. Though the *aguateros* have little legal footing — they are in many respects "informal" and unregulated — they have constructed as much as one third of all the new drinking water connections in these two cities over the past 20 years, investing upwards of US$30 million in private capital. As will be presented below, service quality is generally high and user fees are very competitive with CORPOSANA and SENASA. Moreover, there is little waste of water resources and no drain on public coffers.

3. Characteristics of the *aguateros*

Following the end in 1989 of General Alfredo Stroessner's 35-year rule and movement to a more democratic political system, the business environment in Paraguay gained space and investor confidence grew. As the Government loosened its control over the private sector, entrepreneurs began shifting their focus from rent-seeking toward independent business opportunities. It did not take long for quite a few investors to recognize the potential profits of building a simple, small-scale water supply system based on a single well and a small distribution network. Earlier systems had already been profitable, though limited in scale by investment uncertainty and lack of technical know-how. These systems had depended on water carts or trucks, or consisted of shallow wells servicing only a few families.

Independent water providers slowly increased investments and market share through new techniques. Deeper wells (100–200 m) offered a steady water supply even during the dry season and droughts, allowing systems to grow to 150–200 connections. Such wells have also proven to be more insulated from contamination by common sanitation solutions such as latrines and cesspools. Adding water meters to rationalize consumption permitted expansion to 400 or 500 households. At this scale, the cost regime became unitary, allowing each new connection to be made at a consistent, affordable price. Soon even the family wells, not as immune to seasonal variations in water supply, became a second best option to consumers and the small-scale providers.

Growth of small-scale independent water systems has occurred rapidly and within a single generation. Many of today's *aguateros* started as water carters. They then moved

[2] The World Bank, Project Appraisal Document, *Paraguay Fourth Rural Water Supply and Sanitation Project*, August 6, 1997. The World Bank, Staff Appraisal Report, Paraguay Asunción Sewerage Project, January 17, 1995.

from the cart to the truck, then became well users, and then owned the well and distribution network, all in a span of 10–20 years.

3.1. Regulating informality

While lacking a strong legal footing within the regulatory framework of the water sector, the *aguateros* nonetheless follow a set of regulations monitored by the central government and municipalities that focus primarily on water quality and the collection of commercial taxes.

Most *aguateros* make a considerable effort to certify the quality of their drinking water with SENASA. Such a water quality guarantee helps the provider pick up new clients and maintain customer loyalty, as well as legitimize their activities as a commercial enterprise. Normally, SENASA completes this certification one to two times each year in accordance with the requirements of the municipality where the system is located. SENASA charges the *aguateros* approximately US$20 for the test. Most municipalities require certification as a condition for granting the supplier a commercial permit. The National Technology and Normalization Institute, a government agency within the Ministry of Industry and Commerce, can also grant such a water quality certification, but does so less frequently.

Water provided by SENASA and by *aguateros* rarely varies in quality due to the relatively clean groundwater sources they both rely upon. CORPOSANA systems, on the other hand, must invest more in the treatment of the surface waters that they transmit. The *aguatero* is acutely aware of the need, in the eye of the consumer, to provide service and quality equal to or better than that provided by the State entities.

In most cases, SENASA also reviews the financial and technical specifications of water supply projects that an *aguatero* proposes. Municipalities, in turn, are charged with granting the construction permits that enable the system to be built. Naturally, such a permit implies a fee calculated in relation to the cost of the system. Once completed by the *aguatero*, and inspected by the municipality, the latter provides the commercial license that legitimizes the selling of the water, which is also taxed as any normal business would be. The *aguatero* assumes all costs associated with the construction and operation of the system.

3.2. Family vs. commercial systems

Typically, there are two kinds of operations that evolve: a family-based system and a commercial system. The former simply consists of a single household well expanded to include immediate neighbors. Service may be supplemental to water truckers already working in the area, and payments are usually less regimented and can include labor applied to operation and maintenance (Solo et al., 1999).

A commercial system aims to make a profit. Even if the system still depends on a family well, the owner needs to have access to credit, to maintain employees, and pay taxes as any enterprise would do. Licensing of equipment and other requirements would also be the norm. It is this latter system that now dominates the independent market and which we focus on here.

The key ingredient that defines the commercial system is capital. The operator must have or borrow the capital necessary to establish and build up the service. Investments must be recovered through connection and user charges. Due to the fact that the average client has limited economic resources and must pay connection charges on credit, the provider can also cover some financing costs by passing them on to the customer. The profit margin is small, forcing the most minimal of technical solutions and operational techniques to keep costs down. Income is also constrained by competition among independent providers and subsidized public utilities, a competition which favours the consumer and the rational and sustainable use of the natural resource.

Table 1 provides some basic information taken from a random survey carried out in 1998 of 25 *aguatero* systems. Though the average system has approximately 428 connections, one can see that the larger providers can have systems with as many as 2000 end-users (or about 10,000 individuals). It is debatable whether such providers can be called small-scale. The industry would be quite capable of producing even larger operators were it not for the legal insecurity of private drinking water provision. It is clear that the more successful providers diversify into other activities rather than expand the water-supply side of their businesses because of the risks involved in an activity that has no proper legal or institutional standing.

Table 1 indicates a wide variation in the ages of operations, from 20 years in some cases down to recent start-ups. This variation shows that such initiatives are neither a relic of the past nor a recent innovation. We are, then, dealing with a stable phenomenon, even though it is one with its own internal instabilities, and with a system that constitutes an established and viable way of providing drinking water in Paraguay.

3.3. Competition and the consumer

The most threatening situation to the small-scale water providers relates to their legal standing and competition. CORPOSANA and SENASA currently operate subsidized systems alongside *aguatero* investments and can pull away clients through lower charges financed by the State's access to soft multilateral loans, which are generally not repaid by the utilities themselves. Even among *aguateros*, a unified operation appears to be the exception rather than the rule, and criss-crossing networks can cause confrontation and distrust. Table 1 highlights the frequency of juxtaposed systems, and the fact that few systems are the sole supplier of everyone in the area. There are many instances of competitive warfare between two providers, as there are of a

Table 1
Basic characteristics of a sample of *aguatero* water systems[a]

Number	No. of connections	Overlaps with competitive systems	Connection fee ($)	Minimum tariff/month ($)	Number of years in business
1	44	*Aguatero*	211	5	1.5
2	100	*Aguatero*	175	5	6
3	271	CORPOSANA	123	5	n/a
4	538	*Aguatero*	263	4	8
5	350	SENASA, CORPOSANA, 2 *Aguateros*	158	5	n/a
6	357	n/a	232	5	n/a
7	393	SENASA	204	6	n/a
8	326	SENASA	225	5	n/a
9	355	*Aguatero*	82	7	8
10	390	2 *Aguateros*	123	6	20
11	2000	SENASA, 2 *Aguateros*	123	7	7
12	700	SENASA, *Aguatero*	88	7	16
13	270	n/a	140	6	3
14	150	CORPOSANA	0	5	12
15	70	n/a	0	4	15
16	100	*Aguatero*	0	4	8
17	240	SENASA, *Aguatero*	158	3	8
18	250	n/a	175	5	10
19	1000	CORPOSANA	228	6	19
20	120	SENASA	140	4	6
21	45	*Aguatero*	105	4	7
22	1800	*Aguatero*	367	4	10
23	130	CORPOSANA	70	4	7
24	46	n/a	168	4	0.5
25	660	SENASA	193	5	n/a
Average	428	n/a	154	5	9.1

[a] *Source:* survey conducted by Dr Fernando Troyano in coordination with the Camara Paraguaya de Agua, 1998.
n/a = not available.

provider being forced to sell off his/her assets after falling victim to competition from another provider, either independent or public. In some cases, for example, connection fees are waived to lure customers.

Thus, overlaps among competing systems enable the whole water-supply system to operate to the benefit of the consumer and contribute to rational water resource use. Naturally, agreements in some cases can be reached that do not favour the consumer, but this seems to be rare. As a group the *aguateros* would rather undergo rational tariff regulation and have the legal security to expand systems than remain on uncertain ground.

Most end-users have access, at least in theory, to more than one provider, and often to public-sector provision. One result of all this competition is quite clear: no provider can afford to set connection charges and operating tariffs too high, because the existence of areas of overlap throughout the system means there is effective competition on services and costs of a kind that would never arise in a more conventional setup where concessions depended upon a central licensing authority. In this sense, the system of independent water providers is infinitely more competitive than any conventional system of supply, with or without the participation of large and/or international private firms.

A further guarantee against monopolistic price gouging is the switching between one provider and another that is a common customer strategy, even though the trigger for such switching is usually that the customer has fallen behind with his or her payments rather than any deficiency or shortcoming on the part of the provider. When a customer is unable or unwilling to pay the water bill, the supply is cut off. The reaction of the customer to this is — whenever feasible — to ask to be connected to another provider. Under the peculiar unwritten conventions of independent providers, such connections are usually forthcoming, even when the new provider is well aware of the circumstances under which the application has been made. In practice, no provider has a vested interest in advertising the fact that a customer has been cut off, even where this is entirely the customer's fault. Generally speaking, there is a great deal of understanding in the system, assistance is provided to those in difficulties, and there are few disputes over the reasons behind a customer's switching from one provider to another, except when such switches become too numerous and themselves give rise to open competition between two providers.

The financial well-being of the independent provider depends largely on the satisfaction of the consumer, not the political interests of the current Government, leading to a strong client focus that fewer consumers detect when connected to public systems. If the public service is poor

Table 2
Cost comparison between pump-based and elevated tank-based water distribution systems

	Monthly operational costs ($)	Installation costs ($)	Total ($)	Number of connections served
Pump-based				
Pumping	108	258	366	100
Ground level tank	0	751	751	
Total	108	1009	1117	
Elevated tank-based				
20 m^3 tank elevated to 5 m	0	3900	3900	100
Total	0	3900	3900	

and customers stop paying, there is no feasible option of cutting service to everyone. Naturally, however, in cases where competition is more limited, independent providers do behave in a monopolistic way prejudicial to end-users. One remedy would be to provide a clear regulatory framework and diligent oversight.

3.4. Investment steps, costs, and considerations

Due to this insecurity and competition, Paraguayan *aguateros* tend to operate rather predictably, with variations in scale being the only major exceptions among them. One can describe the general sequence of investment events and issues to be considered.

An *aguatero* finds a peri-urban area with a minimum of one or two dozen potential users with a reasonable expectation that other users will be moving into the area or would want to connect to a system. Steady rural to urban migration will fuel growth. Paraguay's annual population growth rate is 2.5% (1998). Increasing movement to the cities has pushed the urban growth rate well above 3.0% (World Bank, 2000a).

3.4.1. System of 100 connections

Land must be bought and a well dug (100–150 m) for a cost of between US$2100 and US$3500. This investment must be complemented by expenditures for pumping equipment and initial piping (usually polyethylene at first and later PVC for major pipes). These latter costs (pumping and piping) can average around US$5300. The selection of equipment and materials has been largely refined over the years and remains pretty consistent across suppliers as the most efficient methods have become the norm.

The choice of technical solution undergoes a rigorous cost/benefit analysis, particularly with respect to water storage. The type of water tank (elevated or ground level) and its size must be assessed considering topography and the distribution layout, the number of users or potential users, and the financial resources available at the time of construction.

In the case of a ground-level tank, construction costs will be lower but operational costs will be higher, as pumps will need to continuously feed the distribution system, implying higher electricity and pump maintenance costs. Nonetheless, a pump-based distribution system can also more readily use small diameter (and cheaper) piping; thus the overall costs compared to an elevated tank system are usually lower. Many variables must be considered and each case studied carefully, including considerations of the size, location, and longevity of the system. In Table 2, a basic comparison of costs demonstrates the attractiveness of the ground-level tank in the short to medium term.

Table 3
Costs associated with street excavation for pipe installation

Road surface	Cost per metre of road ($)
Soil	0.75
Stone	1.04
Asphalt	6.00

While the pumping and storage station is being completed, often including a small shed from which to operate valves and pumps, the distribution system is laid out to the first clients signed up. The network expands as consumers pay for connections. In most peri-urban areas newly settled and without water services, streets are not paved, so excavation and pipe installation costs are low. Later as the population density increases and the municipality improves and paves roads, pipe repair and expansion costs rise considerably. Thus, there is an incentive to predict expansion needs and keep pace with demand before paving occurs. Table 3 provides a simple comparison of excavation and pipe installation costs for varying road conditions.

3.4.2. System of 300 connections

Once a system begins greater expansion, say from the initial two dozen to 100, and then to 300, unit costs decrease. Some overall costs associated with constructing and operating a system with 300 clients are summarized in Table 4.

Aguateros requiring some credit to get this far will normally obtain a commercial loan from a local bank with a 3–4-year term at interest rates between 37 and 42%, which includes inflation (calculated at 14.6% in 1998), putting the real rate around 22–27% (World Bank, 2000b). Banks may recognize some of the fixed assets of the existing system, but to finance expansion, the *aguatero* must put up some of his/her personal assets (house, vehicle, land, if properly titled, etc.) to meet collateral requirements.

An *aguatero* system will require a piece of land to situate the well and tank. A common parcel for such a need would be 360 m^2 purchased through a bank or developer at a cost of between $27 and $91 per month over a term of 128 months. Land costs are typically financed separately from equipment and construction costs, and are incorporated into operational costs.

Credit can also be arranged with the sellers of materials such as piping (often paid over 3–4 months), pumps

Table 4
Installation, operation, and maintenance costs for a typical *aguatero* water system serving 300 households[a]

Cost categories	Quantities	Cost (US$)
Installation		
Distribution piping ($1.40/m)	12,000 m	16,842
Excavation for piping ($0.70/m)	12,000 m	8421
Well excavation ($21.10/m)	2 × 100 m	4220
Pump and elevated tank	30 m^3 capacity	7544
Equipment		10,222
Design, financing, administration		10,517
Total		57,766
Per connection		193
Operation/maintenance (per month)		
Electricity		421
Amortization of pumping and other equipment.		237
Personal		351
Administration		281
Total		1290
Per connection		4.30

[a] *Note:* US$1 = 2850 guaranas, August 1998 when this data was collected.

(payments over up to 12 months), and wells (payments over 6 months), with interest rates similar to those mentioned above. The incentive to save and avoid dependence on loans is great, though few but the most established can avoid borrowing. Thus the banking sector must be recognized as a key player in the expansion of most of these larger systems.

Naturally, consumption levels will play a big role in how the system develops. In the beginning, with a surplus of water and few consumers, the *aguatero* is not concerned with per household consumption and usually charges a fixed monthly rate. However, once the system has more than around 150 connections, supply begins to get outstripped. If meters are installed and consumption rationalized through block tariffs, the same well may accommodate up to 400 families. The cost of installing meters and the willingness of customers to accept them, must be weighed with the alternative cost of digging a second well to meet demand. Much depends on the density and location of the settlement and predictions for its growth.

Some cushion can be created when the *aguatero* offers financing to clients (the majority) unable to cover the initial connection charge in one payment. Typically, these payments are spread over 1–2 years under terms less favourable than those the *aguatero* has received for the investments. In this way, the *aguatero* adds a little to the profit margin acting as an informal lending institution.

Each *aguatero* will expand his/her system until it borders or even overlaps with another supply system. If the neighbouring system is private (another *aguatero*) a non-aggression pact may be negotiated, but often a price war related to connection charges ensues. In a few cases, a more cartel approach leads to higher tariffs. In cases where the neighbouring supplier is CORPOSANA or SENASA, the *aguatero* is in a more difficult position. The subsidized connection charges these public entities can offer undercut the *aguatero*, who must operate with 100% financial sustainability to cover his/her investments and avoid personal bankruptcy. The minimum monthly consumption charge levied by CORPOSANA is approximately US$2.80, while small-scale independent providers must charge on average between US$3.50 and US$7.00. Most often, the system's owner is the main employee who also handles collections and administration. Larger systems may contract for services. Table 5 records some average user charges for *aguateros* and SENASA.

Table 5
Some average user charges for *aguateros*, SENASA, and communal systems

	Aguateros	SENASA
Number of systems consulted	25	6
Average charge per connection ($)	154	156
Average monthly metered consumption charge ($)	5.00	3.00
Average monthly non-metered consumption charge ($)	7.00	5.78
Average Number of connections per system	428	850

The *aguatero* will not have his/her losses covered by central government appropriations financed by multilateral lenders. Then again, society and the State will not expend any resources to keep the *aguateros* afloat. Still, many consumers prefer the independent provider due to more dependable service and water quality, greater customer care, and more flexible terms — the *aguatero* wants a satisfied client and will do more to ensure customer loyalty.

3.5. Recouping the investment

Given the costs of formal credit in Paraguay, particularly for investments not sanctioned in the legal framework of the water and sanitation sector, independent small-scale water providers must recoup their investments quickly. The repayment period for a commercial loan in this case is short, usually 3–4 years. Moreover, with the competition and insecure legal standing, *aguateros* cannot predict even into the medium term whether they will be able to continue operating their business and supporting a debt, even with refinancing as an option.

The most financially viable solution for the independent provider is to cover these investments through connection charges. Doing so through tariffs is less feasible since they must compete even more directly with public and private providers. Though the connection charge levied by independent suppliers can vary widely, depending on the size and unit costs of the system and the level of competition present, the average charge is approximately US$154. As seen in Table 1, competition is so fierce in some cases that no connection fee is applied, whereas in others this charge can reach over US$300.

With a connection charge of around US$175 per family,

Table 6
Typical payment scenario for *aguatero* connection charges (US$)

Number of payments	1	2	6	12	18
Each payment	144.00	72.00	25.83	18.17	15.11
Total	144.00	144.00	155.00	218.00	272.00

an *aguatero* can recoup the initial investment with between 80–120 clients in the first few years. Otherwise, he/she is on shaky ground, and *aguateros* do go bankrupt. Low-income users will not be in a position to bail them out should the number of clients needed not materialize.

As has been mentioned, *aguateros* commonly offer financing to customers unable to pay this charge outright, which has become another source of income to cover installation and financing costs. Such customer credits can be covered by personal capital or borrowed funds, and usually imply an annual interest rate above 50% (including inflation). Such a rate allows the *aguatero* to make some profit above the commercial rate of up to 42% in order to cover installation costs. Table 6 presents a typical *aguatero* payment scenario and its income potential for the provider.

Many repayment periods are longer than 18 months — commonly 3 years. Thus, most users can connect to an independent system for between US$10.50 and US$14.00 a month over the first three years. Adding in the minimum operating tariff, the total monthly payment for 10–15 m^3 of piped potable water per month can average around US$17.50, which represents about 8% of the national minimum wage, a reasonable amount considering that no subsidies are involved and that after three years, monthly payments drop to as low as US$3.50.[3]

Aguateros who have recovered their investment costs tend to raise the minimum monthly tariff higher — up to US$7.50 per month. Where there is no competition (or where competition is mediated through private agreements between providers), such charges are still very reasonable, representing 3.33% of the national minimum wage. Once metering is established, consumption can be controlled through tariffs. Metered connections average only between 10 and 12 m^3 per household per month, which lends sustainability to the water source.

Thus, while paying off the connection charge, users get a cubic metre of water for between US$1.17 and US$1.75. Once the connection fee is paid, their cost/m^3 can shrink to between US$0.23 and US$0.75. By contrast, in most Latin American cities, similar low-income populations living in squatter settlements without public water service commonly pay water truckers or the like anywhere between US$2.50 and US$6.00/m^3 for water of less dependable quality and safety.

By way of comparison, CORPOSANA requires approximately US$211 to connect to its systems, and allows up to 36 months for repayment with no interest charges, but also with per connection investment costs as high as US$1800–US$28,000. SENASA's user cooperatives charge between US$88 and US$190 with a similar 3-year repayment window and investment costs upwards of US$500 per connection. Of course, the investments required to build, operate and maintain these systems benefit from central government subsidies passed onto the user. It can be roughly estimated that in the case of CORPOSANA, the actual long-run marginal cost of a new connection, considering its dependence on more capital intensive surface water capture, treatment and transmission systems, is many times more than the amount currently levied on a new user. Table 7 shows a two-stage investment plan currently under consideration by CORPOSANA, and highlights the deficit incurred by its subsidized connection fee.

Table 7
Example of planned CORPOSANA investments[a]

Stage	Total cost ($)	Number of connections	Cost per connection ($)	Charge per connection ($)	Deficit per connection ($)
Stage 1	67,000,000	37,000	1811	387	(1424)
Stage 2	70,000,000	25,000	2800	194	(2606)

[a] *Source*: Cámara Paraguaya de Agua, CAPA.

4. Conclusions

The explosion in growth of small-scale, network drinking water systems in Paraguay is largely unprecedented in Latin America, and offers a model of financial, economic, and water-use efficiency. An abundance of groundwater resources, cheap access to electricity for pumping, and a spirit of informal investment, among other variables, has spawned widespread use of this approach. The beneficiaries have been the low-income consumers connected to these systems and the State, which as a result has more than half a million fewer citizens requiring public financing to access water services, a major contribution to avoiding the collapse of the sector's public enterprises.

The *aguateros* demonstrate important lessons in drinking water provision that are often spoken about among public utilities but less often adopted. The use of low-cost technologies and approaches, such as the use of relatively clean groundwater when abundant, smaller diameter piping, and shallower excavation for distribution networks, lower the proportion of investment costs attributed to capital. The State's more capital-intensive methods, on the other hand, are certainly more gratifying to donors needing to disburse grants and loans, and to engineers seeking technical challenges. They require, however, a major diversion of government expenditures that inevitably undermine other social investment priorities.

The *aguateros*' work is not highly technical, it simply

[3] The Pan American Health Organization often quotes a figure of 5% as an ideal maximum proportion of family income dedicated to the acquisition of potable water.

relies on one guiding principal — the bottom line. It is not encumbered by rent seeking, political agendas, donor preferences, or bureaucratic survival. It is remarkable in its simplicity. However, in most cultures, water is not simply a natural resource, it is a social good, and to put its management and distribution for human consumption into the hands of profit-minded businesspersons is not an attractive idea to many.

To its credit, the Government of Paraguay has recognized the benefits of partnering with the private sector to bring this business-like approach to drinking water provision, and has embarked on a sector reform campaign to increase private sector participation. Proposed legislation aims to clarify legal responsibilities and separate regulatory and operational functions, move toward the decentralization of operations, including possibly vesting responsibility for water supply services with the municipality, and create a more encouraging environment for international private sector participation. These reforms, formulated with assistance from multilateral institutions, are currently under review by the national legislature.

Unfortunately, the reforms remain State-centred. The focus is on improving the existing public utilities in partnership with private international firms (e.g. Lyonnaise des Eau, Aguas de Barcelona, etc.). Less attractive to these public utilities is the idea of actually transferring responsibility for water provision to the marketplace. In fact, if approved, these reforms would leave open the possibility that the State could confiscate the assets of independent providers as the public utilities expand coverage. The justification being given for such a move is that this expansion would occur with an international private partner, guaranteeing an inflow of private investment as well as greater service efficiency that would bring financial stability to the sector, to be financed in the end through higher tariffs to consumers. The argument concludes, that without the opportunity to expand into areas now served by independent providers, the international firm may be less attracted to invest. Some efforts are now being made to better understand the *aguateros* and consider ways to preserve their important niche in reaching the poor, but preliminary initiatives have been overshadowed by the overall reform focus. Thus, it is still quite feasible that private sector participation from the international marketplace may substitute for and overtake local and small- and middle-scale private initiative and investment.

There are no lack of public/private alternatives that could take advantage of the *aguateros* willingness to invest. The State could grant management contracts, concessions or leases for small systems to local private operators, or craft build-own-operate or build-own-transfer arrangements. Further still, the public sector could designate geographic areas for *aguatero* investment and adapt its regulatory regime accordingly to ensure the public interest is served. In the end, the public will find few better managers of the natural resource or seekers of customer satisfaction, both crucial elements for the *aguateros'* bottom line.

Acknowledgements

This article includes research accumulated by Dr Fernando Troyano and the *Camara Paraguaya de Agua* (Chamber of Paraguayan Water Providers — CAPA) in 1998 as part of a series of case studies financed by the UNDP/World Bank Water and Sanitation Programme, the German government assistance agency GTZ and the Danish International Development Agency (DANIDA). The studies were managed by Ms Tova Maria Solo of the UNDP/World Bank Water and Sanitation Programme. The authors were involved in carrying out these studies and wish to thank Dr Troyano and Ms Solo for their assistance and support toward the completion of this article. Nonetheless, all opinions expressed herein are those of the authors and should not be considered to reflect the position of the UNDP/World Bank Water and Sanitation Programme, GTZ, DANIDA, or the Cooperative Housing Foundation, or any of their staff.

References

Solo, T.M., Arevalo, C., Brusco, L., Loach, P.W., Nunura, J., Troyano, F., 1999. The Other Private Participation in Water and Sanitation: Tales of Small Independent Providers in Latin American Cities. The World Bank/UNDP Water and Sanitation Program, 12 February.

The World Bank. 2000a. World Bank At-a-Glance Data Sheet for Paraguay, http//www.worldbank.org.

The World Bank. 2000b. Country Information, http//www.worldbank.org January, 2000.