The Strategic Use of Small Scale Water Providers: An Analysis of Private-Sector Participation in Peri-Urban Maputo

By

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ABSTRACT

During Portuguese colonial rule biased service provision throughout the 20th century resulted in a city that today has spatially segregated water services distinguishable along racial lines. In 1975, a newly independent Mozambique lacked the financial and human resources necessary to extend its utility network to peri-urban residents. Water coverage rates and service levels could not keep up with population growth. Donor agencies and policymakers gave a great deal of attention to large scale-private sector participation but it was unable to overcome Maputo's infrastructure challenges. Today, less than 40 percent of Maputo residents have access to the utility network. Maputo's 'other private sector' – small, informal private-sector providers (SPSP) – serve over 150,000 residents with reliable standpipes and private connections and have contributed significantly to coverage goals. Sector planners knew less, however, about how they could contribute to future sector goals. This study aims to answer that question through a detailed analysis of their cost and price structures, investment profiles, and operating environment. We find that Maputo's SPSPs already contribute significantly to the sector's coverage, service, and financial sustainability goals. They should be viewed as an integral part of Maputo's water delivery system and not 'a problem' like much of the literature brands them. Their operations can be made more efficient, affordable, and environmentally sustainable with the appropriate policy and business interventions. We recommend actively promoting larger SPSPs, universal metering, improved electricity supply, reducing costs associated with water pumps, and taxation and regulatory measures so ISNOs can contribute to all sector goals as planning moves forward.

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My only regret is that I was unable to write this thesis in Portuguese for my Mozambican colleagues.

A Revascularization

The pumps at the Umbeluzi,
Fill this system's heart.
Its plasma pulses through arteries,
Spread across the cement city.
The bloodthirsty asphalt,
Ensures an abrupt halt,
The colonists stalled,
What the mighty pumps start.

This peri-urban mass,
A gangrenous expanse,
A result of prejudice,
In basic services.

Amid ideological confusion,
Donors came with their overseas solution,
Large corporate collusion premeditated
a lifesaving transfusion.

The transfusion was Type A,
But Maputo is Type O,
Indigenous residents still rely on an archipelago.

In an act of regeneration,
Came a new peri-urban occupation.
Surgeons of a pockmarked earth,
Try to alleviate their neighbors' thirst…
The system meanwhile still searches,
For the perfect nurse.

-The author

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ACRONYMS

AdM:	Aguas de Moçambique
AdO:	Aguas de Maputo
CPI:	Consumer Price Index
CRA:	Conselho de Regulação do Abastecimento de Água
DNA:	National Water Directorate
EIU:	Economist Intelligence Unit
EOS:	Economies of Scale
FIPAG:	Fundo de Investimento e Património do Abastecimento de Água
GDP:	Gross Domestic Product
IAF:	Inquérito aos Agregados Familiares Sobre Orçamento Familiar
IMF:	International Monetary Fund
ISNO:	Independent Small Network Operator
Lpdc:	Liters per capita per day
MDG:	Millennium Development Goals
MLI:	Micro-lending institution
MOHP:	Ministry of Housing and Public Works
MT:	Mozambican Meticais (local currency)
NWRMS:	National Water Resources Management Strategy
OECD:	Organization for Economic Cooperation and Development
ODA:	Overseas Development Assistance
PSP:	Private-Sector Participation
SSA:	Sub-Saharan Africa
SPSP:	Small Private-Sector Provider
WHO:	World Health Organization
WR:	Working Ratio
W&S:	Water and Sanitation
UFW:	Unaccounted for Water

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CHAPTER 1:

PRIVATE-SECTOR PARTICIPATION IN THE WATER AND SANITATION SECTOR IN DEVELOPING COUNTRIES

1. 1 INTRODUCTION

Fast growing cities in developing countries – many of them former colonies – are currently facing an infrastructure crisis. Colonial policy concentrated on national resource extraction through small, well developed urban centers, "Colonialism everywhere resulted in the dispossession and exploitation of the indigenous population in the interest of metropolitan finance capital" (Bennoune, 1977). This metropolitan capital obliterated the traditional urban structures by superimposing new radial street patterns, forcing the indigenous populations to move to the periphery of the new urban area. The new urban areas were designed for a small, non-indigenous elite that needed electricity, roads, water, sanitation, and drainage to carry out their extractive practices. This practice of spatial segregation is especially evident in the Portuguese crown's early Brazilian and African coastal settlements (Godfrey, 1991; Pereira, 1992). The periphery, where the indigenous were forced to reside, never benefited from the same amenities as the colonial area and remained in a rudimentary state (Elate, 2004). This colonial legacy persists in newly independent states today as their modern cities grapple with a large indigenous population without access to basic services such as water, "The infrastructure crisis now facing fast growing cities is a testament not simply to the technical and fiscal challenge...but the legacy of an incomplete modernity which rested on a brutal distinction between 'citizens' who could lay claim to potable water and mere 'subjects' who were left to make do as best they could" (Mamdani, 1996).

Newly independent states lack the financial and human resources to extend colonial infrastructure networks to all urban residents. When ex-colonies gained their independence many Europeans that possessed the colony's major sources of capital and technical knowledge fled (Ezyaguirre, 1989). These largely low-income countries, which were struggling to create new public institutions and functioning markets, had difficulties managing existing networks and attracting new private investment to infrastructure sectors. Furthermore, rural residents who were either forbidden to enter urban centers or rendered to low-skilled manual labor under the colonial regime began to migrate to cities post-independence in search of better economic opportunities. In some countries conflicts raged in rural areas and citizens would escape *en masse* to the cities, which often experienced less violence or offered more protection. This rural-urban migration greatly exacerbated the financial and human resource constraints; service coverage could not keep pace with city growth

(Cross, 2001). The result is increasingly precarious living conditions for millions of urban residents in developing countries world-wide.

Despite these extraordinary stresses on newly independent countries, governments and donors envisioned a universal level of safe, reliable, and piped water provision that mimicked the kind of 'first class' infrastructure found in former colonial powers. This vision was part of newly independents states' nation building processes. However, these countries' limited economic bases prevented realization of their plans. The 15-20 year plans proved over-ambitious in scope and too determined to retain European standards in levels of coverage, technologies, and service. Financial resources and fiscal policies could not match these standards and a 'downward spiral' in water and sanitation (W&S) infrastructure ensued. As alternative models presented themselves, such as the "appropriate technology" movements in rural areas, countries' leaders were too invested in the idea of infrastructure development as metaphor for nation building to consider prudent alternatives (Mkandawire, 2000).

The vision of universal, safe, and reliable service has not been realized in many developing world cities. Close to 1.1 billion people do not have access to safe drinking water – that is more than 1 out of every 6 people on earth. Of these 1.1 billion, 173 million are urban residents. The situation is particularly acute in Africa, which has the lowest coverage rate of any world region at 62 percent; Asia is a distant second at 81 percent. Three hundred million Africans were without safe drinking water in 2000, 44 million of them live in cities (JMP, 2000). The reasons for this large coverage gap include insufficient financial and human resources in the W&S sector, dysfunctional incentive structures for providers, and planning constraints in informal settlements.

1.2 Planning Constraints

Water and Sanitation receive much less financial support from governments, donors, lenders, and the private sector than other infrastructure sectors. Developing country officials, often at the behest of donors and lenders, tend to concentrate on sectors that create more immediate and measurable economic growth. Sectors like information technology and communications and transport can deliver rapid results on key economic indicators such as export levels. Lenders prefer transport and telecom to water and sanitation because these projects' loans generate greater returns. The rate of return on World Bank loans for highway and water supply projects between 1983 and

1992 was 29 percent and 6 percent, respectively (Davis, 2005); Donors prefer these more lucrative sectors for similar reasons – they must demonstrate high project returns to taxpayers, managing boards, or individual contributors. During the 1990s transport received US$55 billion dollars and energy received US$45 billion in overseas development assistance while W&S received only $25 billion (World Bank 2001; OECD, 2001).

Politicians often maintain water tariffs that are too low for operations' cost recovery let alone generating a surplus for new investments. These tariffs do not reflect the increasing difficulty of maintaining ageing assets, discovering new sources of water, and delivering it over longer distances to a growing population. Elected officials, who view water as a social good that should be provided to customers at low prices, pressure utilities to keep tariffs lower than what residents are willing to pay for improved services (Boland, 2000). If costs are not recovered, existing infrastructure maintained, and new infrastructure built, the goals of a universal level of safe, reliable water will be difficult to achieve.

Governments also give preference to new infrastructure investment over the existing system's operation and maintenance. This was part of the "networked city" goal that infused post-independence technocratic planning; extending the network symbolized progress and was more rapidly achievable than changes in institutions or human resources (Grey, 2006). This was compounded by retaining 'first world' technical standards when investing in new assets. Costly, inappropriate technologies were an inefficient use of limited resources. Although constructing new infrastructure is necessary to achieving sector goals, doing so at the cost of maintaining existing infrastructure is not conducive to the long-term financial sustainability of the system (World Bank, 2006).

Inefficient public utilities present a barrier to achieving coverage and service goals. Non-revenue water, the difference between sourced water and water paid for by customers, can reach up to 50 percent among developing country utilities (Davis, 2005). This means that revenue is only received for one out of every two cubic meters of water produced. Neglected networks literally leak profits into the ground and inefficient billing and failure to prevent clandestine connections create a gap between the level of delivered and billed water. Low collection rates are also problematic. The capacity to enforce payment is low and non-paying customers are often politically protected from disconnection policies. Non-revenue water and low collection rates make full cost recovery difficult

to achieve. Overstaffing also contributes to inefficient operations. Utilities' attempts to achieve 'social goals' like employment generation create bloated workforces that drive up operating costs and result in reduced profits (Davis, 2006).

Utilities have failed to serve a substantial number of households in their service areas, particularly low-income or marginalized populations. This is a result of both financial disincentives and political pressure. Low-income or marginalized populations often live in informal settlements, commonly referred to as 'slums', 'shanty towns', or peri-urban areas, without legal tenure to their land. Politicians often prohibit utilities from connecting these 'squatters' for fear of legitimizing their claim or cementing their presence. When permitted to serve these residents, utilities often fail to do so because they find these areas financially unattractive. They presume residents are too poor to pay for services, will make illegal connections, or will tamper with meters and drive costs up without significantly contributing to revenues (Cross, 2005).

1.3 Large Private-Sector Participation as the Solution

For the last twenty years governments and donors have turned to private-sector participation (PSP) as a way to tackle many of these challenges. By the end of 1997 private companies operating in developing countries had already reached financial closure on US$23 billion (in 1997 values) of investment in water and sewerage projects. In total, 97 projects had been implemented in 35 developing countries, ranging from management contracts to leases, concessions, divestitures, and build-operate-own or build-operate-transfer arrangements[1] (Silva, 1998).

Private-sector participation in state run industries has often found merit on ideological grounds. Margaret Thatcher's administration adopted the ideas of free market economists that blamed Britain's post-war nationalization for a sluggish economy, escalating public debt, and rising

[1] Management or lease agreements, typically 10 to 15 years in length, involve the private sector taking on full commercial risk and responsibility for operation and management of state owned infrastructure, billing, and collections with no responsibility for major capital investments. In concessions, on the other hand, the private operator adopts full commercial risk involved with a management or lease *plus* major capital investments in infrastructure. Concessions typically last 20 or 30 years to allow the concessionaire to recuperate investment costs. Build-operate agreements usually occur for single assets (i.e. wastewater treatment facilities) where the private investor will build or rehabilitate state-owned infrastructure. The government then has the option of keeping the asset, leasing it to the private operator, or selling it to the private operator. A divestiture is the most extreme form of privatization and involves the sale or transfer of state assets to a private company.

unemployment; these same economists encouraged PSP in government industry and reduced government spending as a promising alternative (Yergin, 2002). During Thatcher's two terms, 1979 – 1987, close to 5 billion pounds sterling (in 1984 values) was sold off to private actors. The privatization campaign culminated in the government's privatization of England and Wales' ten water and sewerage authorities in 1989 (Bakker, 2003). International development agencies such as the World Bank, and its private sector arm, the International Finance Corporation, acting in part on the Washington Consensus[2], heavily promoted the privatization wave that expanded to the developing world in the following decade (Davis, 2005).

Enormous capital investment needs have driven privatization in developing countries. Neither public utilities nor sub-national governments have access to the amount of financing necessary to support these large capital investments (Davis, 2005). This is especially true for Sub-Saharan African (SSA) countries that have some of the world's lowest incomes. In a World Bank ranking of countries' gross national income per capita, 22 out of the 25 lowest ranked countries are located in Sub-Saharan Africa (World Bank, 2004). Capital is needed to reach the 1.1 billion people without safe water access and reduce environmental damage to overused water sources. Network extensions can help bring piped water to currently un-served communities while development of new raw water sources can reduce water drawing from polluted or overburdened sources (Davis, 2005).

For the majority, PSP means a single, large private-sector operator. Because investment in the water sector is considered to be "lumpy", or large relative to the size of the market, and long-term, often requiring several decades for cost-recovery, a single provider model is considered most efficient. This rationale is borne out in policy advice to developing country governments who are encouraged to develop a 'networked' city, usually achieved through 'natural monopoly'. It is feared that having multiple providers could result in wasteful duplication of infrastructure or poor coordination of investments and operations. A single provider is also thought to make regulation, uniform water quality, and private investment easier (Ehrhardt, 1999; Solo 1998). Research has helped bolster this advice. An analysis using the elasticity of supply with respect to production costs

[2] The Washington Consensus was formulated between 15th Street and 19th Street in Washington among members of the International Monetary Fund (IMF), the U.S. Treasury Department, and the World Bank. It argued that the keys to success in developing countries were three things: macro-stability, liberalization (lowering tariff barriers and market deregulation) and privatization (Stiglitz, 2000).

in Seoul's metropolitan water supply found that if the Seoul metropolitan region's urban water markets were consolidated into a single water service market, production costs would be reduced by up to 47 percent (Lee, 1998). An econometric analysis of utility benchmarking data such as annual operating costs, number of customers served, volume of water produced, and distribution network length for 270 utilities – 83 in Africa – demonstrated that utilities could reduce unit operating costs by increasing the size of their operation or consolidating several operators. An African utility that doubles the size of the population it serves would increase its cost by only 61 percent (Tynan, 2005).

Despite the rationale for economies of scale and supporting evidence, PSP within the single provider model has had decidedly mixed results with respect to the sector's goals of universal coverage, adequate service, and financial and environmental sustainability. Capital investment and increased access to the poor who regularly lack access to the piped network are both important variables to consider when measuring coverage. Data on investment by W&S utilities before and after PSP ventures in several countries suggest that involvement of the private sector does accelerate capital investment, but capital improvements often fall short of contractual targets established between the firm and government. For example, investments during the first year of a 1994 concession in Cancun, Mexico fell short by more than half: the private concessionaire invested US$56 million when the contract required the company to invest US$120 million. The company's contract also stipulated that it would extend water supply services from 60% to 95% of the city's urban zone by 1996; actual coverage rates in that year were closer to 87% (Merino-Jarez, 2000).

A critical factor in increasing coverage to poor households is an affordable connection fee. Contract bidding for PSP is often designed to obtain the lowest volumetric tariff bidder. This often results in private operators charging high connection prices to increase revenues, often excluding the city's poor residents. Alternative bidding schemes that emphasize increased coverage, like the one in La Paz, Bolivia have shown more promise in reaching poor households (Komives, 2000). Nevertheless, privatization's emphasis on the pursuit of profits (Yarrow, 1986) creates an incentive structure that makes increasing coverage to the poorest of the poor an unattractive venture.

Efficiency gains are often touted as PSP's greatest benefit. Many consider that private management's responsiveness to shareholder goals results in an efficiency advantage for private firms in most circumstances (Yeaple, 1995). Greater efficiency in the W&S sector includes efficiency of investment, usually improved through lower non-revenue water rates, and efficiency of operations

and maintenance, usually improved by lowering the unit cost of water across various inputs. Studies find that efficiency with PSP is mixed. A study in the Asia and Pacific region that compared 22 private and 28 public utilities found no significant effects of PSP on efficiency. A study by the same author found that among 21 utilities studied in Africa, the 2 privately owned ones showed greater signs of efficiency (Estache, 2002). These and other studies conclude that market structure is the largest efficiency determinant. Contracts that reward cost-cutting measures, through predictable but unpopular means such as staff retrenchment or elimination of illegal connections owned by the poor, often witness the greatest efficiency gains.

One of the most hotly debated aspects of PSP is potential tariff increases. Because the private sector is usually brought in to increase investments and break what has been termed a "low-level equilibrium" – poorly maintained systems with insufficient revenues that fail to meet desired service levels (Singh, 1993) – monthly service fees and connection charges are likely to rise. Much of the literature corroborates this presentiment, including documented tariff increases in Guinea, Bolivia, and Argentina (Clark, 2002; Clarke, 2004). These increases can be partially offset by cost saving measures such as staff retrenchment. Regardless, when the private sector is brought in to spur infrastructure investment, there will be pressures to meet tax and fee obligations and return profits to shareholders (Davis, 2005).

Private-sector participation's record on environmental performance is difficult to ascertain due to a dearth of empirical work on the subject. Case studies that do exist paint a varied picture. Private utilities in England and Wales reduced pollution by having to adhere to stringent European Union pollution abatement standards while others in New Orleans, Jakarta, and Manila committed serious pollution infringements (Davis, 2005). One hypothesized post-privatization effect is increased scrutiny from civil society, regulators, and watchdog groups when a privatized utility takes over operations (Brubaker, 2002), but more empirical evidence is needed to conclude if this increased scrutiny results in better sector performance.

Private sector participation contract structures are designed to achieve financial sustainability. Elected officials' decisions are often dictated by the election cycle. This political incentive combined with politicians' close relationships with W&S utilities sometimes lead to short planning horizons that inhibit proper water asset and resources management. In contrast, the private sector, with its long-term lease and concession contracts, usually 15 and 30 years, respectively, has

incentives to manage infrastructure for longer time horizons to recover capital investments and derive profits. This is thought to achieve water systems' financial sustainability. Actual sustainability, however, is highly dependent on the specific incentives the private operator faces (Davis, 2005).

The private sector's failure to achieve the coverage, service, and sustainability goals planners envisioned has critics calling it a 'broken promise'. A backlash has recently emerged with activists arguing that water privatization is akin to 'theft' and 'a human rights violation'. The noted academic and environmental activist Vandana Shiva, in a piece titled, *Captive Water: Privatizing water will lead to war,* calls the right to water a birthright and water's privatization as 'the ultimate human rights violation, the ultimate human wrong' (Shiva, 2003). This backlash, accompanied by evidence that PSP has failed to successfully reach many who lack access to safe water, culminated in a consensus for 'a return to the public' at the fourth World Water Forum in Mexico City in March, 2006. A United Nations' appointed advisory panel began its recommendations with a call to strengthen local public utilities and the director of the World Bank's Water and Energy Department stated that 15 years of development efforts were wasted because multilateral agencies imposed privatization (Malkin, 2006; PSI, 2006).

The issue of public or private water provision is a deceptive dichotomy. Both the public and private sectors have served an important role in water provision throughout history, often trading places multiple times. Nowhere is this more evident than in a country with one of the highest connection rates in the world – Great Britain. The oldest sections of Britain's modern network were built by the private sector in the 1600s in a competitive, unregulated market. As the years passed municipalities increasingly regarded water provision as a normal commercial venture and by 1851 private water companies supplied 60 percent of Britain's urban population with piped water supply (Bakker, 2003). Industrialization, contestation over water resources, the cholera and typhoid epidemics in the mid-1800s, falling revenues, and the need for large capital investments[3] led first to regulation and later to full municipalization of certain systems. The water sector came to be characterized by local, public water providers and heavily regulated, private water companies.

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[3] Interestingly, during 1800s Britain modest profits in the water sector prevented *private* companies from making infrastructure investments necessary for expansion. The government used its borrowing powers under the parliamentary act to expand networks (Millward, 2005).

Continued conflicts over supply and incidences of pollution led to system nationalization in 1974, only to be followed by a renewed enthusiasm for free markets and reduced government spending that resulted in the world's largest water assets' divestiture in 1989 (Bakker, 2003; Millward, 2005). Britain's experience shows that an analysis of the competitive, regulatory, environmental, and public health scenario is necessary before advocating for a particular ownership model.

1.4 Small Private-Sector Providers

Modest investment in large scale PSP, coupled with limited government infrastructure budgets, has led to a different type of PSP in W&S that has attracted substantially less attention in the literature despite the fact that it serves as many, or more, people as compared to the large, single private providers. Low-income countries suffer from low revenues and competing priorities that often leave W&S infrastructure neglected. In addition, although large-scale PSP in infrastructure was a notable US$ 496 billion in developing countries between 1990 and 1998, only 5 percent of that (US$ 23 billion) went to W&S projects (Roger, 1999). Today, small private-sector providers (SPSPs) of W&S services are playing an increasingly important role in urban water provision.

SPSPs are assumed to serve fewer than 50,000 people or 5000 customers, employ fewer than 50 employees, and supply small settlements, either within large cities, small-towns, peri-urban areas, or rural areas (Kariuki, 2005; Vezina, 2002). They operate informally, and sometimes illegally, requiring them to self-finance their infrastructure and rely largely on revenues to cover their costs. They either develop their own water source or draw water from the utility's network. SPSPs take three main forms: mobile vendors who use vehicles or manual labor, point source operators who use standpipes or kiosks, and small network operators who use piped distribution and storage tanks (Kariuki, 2005). SPSPs are estimated to be the principal water providers for 25 percent of city residents in Latin American (Solo, 1999), between 20 and 45 percent in Southeast Asia (Vezina, 2003), and an average of 50 percent, but as high as 80 percent in Sub-Saharan Africa (Collignon, 2000)[4].

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[4] Sub-Saharan Africa had the hardest time attracting large PSP investment among world regions – only 2 percent of all private infrastructure investment (US$ 10 billion) between 1990 and 1998 occurred there (Roger, 1999). By contrast, over 75 percent of investment went to Latin America and the Caribbean and East Asia and the Pacific where relatively higher household incomes, political stability, and government commitment to market liberalization allowed for greater returns on investment. Perceptions of investment climate drive this disparity. According to the

Despite the substantial role SPSPs play in the W&S sector, policy makers have paid comparatively less attention to them, focusing more with urban network expansion through a large utility. This is partially the result of assumptions surrounding SPSP operations. SPSPs are often viewed as "temporary" – although many have been in operation for over twenty years, "rent-seekers" – that take advantage of unreliable public services so as to gouge their customers, and "poor quality" – providing a service that does not meet technical and water quality standards (Kariuki, 2005). Because so little is known about SPSPs' cost and price structures, investment profiles, and operational features, it is unclear whether they suffer from the same shortcomings as large concessionaires and lessees of municipal W&S networks, and under what circumstances, if any, they can be viewed as an integral part of a W&S service delivery strategy. This study seeks to contribute to the dearth of knowledge surrounding SPSP operations in the water sector and also to explore the extent to which they contribute or impede progress towards the goal of providing affordable, safe, reliable, and financially and environmentally sustainable water services for households in developing world cities.

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institutional investor index, SSA is the riskiest investment region in the world. It cites lack of government commitment, weak domestic entrepreneurship and financial institutions, and unclear regulatory and legal frameworks as some of the myriad reasons private investors considering SSA should proceed with caution (Donaldson, 1997). It is less surprising then that SPSP activity is higher in Africa than other world regions. Another reason is the high incidence of failed or post-conflict states in Africa – a literature review found that SPSPs are especially prevalent in these situations (Kariuki, 2005).

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CHAPTER 2:

LITERATURE REVIEW

2.1 Overview

Academic work on Small Private-Sector Providers (SPSP) is very limited. Although a handful of academics did begin looking at private infrastructure services that serve the poor in the 1970s, intellectual work specifically focusing on SPSPs has not culminated in a comprehensive body of knowledge.

Project and policy reports documenting SPSPs' scope, scale, and operating environment are much more prevalent. The World Bank's Water and Energy Department and Water & Sanitation Program are the primary publishers but other bilateral and multilateral agencies have also contributed. These reports are both in response to exponential SPSP growth in the last decade and policy makers' increased awareness of SPSPs potential advantages. Receiving relatively less attention than networked utilities, policy makers considered SPSPs to be temporary, inefficient, rent-seeking, and unconcerned with quality. However, in the last 5 to 7 years realities surrounding utility coverage failures, rapid urbanization, and pressures to meet the Millennium Development Goals (MDG)[5] have forced policy makers to take notice of SPSPs and consider capitalizing on their existing services to achieve sector goals. Although these reports stop short of detailing SPSPs' cost structure, prices, and financing sources, they do provide general business profiles, insight into their operating environment, and a good basis for future research.

Small private-sector providers are most prevalent in countries with low W&S coverage levels, ineffective utilities that provide inadequate or partial services, and remote or difficult to access regions. A World Bank literature review found SPSP operations in 49 countries; the actual number may be much higher since many SPSP operations go undocumented. SPSPs are especially prevalent in post-conflict countries and others with weak or failed states – of the 49 documented countries with SPSP operations, 22 were in Africa, the highest incidence of SPSP activity of any continent. SPSPs have traditionally played three roles: "gap filler" in countries where utilities have high coverage levels but low service quality; 'independent network operator', developing and operating systems in areas where there is no public service but demand exists; and 'sub-concessionaire', buying utility water in bulk and selling it on to the customers (Kariuki, 2005).

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[5] The Millennium Development Goals are eight goals that all 191 United Nations member states have agreed to achieve by 2015. One key facet of the goal 'Ensure environmental sustainability' is to 'Reduce by half the number of people without sustainable access to safe drinking water'.

SPSPs have been in operation for more than 20 years but have seen tremendous growth in the last decade. Most are established for the express purpose of delivering water. The majority are for-profit entities responding to consumer demand, although non-profit SPSPs are sometimes established to respond to crises. SPSPs are especially prevalent in peri-urban areas and small towns with populations of 5,000 to 20,000 inhabitants. Critics of water commercialization might question why community managed systems, which have demonstrated success in villages, are not being implemented in these areas. Peri-urban areas and small towns are generally too populated and the sense of community too diminished for community management to work effectively. At the same time they are still too small and costly to attract the interest of large private companies (Vezina, 2002).

SPSPs include vendors who use carts, bicycles, or poles to carry containers of water to customers; kiosk or standpipe operators; tanker truck delivery persons; independent network operators that bring water directly to private connections; and households that sell water from their private connections to neighbors. They either use their own independent water source such as groundwater from a borewell or surface water from a natural source, or a dependent source such as bulk water from a utility network (Davis, 2005). In general, SPSPs can be classified into 6 typologies:

Table 2.1: Typology of SPSPs in water supply

	Independent	Dependent
Network operator	Type I: Uses own water source and sells via mini-grid	Type II: Purchases water from utility and sells via mini-grid
Stationary provider	Type III: Uses own water source and sells at fixed location	Type IV: Purchases water from utility and sells at fixed location
Mobile distributor	Type V: Uses own water source and delivers to customers	Type VI: Purchases water from utility, delivers to customers

Source: *Adapted from Kariuki and Schwarz (2005)*

SPSPs are inherently different from large providers mainly because of their: 1) size; 2) sources of financing; 3) operating environment; and 4) prices. They distinguish themselves from large

providers through a variety of factors such as areas and populations served, service levels, technology employed, and cost recovery methods.

SPSPs finance their investments mostly through their own earnings or savings, but also use loans or donations from family and friends or money borrowed from informal lenders. Access to formal credit, such as bank loans, is rare and a major business constraint. In comparison, public utilities are often financed through taxes or overseas development assistance (ODA) in the form of loans or grants. Concessionaires self-finance new investments but are often aided by government subsidies or ODA, as was the experience in Conakry, Guinea (Clarke, 2002).

SPSPs operate in an informal economy, sometimes illegally in the shadow of a "legal monopoly". While governments provide financial, regulatory, and administrative support to utilities, SPSPs receive no such benefits. Unlike utilities they are not eligible for subsidies or public works' contracts, fall outside the scope of regulatory policies, and have little or no access to government institutions (Collignon, 2000). Their illegal status leaves them open to sudden dispossession or closure, often compelling them to recover investment costs rapidly through relatively higher prices. Without an official contract, SPSPs are most susceptible to changes in the macro-economy, especially with respect to inflation on input prices. They also serve the populations utilities consider too costly to serve: populations on the city's margin or on hillsides obtain most of their water from SPSPs (Kariuki, 2005).

SPSPs have been documented as charging as much as twelve times more than what utilities charge for the same quantity of water, but this is highly dependent on SPSP type. Mobile distributors such as manual carters and tanker trucks charge the most while kiosk and standpipe operators and small independent network operators (ISNOs) charge much less. For example, on average, ISNOs only charge 1.5 times what utilities charge. SPSPs often charge more than utilities because of the higher costs associated with their operations. In theory and practice, we know that utilities enjoy economies of scale that SPSPs cannot capture. Thus, we expect some increase in price among SPSPs. However, sector planners are still uncertain whether economies of scale fully explain the often considerable price differences seen around the developing world. Some studies have found clear examples of SPSPs earning exorbitant profits (Lovei, 1993); others have found that SPSPs earn roughly the equivalent of unskilled labor (Whittington, 1999). In general, however, very little is known about SPSPs' cost structure that allows for reliable estimates of profit margins and

identification of cost components that could be favorably affected by strategic policy and business support interventions. This study seeks to provide such an analysis in the case of Maputo, Mozambique.

2.2 Operating Environment

Some of the growth and entry constraints in the informal economy include (1) lack of credit for capital expansion; (2) lack of transparent money handling procedures; (3) delinquent customers; (4) robbery and "pirate" connections; and (5) exclusion from government subsidies (Snell, 1998). SPSPs that operate in a risky environment will concentrate on recovering initial investment costs as quickly as possible, usually through high connection fees, which serves as an access barrier to poor households. Also, they may not optimize coverage because the threat of closure influences their decision to expand. Although the literature describes these different influences it does not assign them weights.

Macro conditions include the home country's economic performance and institutional capacity. For example, if inflation is high then input prices will go up, directly affecting costs and consumer prices; because SPSPs are small they are less able to internalize these costs than a large utility would. An analysis of African utilities discovered that institutions and governance issues such as corruption were central to inefficiencies (Estache, 2002). It is possible that the same institutional weaknesses that affect water utilities could affect SPSPs. Location affects SSPS prices because, for example, the further truckers and carters have to travel to obtain water the more costly their fuel or labor costs become. Physical terrain is a factor, especially for ISNOs (Types I & II), because the more difficult it is to dig a borehole or lay pipes, such as in hilly areas, the more expensive it becomes to deliver water or expand coverage (Kariuki, 2005).

2.3 Financing and Credit

There are myriad financing and credit instruments in the developing world. Institutions offering these instruments range from the formal, such as private banks, to the informal, such as revolving credit groups. Some of the instruments available to borrowers are private bank loans, credit union or cooperative loans, microfinance or micro-credit loans, government agency loans,

revolving credit or community loans, and loans from informal money lenders. Many entrepreneurs also borrow from family or friends.

The instrument's requirement is highly dependent on the lender. Interest rates are significantly lower for formal institution loans such as private banks and micro-lending institutions (MLI) than informal money lenders; informal money lenders charge effective interest rates as high as 78 percent (Banerjee, 2004). Repayment periods also vary with micro-lending institutions requiring payments rapidly after fund disbursal, in some cases after two weeks, and banks usually requiring the first payment after one month (Morduch, 1999).

Entrepreneurs in the informal economy have been largely bypassed by formal financial institutions. Informality has been associated with greater risk and lenders are risk averse – they go bankrupt if they cannot recuperate their loans. Therefore, banks in both developed and developing economies have largely served entrepreneurs and individuals in the formal economy where asymmetries of information are lower, contracting is backed by the rule of law, collateral more easily guaranteed, incomes are higher, and perhaps most importantly, enforcement costs are lower (Banerjee, 2004; Morduch, 1999). As a result, informal entrepreneurs, who we now know have a capacity to make productive use of their loans and repay them on schedule, were left with little recourse except funds from family and friends, and where none existed, informal money lenders. Micro-lending institutions and their variants, such as revolving credit loans, existed since the 1950s but really began to fill the formal credit gap left by banks in earnest during the 1970s (Morduch, 1999).

Empirical evidence on micro-lending has indicated that both the borrower and lending institution benefit from greater borrower wealth. Average loan balance for a borrower from a financially self-sufficient program was $430 (Morduch, 1999). In low-income countries, borrowers at that level tend to be among the "better off" poor or are even slightly above the poverty line. Micro-loans are less costly and more easily administered to the "better-off" poor. There is an inverse relationship between a borrower's income and the loan's poverty reducing impact. Expanding financial services in this way can foster economic efficiency and perhaps economic growth but it will do little directly to affect the vast majority of poor households (Morduch, 1999).

An empirical study of thirteen MLIs in seven countries discovered that the poor are probably more risk-averse. Very poor borrowers, given the choice, tend to take out small, subsistence

protecting loans. These are seldom invested in new technology, fixed capital, or even hiring of labor; the willingness to take risks and to invest in new technology increases with income. Loans to higher income groups are more often used for promotional activities such as the purchase of fixed capital and the hiring of labor from outside the borrower family. In addition, higher income households can commonly access larger loans because of their greater savings capacity and their ability to offer collateral and this widens the choice of investment opportunities to include "lumpy" investments. Some very poor households, against the general pattern, achieved substantial increases in income from their loans. These outliers fell into a rather specialized category of investors in capital entailing a low increase in risk, for example, minor irrigation (Malawi), high yielding seeds in rain sufficient areas (Indonesia) and replacement of existing handicrafts-making equipment (Bolivia) (Mosley, 1998).

African MLIs lag behind those in Asia and Latin America with respect to market size and penetration, outreach, financial performance, and product diversification. One of Africa's most successful micro-lenders reaches only 14,000 households and Mozambique's only lender reaches 4000, while lenders in Asia and Latin America reach well over 100,000 households (Mehta, 2003). Although there are over 1000 MLIs in Africa, only about 20 are on their way towards sustainability. Most African MLIs have negative profit margins and perform worse than their Asian and Latin American counterparts on operational sustainability and portfolio quality. In general the majority of African MLIs offer only one product: loans for income-generating activities (Mehta, 2003). African MLIs' poorer performance is largely a result of their environment. African countries are very low income and households have very little demand for these loans because markets do not exist for their products. Micro-lenders must also be more selective since extensive lending to low-income households could result in major defaults and eventual bankruptcy.

SPSPs would mainly use loans for capital investments either for start-up or expansion. Some might also use them to 'stay afloat' when revenues fall below operating costs. Lack of access to credit is often a major constraint to service expansion or new entry. SPSPs will likely make productive use of their loans since they are considered to be the 'better-off' poor. Micro-credit can reduce their cost burden, potentially lowering customers' prices, eventually benefiting the 'worse-off' poor that MLIs still struggle to reach and impact.

2.4 Economies of Scale and Prices

SPSPs have long been criticized for their small, inefficient operations that are unable to achieve adequate economies of scale (EOS). Economies of scale are defined as a decrease in the unit cost of water as water production increases. It is considered important because cost reductions through scale economies can be passed onto customers in the form of lower prices. There are at least two types of scale economies: EOS in capital equipment and EOS in business operations (Winston, 2004). Because the water sector is characterized by costly up-front investments, there is widespread agreement that a "natural monopoly" model is the most appropriate one for urban water provision and achieving economies of scale in capital equipment. Proponents argue that this model will achieve the greatest cost savings from economies of scale by externalizing the single provider's capital risk, thereby allowing it to recuperate water source, treatment, and network investments in a non-competitive environment. They are less clear how a "natural monopoly" model can increase EOS in business operations, believing instead on private sector management models to increase operating efficiency.

An analysis of 270 utilities by the World Bank found that the evidence for scale economies is most consistent when volume of water produced is used as the measure of size (other indicators included number of customers served and network size). However, optimal utility size is also sensitive to customer characteristics in terms of settlement patterns and density. Results also varied by region with Africa and South East Asia showing significant returns to scale and Peru showing constant or even declining returns to scale. Small utilities – 125,000 or fewer customers served – have the most to gain from expansion (Tynan, 2005).

Although size is a significant cost determinant it is not the only one. The cost of raw water supply, spatial distribution of customers, efficiency of inputs, and operating environment, among other factors, all affect unit cost. To better understand how small water systems fared along both scale and the other various factors, *Resources for the Future* conducted an analysis on United States' community water supply data from 1995 and 2000. Although the regulatory and institutional frameworks in the US are very different from those in developing countries, especially Sub-Saharan Africa, the economics of water supply are largely the same. The results of the study apply most directly to ISNOs – Types I & II from the table above. The researchers analyzed between 132 and 1900 water systems in both years depending on the analysis model; the majority of systems use

groundwater. They found that, in general, costs do decline as system size increases. However, they found very little difference between the median cost of very small systems – 25 to 500 customers – and small systems – 5001 to 3300 customers. A disaggregated analysis showed that the greatest economies of scale exist in capital costs, outside costs (analytical lab services and other contract services), other costs (general and administrative expenses, payments in lieu of taxes and other cash transfers out), and materials costs, while labor costs and energy costs exhibit the fewest economies of scale of the six factors. This suggests that larger systems may be relatively better than smaller systems at bargaining and receiving outside services and materials for a lower cost (Winston, 2004). This claim is corroborated by a small rural water systems' study in Virginia, United States. The author found that if the small systems were to organize under a shared cooperative or association they could purchase goods, such as water treatment chemicals, and technical services, such as repairs, in bulk, thereby reducing the unit cost of these inputs across small providers (Young, 2002).

Studies analyzing SPSPs' scale economies in developing countries have not do date been done in a systematic or rigorous way. What we do know is that ISNOs and kiosk / standpipe operators demonstrate lower unit costs than tanker trucks or mobile vendors using carts, bicycles, or poles. The cost of a truck is significant and the labor involved in delivering jerricans manually is very costly. There is also the issue of capacity. A truck can only hold so much water and a human can only cart or carry so much water. The greatest opportunity for scale economies rests with ISNOs or kiosk / standpipe operators. Their infrastructure allows for increased water production and delivery with a smaller burden on inputs.

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CHAPTER 3:

STUDY SITE AND METHODOLOGY: MAPUTO, MOZAMBIQUE

3.1 MOZAMBIQUE

Mozambique began to form settlements as early as the 10th century. Bantu speaking people had already established kingdoms along the Southern African coast when the Arabs arrived in 900 A.D. The Arabs set up trading posts along the coast as part of their Indian Ocean network that included the Middle East, India, and other parts of Africa. These posts soon became thriving settlements as the Bantu kingdoms and Arab traders came together in commerce. Vasco Da Gama arrived in 1498 and established Portugal's presence at Ilha de Moçambique, the country's first urban center and colonial capital (Pereira, 1993).

Mozambique endured nearly five centuries as a Portuguese colony until independence in 1975. While the Portuguese expanded their rule and influence over Mozambique, power was limited to individual settlers who were granted extensive autonomy by the Portuguese crown. Portuguese landowners exercised almost total control over the indigenous people living in their areas, and conscripted labor to work their plantations; many also built up private armies, creating mini-fiefdoms. Power was disputed among many of these semi-autonomous land holders and Portuguese central control of the colony was weak. This institutional arrangement, Portugal's preoccupation with more lucrative trade with India and the Far East, and concentration on Brazil's colonization, all contributed to Mozambique's slow development (Saul, 1985).

Britain's interest in colonial Mozambique began as early as the 1800s. The British feared that a poor and weak Mozambican colony was a liability to their nearby Rhodesian Empire and threatened to invade the Portuguese if they did not manage the situation better. In fact, the Portuguese crown had already put the colony into receivership in the 1740s, but it was not until the dictator Antonio Salazar came to power in Portugal in 1932 did Rhodesia's influence increase. Foreign investment –particularly British investment – was given priority over the indigenous population's welfare. A system of forced labor, or *"chibalo"* was put into place; men over the age of 15 were forced to work on Portuguese or British plantations, often in chains. The Portuguese shifted most of the country's administration into the hands of large British financed private companies, which often "borrowed" Mozambican laborers. Accordingly, migration to South African mines became a significant characteristic in the Mozambican economy. Only the Portuguese settlers benefited from these extractive policies and the country's economic, social, and physical infrastructure further deteriorated (Hall, 1997).

A long, fragmented nationalist movement finally culminated with independence in 1975 after 10 years of fighting. The *Frente de Libertaçao de Moçambique* (Frelimo), established in 1962 and led by the national hero Eduardo Mondlane, emerged victorious. The Portuguese, upon leaving, did their best to sabotage the new Mozambican state by destroying property and infrastructure and removing as many assets from the country as possible. Additionally, the vast majority of skilled workers such as academics and doctors fled (Jenkins, 2000).

Frelimo adopted a radical social and economic agenda based on Marxist-Socialist principles. Because the Portuguese left behind a legacy of inequitable land distribution and food insecurity, land was nationalized and development policies targeted to rural areas after independence. Frelimo's policies concentrated on food production, literacy, and health. These programs greatly benefited the country, but as a result little attention was paid to urban infrastructure (Grest, 1995).

Migration to urban areas during and after the civil war put increased pressure on already underdeveloped urban infrastructure. Resentful and fearful of Frelimo's success, the South African apartheid regime formed the *Movimiento Nacional de Resistencia de Mocambique*, or Renamo, shortly after Mozambique's independence. Renamo, supported largely by South Africa and Mozambicans who lost land during nationalization, waged a brutal 16-year guerilla style war against Frelimo using "scorched earth" and massacre tactics in villages. By the time fighting ended in 1992, a large part of the 4.5 million internally displaced persons settled in southern cities, especially the capital city of Maputo, which put a great burden on urban infrastructure and service delivery. Between 1990 and 1995 the urbanization rate reached 9 percent per year and is currently 5 percent per year. Given that the fertility rate averaged 3 percent during the last 15 years, inward migration accounted considerably to urban growth rates (Jenkins, 2000; INS 2004). Although the majority of Mozambicans are still rural, by 2015 urban Mozambicans will outnumber rural Mozambicans with an estimated urbanization level of 52 percent (UN HABITAT, 2006).

Over 25 years of armed struggle have taken its toll on the Mozambican economy. The nation is one of the world's poorest with a gross national income *per capita* of $250[6], 20 percent of the country living on less than a dollar a day, a life expectancy of 41 years, and a majority illiterate population (World Bank, 2005; INS, 2004). Only 42 percent of the population, well below the Sub-

[6] Mozambique had a population of 19.4 million in 2005.

Saharan African average of 58 percent, has access to an improved water source and 25,000 cholera cases were reported in 2002 (World Bank, 2005; WHO 2004). A 2002 report on the MDGs cited Mozambique as "unlikely" to reach the Basic Services goal of "Halving the proportion of population without sustainable access to an improved water source by 2015" (MDG, 2002). Despite healthy gross domestic product growth in the last 5 years (over 7 percent per year), Mozambique has been largely dependent on both bilateral donor aid from the United States, Germany, and Japan, and multilateral donor aid from the World Bank and International Monetary Fund (IMF) since the late 1980s; development aid has averaged US $600 million a year through the 1990s (EIU, 2004). This has led to development scholars' criticisms over the country's recent development priorities and the disproportionate influence the Bretton Woods institutions have had on government policies (Jenkins, 1999).

Mozambique joined the privatization movement that swept the developing world in the 1990s. The Bretton Woods institutions began structural adjustment in Mozambique during the civil war in the mid-1980s; privatization began in earnest in 1989. Between 1985 and 1997 approximately US $685 million had been lent to Mozambique in structural adjustment aid and the International Finance Corporation, which tries to promote economic growth in developing countries by financing private sector investments, had a portfolio of US $146 million in Mozambique by 1999. Of the US $1.25 billion Mozambique has borrowed from the World Bank in *investment* loans, US $783 million is still outstanding (Coates, 2000).

One aim of the World Bank's loans was to facilitate institutional restructuring and private sector participation (PSP) in the water sector. Fourteen percent, or US $111 million, of the US $783 million in outstanding debt is for a national water project that includes new regulatory and investment institutions and a management lease contract for five major Mozambican cities. The loan's goal, in the World Bank's words is: "To improve the quality, reliability and sustainability of water services for the cities of Maputo, Beira, Quelimane, Nampula, and Pemba, through promoting greater private sector participation in the provision of these services" (World Bank 2003). The project is still ongoing in all five cities.

3.2 MAPUTO

Modern day Maputo[7] was established as Lourenço Marques, the name of a Portuguese navigator, in 1781. Lourenço Marques was originally just a port but Lisbon elevated it to town status in 1876 after trade in gold and diamonds increased its importance. Official statistics put the city's current population between 1.7 and 1.8 million.

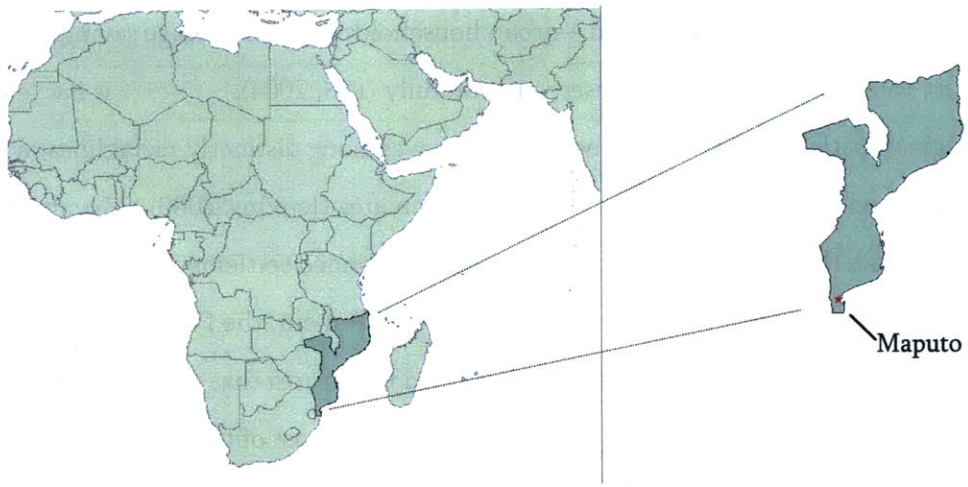

Figure 3.1: Maputo and Mozambique in regional context
Source: *Earth Systems Resource Institute's Geographic Information Systems*

Approximately 9 percent of these residents live in the cement city (AdM, 2006; Jenkins, 2000). Annual growth rates averaged over 9 percent in the 1990s, largely due to inward migration from the closure of South African mines to Mozambicans, severe drop in agricultural exports, and the civil war (Boucher, 1995; Jenkins, 2000). The average household size is 6.3 persons; Maputo has the largest household size anywhere in the country (INS, 2004). Infrastructure services have not kept pace with city growth: currently only 37 percent have direct access to utility drinking water, either through private connections or standpipes (AdM, 2006).

Before independence, Maputo's African population was largely employed in the city as unskilled labor in transport, domestic services, and South African mines and farms. Of Maputo's

[7] In this paper Maputo refers to the metropolitan region made up by Maputo, the capital city, and its urban neighbor Matola, which are supplied by the same water system and together make up the nation's primary urban area. When necessary, an explicit distinction will be made.

approximately 660,000 working age residents[8] today, at most 83 percent have some labor force participation. The Port and Rail authority is still the largest formal sector employer and many residents work in the commercial, financial, and service sectors, including national administration. The informal sector employed 225,000 people in 1997. The informal economy today mainly consists of domestic services, street vending, local services provision, and small scale productive activities (Jenkins, 2000). Household expenses in urban areas equaled $148 per month in 2005 values. Incomes, on the other hand, only averaged $139 per month – urban households have an average savings rate of zero percent and must balance income and expenses very carefully (INS, 2004).

Maputo's original spatial distribution of the population was along distinctly racial lines, with the majority of African residents living outside the planned urban area (Jenkins, 2000). Mozambicans were forbidden to own land; they had to resort to squatting on unplanned settlements in this peripheral area. Additionally, during the Frelimo independence movement, the Portuguese used foreign investment to finance large urban projects in the planned urban area that pushed many proximate Mozambican families towards the fringe. At independence, most of these 'shantytown' areas housing African Mozambicans did not have basic water, sanitation, or community services. President Samora Machel described this situation in a March 1980 speech:

> "Lourenço Marques, city of cement, built high to mark the difference between us and the colonists.... Lourenço Marques city of reeds and tin, relegated to the flood plains, storehouse of human labor and suffering used to create luxury for the colonists...On the one side; cement, opulence, the brilliantly clean streets, on the other side; the insecurity of social injustice, the discrimination, the poverty and the gloom of misery" (Pinsky, 1982).

Today Maputo is a still a bifurcated city – a "cement" center with reasonably adequate infrastructure services where the wealthy live is juxtaposed with the peri-urban[9] "fringe" zones which have very limited infrastructure and house the city's lower-income residents.

Although the city covers a total area of 675 square kilometers, as of 1999, ninety-six percent of the total urban population occupied only approximately 320 square kilometers (Jenkins, 2000).

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[8] Working age is 15-64 years of age. This figure may only include residents in Maputo's cement city and immediate surroundings and major parts of Matola. The actual working age population is likely to be higher than this figure.

[9] Maputo's peri-urban areas are typical of Africa in that they exhibit (1) rapid and unplanned growth with negative impacts on public health and environmental degradation; (2) inadequate infrastructure to meet even basic needs; and (3) a significant proportion of low-income residents (SEAP, 2004).

The colonial regime defined the administrative structure in the 1960s by breaking the city down into 5 districts, and if adjoining Matola is considered, 8 districts. Districts are unofficially broken down into neighborhoods, or bairros; Maputo has 108 bairros. Bairros are broken down into block groups, or quarteirão, but districts are the smallest official administrative unit.

The table below is a network service and density level assessment for the city's principal areas. In total, Maputo's peri-urban areas, minus the semi-urban area, include over 1.2 million residents, or two-thirds of Maputo's population. These zones of the city are expected to grow faster than the city's center. It is estimated that by 2015, peri-urban Maputo will have 1.6 million inhabitants and the utility will have difficulty keeping up with this growth (Hydroconseil, 2005).

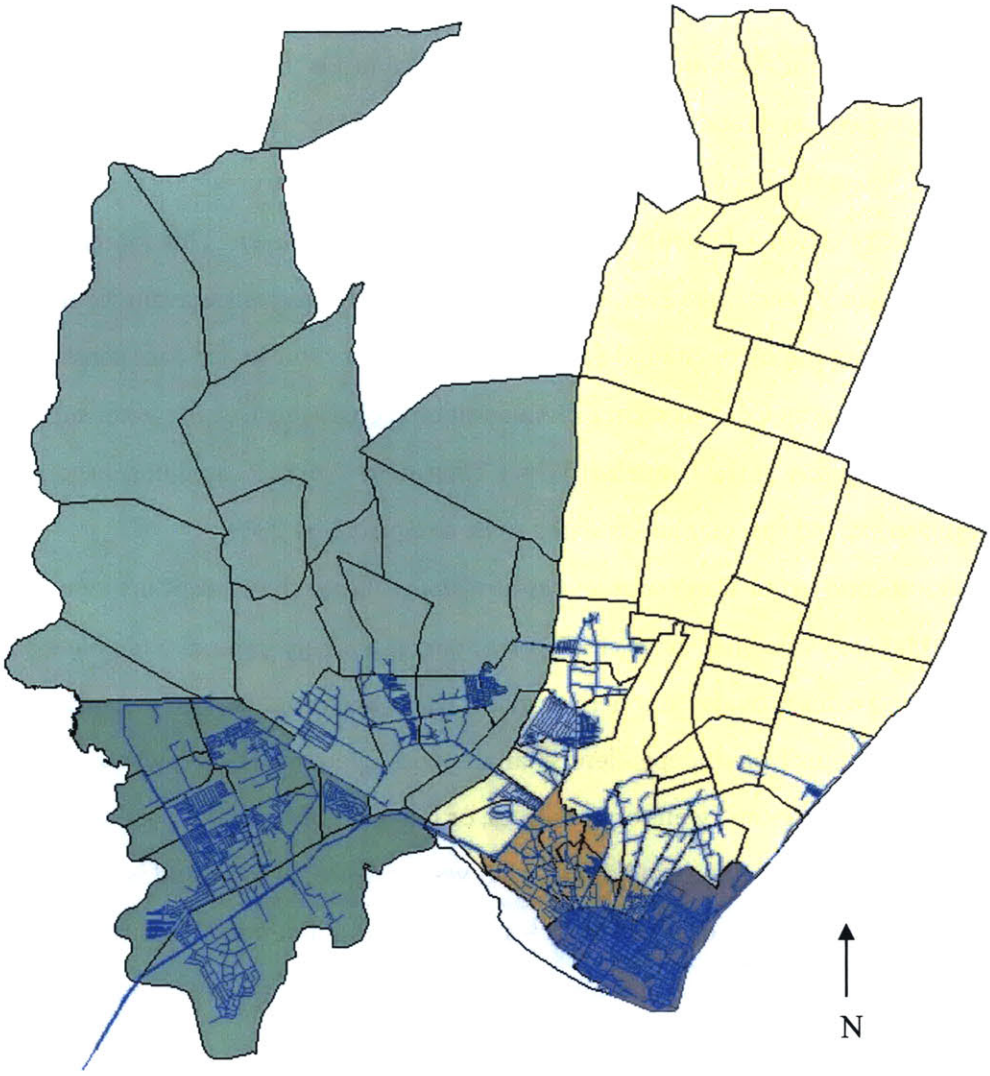

Figure 3.2: Cities of Maputo and Matola
Source: *Hydroconseil Geographic Information Systems Files*

Table 3.1: Density and in service level in different Maputo and Matola areas

	Density, service level	*Number of Bairros*	*Legend*
Cement City	dense, good	11	Dark grey
Semi-urban area	dense, fair	11	Dark orange
Northern Maputo	sparse, poor	56	Beige
Matola proper	sparse, good	12	Green
Northern Matola	sparse, poor	18	Light green
Utility Network	-	-	Blue line

3.3 The Water Sector

The main source for the water supply system for Maputo is the Umbeluzi River. The Umbeluzi river basin covers a total area of 5,460 km^2, of which 41% is located in Mozambique, 58% in Swaziland, and 1% in the Republic of South Africa. The current water supply system is solely based on intake from Pequenos Libombos dam along the Umbeluzi River. This source will become insufficient within 6 to 9 years. However, sufficient additional resources are available from other nearby rivers, including the Incomati and Sabie Rivers; feasibility studies for dam construction or augmentation are underway for both sources. An additional challenge to bulk water supply for the region is treatment capacity at the Umbeluzi Water Treatment Works located in southern Matola. Work has begun to expand capacity and is slated to be completed by 2009.

Maputo's second major water source is groundwater. Since the current utility network does not reach all of Maputo's inhabited areas, alternative sources, namely groundwater, have been in use for decades. Groundwater provides as much, or more, water as the network to peri-urban residents. Residents either buy water from independent small network operators (ISNO) who all currently source groundwater, dig personal wells or boreholes, or buy water from neighbors' wells or boreholes. The upper aquifer – fine sand dunes – has very low productivity and is not suitable for bulk extraction. By contrast, the deeper aquifer - sandstones and limestone – has a much higher productivity and is generally suitable for bulk extraction; 60 meters is the recommended minimum depth for boreholes (Hydroconseil, 2005).

Throughout the 1900s government authorities worldwide provided water to its citizens. Water's property as a merit good[10] and ability to produce public health externalities committed public authorities to provide this most basic of entitlements. Colonial regimes, however, gave service priority to the elite living in city centers and Portugal's practices in Maputo were no exception.

After Mozambique's independence in 1975, state investment in Maputo's urban infrastructure nearly halted due to the civil war – during the mid-eighties gross domestic product grew very little and actually declined between 1982 and 1983, and government consumption grew no more than 10 percent annually (IMF, 2006). Even when the government was spending, it concentrated its resources on education, health, and rural infrastructure to make up for colonial injustices; a third of total government spending went to these areas between 1998 and 2000 (Heltberg, 2003). As a result of Mozambique's economic woes and urban population boom, the public utility's coverage and service levels suffered dearly. Aguas de Maputo (AdO), the public water utility at the time, lacked the necessary capital to rehabilitate, upgrade, or expand its infrastructures. There is also evidence of central government's reluctance to serve peri-urban areas during the 1990s when AdO was still in operation (Pinsky, 1982).

The current Maputo water coverage situation is disconcerting. Although a slight improvement from over a decade ago, the government and privately managed water utility are still falling short of sector goals and are underperforming in absolute terms (DNA, 2004). The network currently reaches approximately 50 percent of Maputo's residents; 37 percent obtain water from private connections or standpipes and 13 percent retrieve water from a neighbor's connection to the network[11]. Although the Cement City accounts for only 9 percent of Maputo's population, it receives 36 percent of the network's private connections. A larger proportion of peri-urban residents rely on a combination of the network's standpipes and neighbors' connections than direct connections to the network, 27 and 18 percent, respectively. This negatively affects peri-urban residents' consumption, water quality, and service levels.

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[10] A merit good may be defined as a good or service 'whose consumption is believed to confer benefits on society as a whole greater than those reflected in consumers' own preferences for them' (Black, 1997).

[11] Reselling occurs virtually only through utility connections and not SPSP connections because they can monitor their customers more closely.

Maputo's water consumption levels are not ideal. A person needs between 20 and 50 liters per capita per day (lpcd) to meet basic needs (WHO, 2004). Most peri-urban Maputo residents use between 23 and 56 lpcd, with standpipe users consuming significantly less – between 25 and 30 lpcd – than customers with household or yard connections who consume 57 and 80 lpcd, respectively (Hydroconseil, 2005). A larger city-wide survey showed similar consumption levels, with households connected to the utility consuming 73 lpcd on average and standpipe users consuming between 25 and 29 lpcd. Well users consume the least – 18 to 24 lpcd (DNA, 2004).

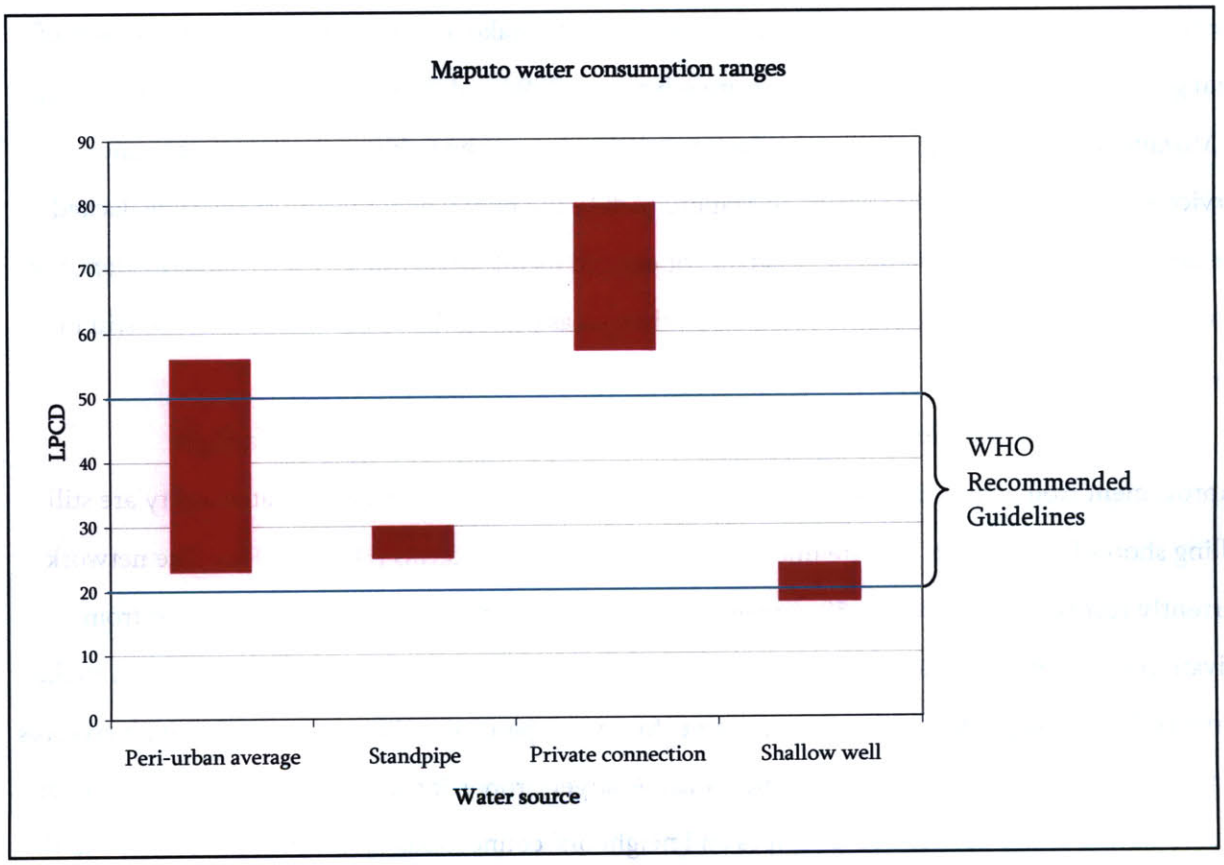

Figure 3.3: Maputo's consumption ranges for various water sources
Source: *National Water Directorate and Hydroconseil*

But adequate consumption is not the whole story. Water quality also matters. In 2003 a government sanitation planning report said that Maputo residents suffered 53,740 diarrhea cases that led to 256 deaths and 1,157 cholera cases that led to 15 deaths; cases and deaths significantly increase during floods (DNA, 2004). The government also reported that AdM fecal coliform and microbiological tests were negative and AdM self-reported that 98 percent of its treated water was

potable (Naienne, 2006). This evidence would indicate that a large number of diarrhea and cholera cases occur in areas where the network does not exist or, in other words, peri-urban Maputo. The government did not state the exact bairros where these sicknesses occurred, but a recent survey in 5 peri-urban bairros by Estamos, a local NGO, shows that Costa do Sol had the highest number of households (43 percent) reporting a member with a stomach related illness in the month previous to the survey (David, 2006)[12].

Maputo's environmental health is rapidly deteriorating. There is growing soil salinity in the coastal plains and river valleys, due mainly to the excessive extraction of subterranean water. The only existing solid waste landfill in Maputo is unsuitably sited[13], virtually unmanaged, and growing inexorably in size; it has begun to contaminate the subterranean aquifers used for water supply. The wide use of latrines – and their numbers are rising – has led to nitrate build up in the soil and has also contaminated shallow wells and the subterranean aquifers (Jenkins, 2000). In fact, water from some of the utility's boreholes[14] show alarming levels of nitrate concentration and in some cases of bacteriological contamination such as *E. coli*. A survey taken in 2003 showed that 40 percent of these boreholes had higher than permissible nitrate and/or *E. coli* values (Hydroconseil, 2005). The water sector has to coordinate with the sanitation and solid-waste management sectors to improve water quality in the Maputo basin if groundwater is to be a sustainable peri-urban water source.

If peri-urban residents could decide the government's priorities in their neighborhoods they would overwhelmingly choose water supply. One half of residents who participated in the Estamos survey chose "Guaranteeing an adequate supply of water" as their number one priority for government action. The second most frequently selected action area was improving public health and hospitals, with only 17 percent of residents citing it as their number one priority[15] (David, 2006).

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[12] It is important to note that Costa do Sol also had the highest percentage of families using well water, and the only bairro of the five surveyed where families used rivers, drains, or tanker trucks as a water source (David, 2006).

[13] The landfill is located in the peri-urban *bairro* of Hulene.

[14] Some of the utility's 350 standpipes in peri-urban Maputo source water from boreholes.

[15] Respondents could choose from 1) Guaranteeing an adequate supply of water; 2) improving public health and hospitals; 3) improving household sanitation; 4) improving secondary schools; 5) improving transport and roads; 6) scaling up electricity; or 7) reducing crime. Options were read out loud for respondents but the first option to be read was chosen randomly. Bairros included in the survey were Costa do Sol, Albazine, Hulene, FPLM, and Mahotas; 1373 persons in total responded. It should be noted that the inclusion of bairro Costa do Sol in the survey is the likely reason why "water supply" is the number one priority since neither AdM nor SPSPs are active in this area; most residents rely on personal or neighborhood wells.

Given that two out of every three peri-urban residents do not have direct access to the utility network, this finding may not be surprising.

Peri-urban residents prefer household connections over other water supply service types. Household connections are desirable not only because they allow for more water consumption, they reduce physical burden, the opportunity costs of water fetching, and the health dangers associated with improper water storage. A household survey targeting 10 peri-urban bairros with a sample of 640 households demonstrates that, when residents were asked what they would consider as an improvement in their present water supply situation, 50 percent of the respondents mentioned "having their own house connection" and 49 percent mentioned "cheaper water" (categories were not mutually exclusive) (Hydroconseil, 2005).

The Mozambican government looked to external financing sources for utilities' upgrading but funding agencies were reluctant to finance projects without a clear institutional framework for the water sector. In 1998 the World Bank agreed to fund the National Water Development Projects to improve coverage and performance, but also created a new institutional architecture, dubbed the 'Framework for Delegated Management', to attract PSP for Mozambique's urban water provision. Large scale PSP would become part of a triumvirate institutional design where a private operator manages the utility, a public investment agency, FIPAG (Fundo de Investimento e Património do Abastecimento de Água), takes over municipal water supply fixed assets and investment duties, and an independent regulator, CRA (Conselho de Regulação do Abastecimento de Água), monitors the utility's operations and mediates conflicts between the utility and FIPAG[16]. The National Water Directorate (DNA), under the Ministry of Housing and Public Works (MOHP), is responsible for promoting this framework's implementation, mobilizing funds, and preparing legal support when necessary. The municipal government plays a very minor role and has little sector influence in the face of these larger actors. It is still, however, the people's representative and is responsible for voicing community concerns to the other institutions (Thompson, 2005). This framework still exists today

(Figure 3.4):

[16] The World Bank's institutional paradigm believed regulation works best when divorced from financing, management, and operating activities. This theoretically allows the regulator to monitor tariffs and other sector activities without political interference.

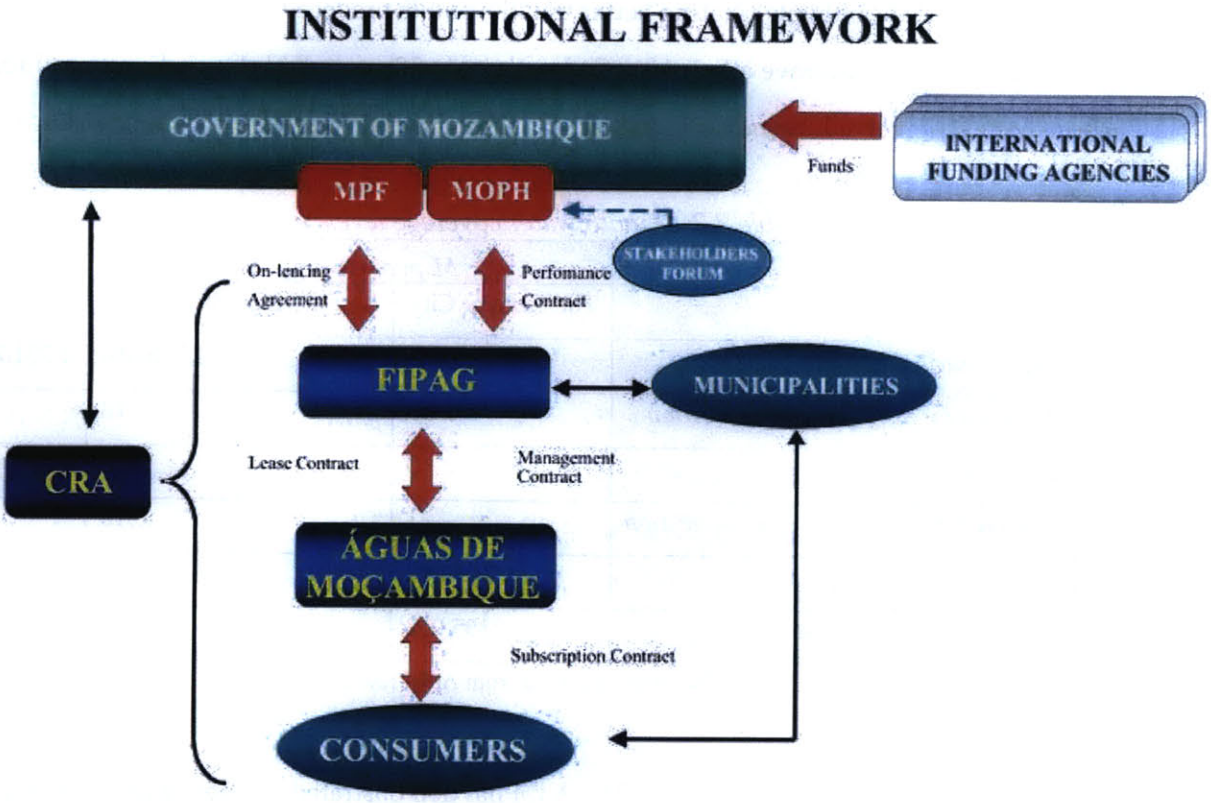


Figure 3.4: Institutional Framework for Maputo's Water Sector
Source: *Fundo de Investimento e Património do Abastecimento de Água (FIPAG)*

Immediately following the transfer of municipal assets to FIPAG, a private operator was sought to take over utility operations. FIPAG entered into a 15 year lease contract in September 1999 with Aguas de Moçambique (AdM), a consortium of French, Portuguese, and Mozambican companies, to manage potable water supply service in Maputo; the major shareholder was France's SAUR International. Immediately following the lease agreement in February 2000, disastrous floods struck Maputo that damaged the distribution infrastructure, washing away sections of large mains completely, and the main treatment plant's raw water pumps. That year AdM was unable to meet financial obligations to its main shareholder, SAUR International, and called for a tariff increase. The contract renegotiation that ensued was unsuccessful and resulted in SAUR leaving the consortium in October 2001. Aguas de Portugal took over SAUR's equity and is now the major shareholder of AdM, whose lease expires in late 2016 (FIPAG, 2001).

Aguas de Moçambique is faring better than its public predecessor but is still struggling to increase coverage and improve efficiency. Currently only 50 percent of the city is either directly (private connection or standpipe) or indirectly (household resale) served by the network:

Table 3.2: Maputo water coverage levels in 2004

	*Maputo coverage levels in 2004**		
	The Cement City	Rest of Maputo & Matola	Total
Population	155,063	1,576,656	1,731,719
% served by AdM private connection	>99	18	25
% served by AdM standpipe	0	14	12
% served by AdM neighbor connection	<1	13	13
% served in total	100	45	50
Total population served	155,063	709,495	865,860

*Numbers adapted from AdM raw data

Since it took over operations in 2001, AdM has demonstrated progress with respect to coverage, water quality, and collections. However, significant challenges prevent their strategies from being wholly effective in peri-urban areas. At the moment, AdM is only present in 41 of the 97 peri-urban bairros and provides service in the form of private connections and publicly managed standpipes. Service in the bairros is very different than service in the cement city. Private connections face lower pressure and more limited supply times; most operate for 14 hours a day. There are approximately 350 publicly managed standpipes with daylight service, usually 14 hours a day for standpipes connected to a network, and 4 hours a day for standpipes connected to a borehole (Naienne, 2006). Over half of Maputo's residents have to rely on alternative water sources.

Peri-urban residents currently use four different waters sources – groundwater, utility water, rainwater, and river water[17] - retrieved in five different ways – private connections, neighbors' connections, private well, neighbors' wells, and standpipes. This inequitable access to the utility network results in what Karen Bakker calls an "archipelago" – spatially separated but linked 'islands' of networked supply in the urban fabric – that better characterizes Maputo's heterogeneous,

[17] The percentage using river water is very small – less than 1 percent.

alternative service delivery mechanisms that overlap with and inter-penetrate the network (Bakker, 2003).

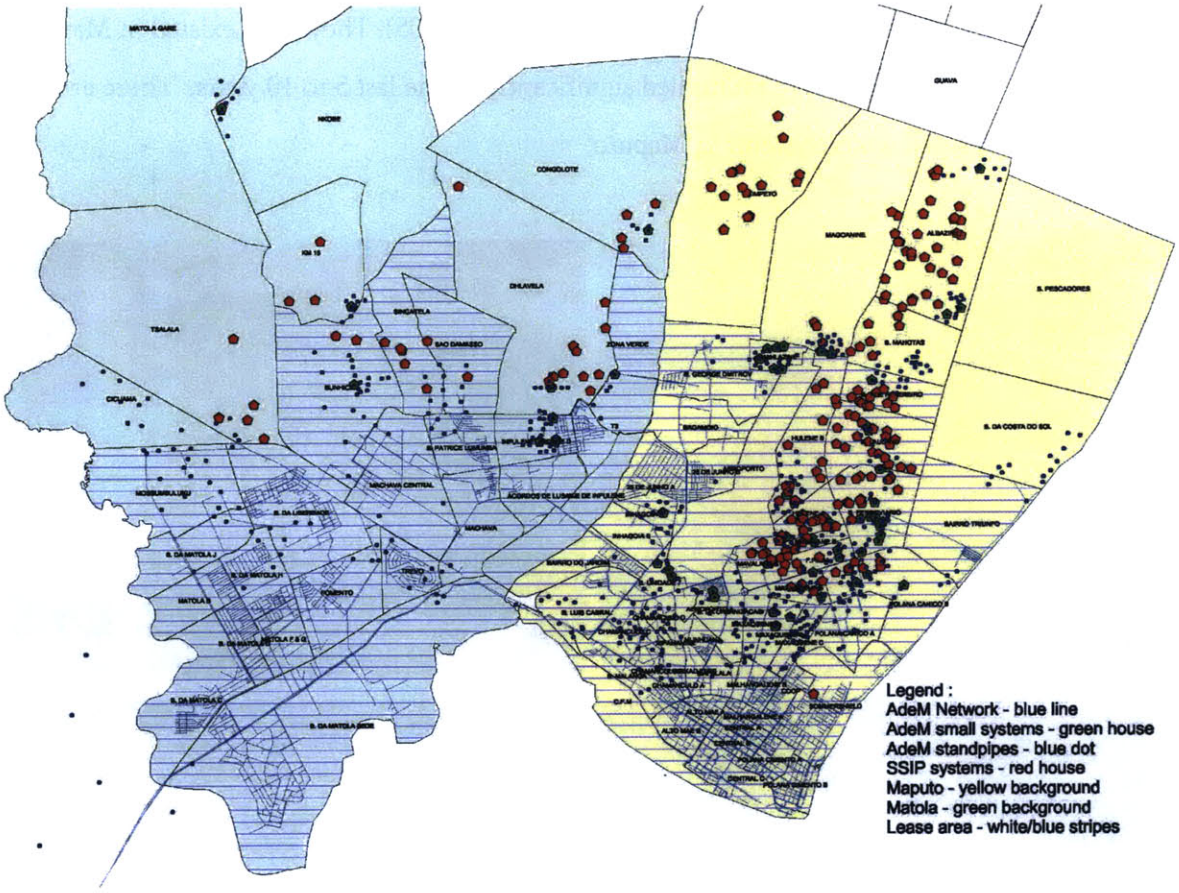


Figure 3.5: Maputo's 'Archipelago' (AdeM=AdM & SSIP=Small private-sector provider)
Source: *Hydroconseil Geographic Information Systems*

This service gap is partially a result of the PSP contract structure. A lease delegates capital investment obligations to FIPAG, a government agency, and not AdM. FIPAG and AdM must negotiate and reach an agreement prior to expanding coverage or improving service in a particular area. Because of commercial disincentives to serving relatively poorer peri-urban areas, the government's limited resources for infrastructure investment, and time it takes to extend major infrastructure like water networks, AdM will not serve a majority of Maputo residents with private connections or standpipes for the foreseeable future. In its place, the "other" private sector – small private-sector providers (SPSP) – are filling the service gap for many households in the peri-urban area.

Maputo's SPSPs, predominately in the form of independent small network operators (ISNO), are an integral and dominant part of Maputo's "archipelago", serving between 175,000 and 210,000 peri-urban residents with standpipes that offer water during daylight hours and private connections that for the most part provide 24 hour service (Hydroconseil, 2005). They have existed in Maputo since as early as the 1970s but have multiplied significantly in the last 5 to 10 years. There are now approximately 210 small water systems in Maputo.

Figure 3.6: Examples of small network systems in peri-urban Maputo, Mozambique.
Source: *The author. For more photos see Appendix D*

Maputo's ISNOs are truly independent – they do not deliver water from the existing utility networks but instead dig boreholes (also referred to as deepwells) and extract groundwater with a motorized pump. This water is then stored in elevated tanks and delivered via a rubber pipe distribution network. They cater mostly to residential customers and average 76 household connections per network. Three out of four providers have a privately managed standpipe with

multiple faucets, almost always adjacent to their borehole, as part of their water system. They operate year round and are known for their ability to respond to demand, provide a decent service level, and reduce Maputo's coverage gap. Less is known about their business structure and operating environment.

FIPAG is currently in the process of building two new distribution centers and expanding its network in the north and west of the city; one center is being built in an area with the densest concentration of ISNOs[18]. Because ISNOs are so predominant in this peri-urban area, FIPAG has begun to study them and communicate with them in order to seek avenues for collaboration. FIPAG views ISNOs as financially sustainable and would like to capitalize on their existing infrastructure to expand coverage. CRA, on the other hand, is more critical of ISNOs' motivations, environmental impact, and ability to serve the poorest of the poor.

Currently it is understood that Maputo's ISNOs play a considerable role in the peri-urban water market and have done so for the last 10 years. Next to the utility, as a group, they are the largest water provider in Maputo. It is clear that their presence must be acknowledged, less clear is the future role they should play as an integral part of Maputo's water and sanitation service delivery strategy. In this vein, a study was conducted to assess the positive and negative aspects of ISNOs' business structure along with the limits and potential of their operating environment to help determine the optimal role for ISNOs in the future of Maputo's water sector.

3.4 Study Methodology

This study used mixed-methods to obtain a holistic understanding of Maputo's water sector and detailed information on a sample of ISNOs' businesses. Research began in July 2005 with desk research and open-ended interviews with policy makers and 15 ISNOs. A literature review on PSP in the water sector, SPSPs, W&S technologies, and infrastructure planning in low income countries from both academic and professional sources was completed. Four senior officials in FIPAG's legal and engineering departments and CRA were interviewed, along with AdM's commercial director and two consultants working for FIPAG.

[18] These distribution centers are slated for completion in 2006 but cannot become operational, however, until the main water treatment plant is upgraded. The plant upgrading has been slow and is a bottleneck in the process; professional estimates say it will be completed in 2009.

The ISNOs interviewed were selected using the "snowballing" method; three of the 15 were non-profit enterprises that delivered water to schools and targeted disabled residents. Interviews were semi-structured, informal, and conducted in Portuguese with the assistance of local research assistants. I returned to Cambridge, MA in September to analyze the results and continue desk research.

In January 2006 I traveled to Maputo a second time to carry out a survey effort with 30 ISNOs and follow-up with policy makers. The provider study was an in-depth survey of a stratified random sample of Maputo's ISNOs. This survey effort benefited from an existing provider list of all Maputo ISNOs compiled by FIPAG and its consultants; The list of 190 providers who were operating prior to July 2005 was categorized, based on self-reported numbers of household connections, into "large" (>30 connections) and "small" (≤30 connections) operations. Eighty-five providers (roughly 40%) were classified into each category; the number of connections was not available for another 40 providers (20% of the total). A stratified random sample was drawn that mirrored the distribution of providers among these three categories. The study's original target was 30 randomly chosen ISNOs. Favorable field conditions and cooperative providers allowed for 38 interviews instead of 30.

Table 3.3: Sample composition

Provider Category	# of household connections	Total # (%) in Maputo*	# (%) included in sample
Small	≤30	85 (40%)	16 (42%)
Large	>30	85 (40%)	14 (37%)
Unknown	Unknown	40 (20%)	8* (21%)

*of the 8 SPSPs of unknown size, 3 turned out to be small and 5 turned out to be large, resulting in an even sample of 19 providers of each size type.

Sampled providers were contacted by phone or in person to arrange for an interview. Those who were unreachable because of outdated or incorrect information (approximately 20% of the original sample) were replaced with substitutes drawn at random from the relevant stratum. At the start of each interview, enumerators described the purpose of the investigation and asked each

individual to participate in the study[19]. Not a single provider refused, although several asked for enumerators to bring written documentation regarding the study's goals and funding sources. Thirty-five of our respondents were system owners and the remaining 3 were regular managers who knew operating details well.

In some cases a provider had more than one system under his or her ownership. Often they had one system at their residence and others either in the same neighborhood or elsewhere in Maputo's peri-urban area. In these cases, in order to maintain the system as the unit of analysis, the provider was asked to list his or her systems. Through discussion the enumerator determined for which system the respondent had the most cost, revenue, and pricing information. The ensuing interview focused solely on the operations related to this system. This approach may have led to providers with multiple systems conducting their interviews based on the system located at their homes. This is the system they usually have the most information about. Qualitative research shows that systems located at providers' homes are usually the first system the provider ever built. Therefore, among providers with multiple systems, responses *may* be biased towards a provider's first system.

The provider survey included ten sections. The interview resulted in detailed quantitative and qualitative information on costs, prices, and financing of ISNO businesses and categorized characteristics of their operating environment. Field interviews were completed by four enumerators (three males and one female) with professional training and prior experience in quantitative and qualitative data collection methods and interviewing techniques. The enumeration team underwent an intensive three-day training to familiarize them with the topic of water SPSPs and to provide an opportunity to pre-test and revise the survey instrument. Following the training, I accompanied each interviewer to the field to monitor their performance. After satisfactorily completing two interviews, they proceeded independently. Interviews were carried out in either Portuguese or Tsanghana as per the respondent's preference and were generally carried out in providers' homes, which in most cases was also the location of their water systems.

The median interview length as recorded by the enumerators was 2 hours and 20 minutes. I reviewed each completed survey and entered the responses into a database. This database was then

[19] In several cases, the contact information of sampled providers was incorrect and the individuals could not be reached. In each instance, an alternate provider was randomly selected from the relevant category and included in the sample.

used to perform analyses using the statistical software packages SPSS and SAS. The study relies on the statistical analyses, a thorough literature review, in-depth knowledge of Maputo and its water sector, and ISNOs' attitudes and opinions.

CHAPTER 4:

SMALL PRIVATE-SECTOR PROVIDER STUDY FINDINGS

4.1 Background

All study findings are based on our study sample of 38 providers unless specified otherwise. The dominant form of SPSP in Maputo is the independent small network operator (ISNO). These ISNOs mainly serve households who use the service to fulfill their daily drinking, cooking, bathing, washing, and other domestic needs. Independent small network operators have existed in Maputo since as early as the 1970s but have multiplied significantly in the last 5 to 10 years; Over 50 percent of all providers in our sample entered the market in the last 5 years. The survey effort's main goal is to understand the ISNO's prices, cost structure, and operating environment. The study conceptualizes the per unit production costs for the ISNO as a function of several input costs, service characteristics, and contextual factors.

4.2 ISNO Profile

Maputo has approximately 210 independent small networks run by approximately 180 operators (Hydroconseil, 2005). Four out of five operators interviewed are male. These providers have no formal relationship with the utility AdM, as they install private boreholes (often referred to as deepwells) and extract groundwater with an electric motorized pump. Water is stored in elevated tanks and delivered *via* a rubber pipe distribution network largely to residents' private yards and occasionally into their homes. Almost all SPSPs cater exclusively to residential customers; only one provider interviewed reported business connections and three reported "other" types of connections: a school, a small military barracks, and an association. The providers interviewed operate networks with a median number of 50 household connections and 600 meters of distribution pipe.

In many cases, the providers interviewed have converted a water supply system initially installed for his/her family's private use into a small network. When asked about the principal reason that the provider decided to enter into the water supply business, 29 percent said they had responded to requests of neighbors in their communities.

Table 4.1: Primary reason provider began selling water
(Percentage of ISNOs reporting, N=35)

"Area lacked water"	31
"Requests from neighbors or the community"	29
"Business / an opportunity to earn money"	20
"To help / reduce the suffering of the community"	17
"Other"	3

Providers who started selling water because their "Area lacked water" were both entrepreneurial – responding to customer demand – and altruistic – providing a public service. However, those who began selling water mainly to provide a community service are likely to have mentioned "To help / reduce the suffering of the community" as their primary motivation. In other words, it is more accurate to conclude that only 17 percent, and not 48 percent, of providers began selling water to help their communities.

The majority of Maputo's ISNOs have only one system. There is evidence that a single system can serve over 600 households with private connections. In fact, the approximately 15 providers with more than one system are often able to provide an even larger number of connections; one provider has been able to provide over 1000 connections with seven systems. Seventy-five percent of providers have a privately managed standpipe adjacent to or a short walking distance from their borehole as part of their business; independent networks can include *both* exclusive household connections and standpipes. These standpipes often have multiple faucets emanating from it resulting in multiple jerrican filling points at a single water source.

Small-scale water providers are not required by any public authority to register their operations (Thompson, 2005). Forty percent of the ISNOs interviewed, however, have chosen or been required to register their enterprises on an *ad hoc* basis at the neighborhood or district level. Among those who are registered, 40 percent said they did so because "it was required" and 33 percent do so "in order to avoid prosecution." In some cases, providers actively pursued the license and cited reasons from, "To gain access to credit", to "To have the right of official appeal". No difference was documented between registered and unregistered ISNOs with respect to size (network length and number of connections), gender, age, education level, years in business, sales volume, customers served, number of loan sources used in the past year, or whether their water quality is regulated.

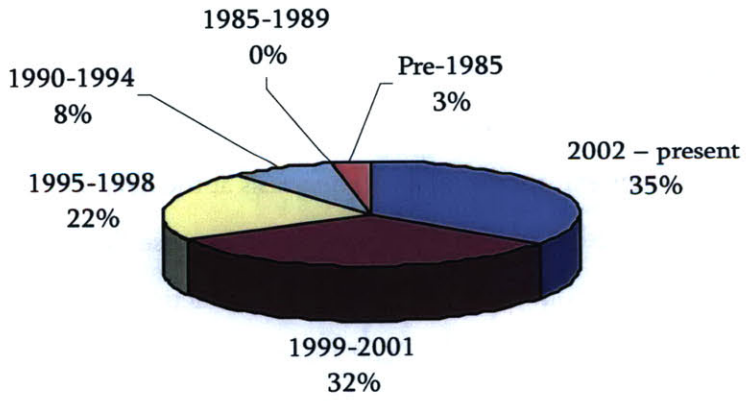
This suggests either that some other characteristic determines an ISNO's registration requirement, or that the registration process is completely arbitrary.

Three out of four providers interviewed reported having another job or business. These alternate occupations range from operating a small food stand at the provider's home to professional occupations like accountant and economist. Although information on providers' household incomes was not collected, we do know that 16 percent of providers' household incomes originate entirely from water sales. These providers would be the most vulnerable to changes in the market or regulation. Another 51 percent that obtain half or more of their monthly household income from water sales would also be at risk, but less so because other family members also contribute or they have additional income sources.

4.3 Firm Characteristics

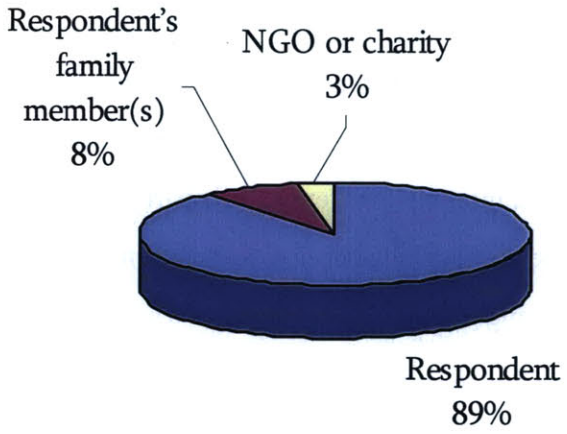
Small scale water provision in Maputo has largely been a phenomenon of the last decade. About 90 percent of businesses in the study's sample have been in operation for 10 years or less. While the typical operator has been in business five and a half years, one in our sample has been operating for over 20 years and some started as late as 2004.

Chart 4.1: Year of enterprise establishment:
(Percentage of ISNOs reporting, N=37)



Virtually all of the up-front investment in the surveyed businesses took the form of private capital from the respondents or their family members. Similarly, current ownership of water supply assets rests predominantly with virtually all (97%) of the interviewed providers.

Chart 4.2: Source of start-up capital for system construction
(Percentage of ISNOs reporting, N=38)



The typical provider serves 442 peri-urban residents a day, including both household and standpipe customers. This puts the ISNO peri-urban customer base around 147,000 residents.[20] This is consistent with another published estimate that puts the customer base at approximately 170,000 (Hydroconseil, 2005).

Table 4.2: Number of customers served by sampled ISNOs (N=38)

Median	Mean	Std Dev	Minimum	Maximum
442	632	601	95	2602

Almost all providers – 97 percent – began their operations with some form of labor, paid or unpaid, full- or part-time. The majority of ISNOs, 71 percent, claimed to have 1 or more paid laborers at operation's start; 45 percent reported having had unpaid labor. With respect to hours employed, 71 percent of our sample employed at least one full-time worker while 39 percent used at least one part time worker at operation's start; full time labor was more predominant among ISNOs

[20] This figure was derived using the following assumptions: The sum of the sample's customer base is 24,154 residents. Private connection users were calculated using an average household size of 6.3 and standpipe users were calculated using the average volume sold from providers' standpipes divided by 27 lpcd, the average Maputo standpipe consumption rate from government and consultancy sources. Since our sample represents 18 percent of all Maputo ISNO systems (38/210=.18), the sample's customer base was multiplied by 5.5263 to arrive at 133,482 customers. However, some of Maputo's systems were not included in the 2005 census so there may be more than 210 and some of the largest ISNOs did not get interviewed in this study because they were unavailable at the time. To account for missing systems, potential multiplying effects from large systems' customer bases, and a small percentage of re-sold water, the figure here has been rounded up to 147,000 customers.

than part-time labor. The most expensive form of labor for ISNOs and most valuable to peri-urban employees in the informal labor market – full-time paid labor – was employed by 58 percent of providers at operation's start.

Although systematic data on employees' roles were not obtained, qualitative evidence suggests that most full-time employees manage standpipe operations (monitoring clients, collecting payments, responding to service interruptions, etc.) while part-time employees help maintain systems, install new household connections, service existing connections, and perform various other operations-related tasks. One might wonder why system owners do not attend to technical matters themselves, or in the event they do not have technical knowledge, why they do not at least manage their own standpipes and revenue collections. The reason may be that opportunity costs are too high. Among system *owners*, 80 percent have another job or business. Among those with another job or business, sixty-eight percent use either paid or unpaid full-time labor; in fact sixty-one percent use full-time paid labor. Unpaid labor is usually in the form of family members, such as housewives or older children, who might experience lower opportunity costs. This trend is not entirely surprising since many providers have professional or technical jobs such as an accountant, economist, and import / export officer.

The reliance on paid labor appears to have grown over time. The net increase in paid labor among our sample was 9 employees. Unpaid labor decreased by 6 employees. Small-network systems by design rely less on labor as a production factor than other SPSP types such as mobile vendors and manual carters, which often demonstrate more labor intensive operations (Davis, 2005). System growth was commensurate with labor growth. The typical ISNO's staff to connection ratio remained largely unchanged between operation's start and now with 17 and 16 full-time workers per 1000 connections, respectively (extrapolated from actual data).

Table 4.3: Paid and unpaid full-time and part-time labor employed by ISNOs (Percentage of ISNOs reporting)

	Full-time paid labor *(N=38)*		Full-time unpaid labor *(N=38)*		Part-time paid labor *(N=38)*		Part-time unpaid labor *(N=38)*	
Workers	*Start-up*	*Now*	*Start-up*	*Now*	*Start-up*	*Now*	*Start-up*	*Now*
0	42	42	79	82	79	82	76	74
1	37	21	13	16	5	5	8	16
2	13	26	8	3	11	5	13	11
3+	8	11	0	0	5	8	3	0
TOTAL	*100*	*100*	*100*	*101*	*100*	*100*	*100*	*101*

Table 4.4: Change in systems from operations start to now: standpipes and household connections

	Change in standpipes (absolute, N=38)	*Change in standpipes (% - among those with > 0 standpipes at start-up, N=31)*	*Change in connections (absolute, N=38)*	*Change in connections (% - among those with >0 connections at start-up, N=21)*
Median	0	0	39	300
Mean	0.13	1.60	64.6	858
Std. Deviation	1.21	71	85.8	1567
Minimum	-2	-100	-30	-49
Maximum	6	200	370	7000

4.4 SPSP COSTS

Providers were asked a series of detailed questions regarding both the costs of starting their business, as well as the recurrent costs associated with ongoing operations[21]. Two methods were used to collect start-up costs. First, the provider was asked how much he or she spent to start his or her system on the whole. Then, the provider was asked to give a more detailed breakdown of start-up costs with respect to a system's major components. The individual component costs not only provide a more detailed cost picture but were tallied to cross-check the broader figure stated earlier in the survey. Providers reported spending anywhere between $5,000 and $45,000 to start their businesses, with the typical provider spending between $10,000 and $12,000. This value is equal to between 6 and 7 times the *annual* gross average Mozambican urban household incomes or between 9 and 11 times the *annual* gross Mozambican minimum wages, indicating that barriers to entry are very high; not just any family can build a small water network.

Tallied start-up costs were very close to the whole figures, but the median and mean were slightly less[22]. We also asked providers how much money they would need to set up their system as it exists today. This figure lends confidence to our self-reported start-up costs, which can often be

[21] All cost and price figure throughout the report are in 2005 US$ values using officially published current population index (CPI) and exchanges rates from the International Monetary Fund's (IMF) on-line database. The exchange rate used in this report is 24,076 Mozambican Meticais (MT) for 1 US $.

[22] There are two potential reasons for this. First, providers often did not remember costs for smaller system components such as a standpipe or metal faucet and reported spending nothing on those parts instead of saying 'I do not know'. Second, one system component – the elevated water tank structure – was omitted from the components' list and is a cost that virtually all providers must bear. The elevated structure's cost may account for the entire difference between the tallied cost figure and the whole figure.

unreliable because of recall difficulties[23]. The typical provider said he or she would need $11,000 to set-up his/her system as it exists today.

*Table 4.5: About how much money did you spend to start your water supply business initially? (in 2005 US$ values)**

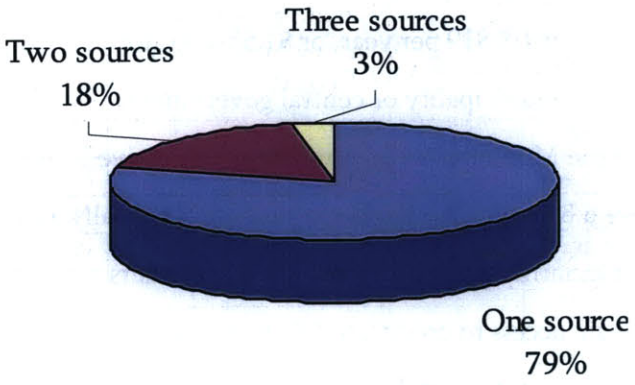
	Self-reported figure for total system costs N=29	*Calculated sum from self-reported component costs N=35*	*Money needed to set up system as it exists today N=33*
Median	$12,187	$10,000	$11,007
Mean	$14,539	$13,804	$13,574
Std. Deviation	$9,205	$8,407	$7,811
Minimum	$4,853	$5,105	$5,400
Maximum	$45,129	$43,625	$41,535

*Prices were adjusted using the IMF monthly consumer price index

Providers financed their systems primarily from private capital. Ninety-two percent reported using their own savings to finance their systems; 80 percent of those using their own savings used it as their *only* financing source. Given the high cost of starting a system – well out of the reach of an average Mozambican urban household – providers often invest their life savings or savings from sales of other assets such as livestock or vehicles to finance system construction. Another 14 percent of providers reported using family savings as a source of funds for their initial investment; one half of those using family savings reported it as their *only* financing source. Other sources included one instance of partner's savings, a bank loan, a community donation[24], and loans from a former employer. Most providers used only one source of financing.

[24] A mosque financed a small network system on behalf of an Islamic community. The 15 original members receive water for free.

Chart 4.3: Number of financing sources (N=38)
(Percentage of ISNOs reporting)



4.4.1 Recurrent Monthly Costs

The typical provider spends $174 per month on operating costs, or 1.2 times the average Mozambican urban household expenditure, to keep his piped water network running. Some providers spend as little as $59 a month while other providers' costs can escalate to over $1000 a month. The typical provider's monthly cost per cubic meter sold is $0.28.

Electricity comprises by far the largest share of a provider's monthly outlay; a typical provider spends 47 percent per cubic meter on electricity. This is followed by salaries for full- and part-time labor at 24 percent per cubic meter a month. Purchases of spare parts and tools also affect providers' monthly expenses, with motorized pump repair and replacement being the primary expenditure for that cost category. The three categories combined account for 75 percent of a provider's monthly costs. Other costs were negligible.

Table 4.6: Leading cost components for ISNO operations (N=35)

		Median % of total	*Median*	*Mean*	*Std. Dev*	*Min*	*Max*
Largest cost	Electricity	47	$0.10	$0.15	$0.12	$0.01	$0.53
2nd largest cost	Full & Part time labor	24	$0.05	$0.08	$0.08	$0.00	$0.35
3rd largest cost	Spare parts, tools (largely motorized pump replacement)	3	$0.00	$0.04	$0.11	$0.00	$0.63
Total Costs	-	100	$0.28	$0.35	$0.36	$0.06	$1.98

4.4.2 LICENSES

Currently 15 providers in our sample have a license, and 9 of them paid to have it. The typical license costs a provider US $19 per year, or $1.55 a month. This license is recognized by the bairro or district but not the municipality or central government. The district is able to furnish this informal license because the Municipality does not heavily involve itself in district or bairro affairs (a district is one level above a bairro). The license is paid once annually and the fee is negligible, on average, 2 percent of net monthly profit. In some cases, providers actively pursued the license and cited reasons from, "To gain access to credit", to "To have the right of official appeal". Those not registering cited on major reason for not doing so – never head that registration (i.e. a license) was required or existed. Some were ready or tried to obtain a license but cited lack of procedures for not doing so.

4.5 SPSP PRICING PRACTICES

Questions about price levels and structures, including discounts and the availability of financing by providers, were asked of respondents in both the provider and household survey. All providers in the survey claimed that their prices stayed the same rather than increased or decreased during the past year[25]. Also, only 3 percent of providers (1 respondent) claimed to have received assistance in deciding how much to charge customers for water; this assistance was from an SPSP association in the provider's area and not an official government institution. The analysis below examines the extent to which the providers are meeting cost recovery goals, based on the revenue and expenditure data they supplied.

4.5.1 PRICE STRUCTURE: UP-FRONT FEES

Maputo's ISNOs have a fairly complex way of charging customers for a private connection and one that varies significantly from provider to provider. All providers charge what is called a contract fee. There are four major costs associated with this private connection contract: 1) an administrative fee for connecting to the provider's water source; 2) a materials cost that mainly consists of rubber tubing and the yard tap steel faucet; 3) labor costs for installing the connection; and

[25] Inflation was 12 percent in 2005.

where applicable, 4) the cost of a meter to track water usage. The contract fee can encompass any combination of the administrative fee, materials, labor, and meter[26].

The typical provider charges $42 in administrative costs, and irrespective of payer (provider or customer), typical materials cost $32, the typical labor charge is $8, and the typical meter, where applicable, costs $17[27]. The average net cost of connection to the client is $77. This is equivalent to 55 percent of the average Mozambican monthly urban household income, or a little over one and a half monthly minimum wages for a peri-urban household. Forty-five percent of providers allow clients to pay using financing, usually without a finance charge.

By comparison, households connected to the main water utility, AdM, pay a total of $44 for a ½ inch pipe and $52 for a ¾ inch pipe private connection, or roughly 37% less than the cost of the typical ISNO connection. The AdM fee includes the deposit, visit charge, administrative fee, and average labor cost (labor is the client's responsibility).

Table 4.7: Private connection costs, irrespective of payer (US $)

	N	*Median*	*Mean*	*Std Dev*	*Minimum*	*Maximum*
Administrative	33	42	34	26	0	113
Materials	32	32	39	24	8	93
Labor	33	8	10	6	0	33
Meter	29	17	18	5	12	39

Table 4.8: Private connection costs to client (US $)

		SPSPs					*AdM*	
	N	*Median*	*Mean*	*Std Dev*	*Minimum*	*Maximum*	*½" pipe*	*¾" pipe*
Cost to client (gross)	27	89	94	38	22	158	-	-
Cost to provider	*33*	0	13	25	0	85	-	-
Cost to client (net)	*27*	77	82	34	22	149	44	52

[26] Often responsibility for the non-administrative costs is relegated to the client and is not reflected in the total contract fee. For this reason, we asked what the overall contract fee was and then added or subtracted materials, labor, and meter costs as reflected in the provider's policy.

[27] They typical *provider* bears responsibility for none of these costs.

4.5.2 PRICE STRUCTURE: USAGE FEES

The usage fee an ISNO charges his or her customers is largely dependent on whether the provider uses meters or not. In some cases, providers even allow the customer to decide if they want a meter. Ninety-three percent of providers using a volumetric fee charged customers the same amount per cubic meter irrespective of volume consumed. Conversely, 7 percent charged a decreasing block tariff where greater volumes consumed resulted in *lower* fees per cubic meter. The typical provider charges $0.83 per cubic meter. A few providers charging high volumetric fees drive the average up. The average price per cubic meter up to 10 m3 is $0.90, from 11 m3 to 15 m3 it is also $0.90, from 16 m3 to 25 m3 there is a slight drop to $0.89, and every cubic meter consumed after 25 m3 also gets charged an average of $0.89.

The decreasing block tariff employed by a minority of ISNOs is in contrast to most African water utilities that charge higher unit prices as the quantity consumed increases in order to finance cross-subsidization schemes and / or discourage wasteful usage (Collignon, 2000). Maputo's utility is no exception to the increasing block tariff. It charges a minimum monthly fee of $2.94 for ten cubic meters, which can theoretically be viewed as $0.29 per cubic meter up to the first 10 cubic meters, and the next cubic meter up to 20 cubic meters is more than double that rate at $0.72. Each cubic meter from 20 to 30 is $0.76 and each cubic meter greater than 30 costs $0.77. In addition, AdM charges a monthly meter rental fee between $0.50 and $0.72. Therefore, the minimum monthly household charge for 10 cubic meters is between $3.44 and $3.66.

Table 4.9: SPSP volumetric charge for residential clients in US $ (N=28)

	Median	*Mean*	*Std Dev*	*Minimum*	*Maximum*
Price / m3 up to 10 m3	0.83	0.90	0.17	0.42	1.25
Price / m3 for 11 m3 to 15 m3	0.83	0.90	0.16	0.42	1.25
Price / m3 for 16 m3 to 25 m3	0.83	0.89	0.16	0.42	1.25
Price / m3 for 26 m3 or more	0.83	0.89	0.17	0.42	1.25

The National Water Policy states that a household should not pay more than 4 percent of two monthly minimum wages, or $3.72, for monthly consumption. On average, a Maputo family uses less than 10 cubic meters of water per month. This may be because AdM has a minimum monthly charge equal to 10 cubic meters of consumption and the cost per cubic meter more than doubles after 10

cubic meters have been consumed. Thus, an AdM customer usually pays $3.44 to $3.66 in monthly user charges, or 2 percent of 1 Mozambican monthly minimum wage. The typical ISNO customer would end up paying $8.30 for 10 cubic meters of water per month, or 9 percent of 2 Mozambican monthly wages. Thus, it is 2.4 times more expensive to buy water from an ISNO. One caveat is that whereas AdM customers *must* pay for 10 cubic meters regardless of how much water they use in a month, ISNO customers can pay per cubic meter. An ISNO household can get about 4.3 cubic meters a month, or about 25 lpcd, for the same price as 10 cubic meters from AdM. Thus, if and only if a household wanted to use less than 25 lpcd would an ISNO be more affordable (at 4.3 cubic meters per month, the average consumption would be 24 lpcd). However, this amount is less than ideal since the WHO recommends a minimum of 20 to 50 lpcd for human needs.

Household surveys show that although customers of standpipes and neighbors' connections use 25 lpcd on average, customers with private connections demand more. One survey showed ISNO yard tap customers using 9.5 cubic meters per month (50 lpcd), which is not very different from the AdM house connection average of 9.7 cubic meters (Hydroconseil, 2005). Another household survey showed ISNO customers using considerably *more* than AdM house or yard connection customers, 15.8 versus 11.8 cubic meters (83 lpcd vs. 62 lpcd), but the sample size for the ISNOs is very small and may thus be unreliable (DNA, 2004).

Fifty-three percent of providers use a fixed monthly fee for non-metered customers; 26 percent of providers use *only* a fixed flat fee. For non-metered customers the typical fixed monthly fee is $10.38. This fee is charged irrespective of quantity of water consumed. Many providers indicated that they charged this fee as a pro-poor measure. They hypothesize that poor households include a large number of individuals and it is to their benefit to have an unlimited supply for a fixed price. This is likely a misconception since official statistics show that Maputo households, irrespective of neighborhood or income class, do not usually consume more than 10 cubic meters per month (DNA, 2004).

Table 4.10: Cost Comparison

	Price for 10 m3 a month (55 lpcd)	Average monthly meter rental fee	Total monthly costs for 10 m3	10 m3 as % of two monthly minimum wages	10 m3 as % of average monthly urban HH income *(PAHO:<= 5*)*	Total monthly cost for 20 m3	Cubic meters possible with an AdM minimum monthly charge
AdM	2.94	0.61	3.55	4	2	10.75	10
ISNO w/ meter	8.3	0	8.3	9	6	16.60	4.3
ISNO fixed fee	10.38	0	10.38	11	7.5	10.38	0

*The Pan American Health Organization (PAHO) recommends that households should spend no more than 5 percent of their monthly income on water consumption (Gomez-Lobo, 2001).

Many small networks also have accompanying standpipes at the water source's site or within a short walking distance of it. Standpipes are particularly useful to low-income households who rely on smaller quantities of water and manage household finances on a daily basis. In addition, very few lines were observed at providers' standpipes, essentially minimizing the poor households' opportunity costs of water collection. Approximately two out of three providers had at least one standpipe as part of their system. Charges at standpipes are per container: one 20 liter jerrican costs $0.02; in comparison, 20 liters from a metered private connection costs one and a half cents. Seventeen percent of providers with standpipes give a bulk discount to standpipe customers essentially providing a "buy two, get one free" scheme by charging $0.04 instead of $0.06 for three jerricans[28]. Although all providers charge by the jerrican, 15 percent of providers owning standpipes also provide a flat fixed monthly standpipe fee. One provider sells unlimited jerricans for $0.83 per month, two others for $2.08 per month, and a fourth for $2.28 per month.

On a purely volumetric basis, ignoring up-front connection costs, standpipes are more costly than private metered connections. One cubic meter at a standpipe from providers who do not offer the bulk discount would cost $1.04. Conversely, the typical provider charges $0.83 per cubic meter from a private connection. Even with the bulk jerrican discount that some providers offer at standpipes, a cubic meter would cost $0.67. This is 20% lower than the typical $0.83 per cubic meter from a private connection. One must also weigh the opportunity cost of fetching and inconvenience associated with standpipe versus in-home water. Although poor households might benefit from or

[28] It should be noted that the $0.02 per jerrican price could be set out of convenience – the smallest denominated Mozambican currency available is equal to $0.02; charging less would be equivalent to asking someone to pay for something with something smaller than a penny

prefer to buy small quantities of water on demand at standpipe prices, they also lose time and risk injury by having to fetch water from the source.

4.5.3 DISCOUNTS

Maputo's providers give a variety of discounts to low-income customers (broadly defined). Unlike the bulk discount at standpipes that some providers grant, which apply to anyone, 37 percent of providers cited giving discounts to both standpipe *and* private connection customers who they considered to be vulnerable. When asked about the basis upon which such discounts are granted, respondents cited a variety of metrics, most of which appear to be applied on an *ad hoc* basis. Two particular categories, however, were repeatedly cited. Seventy-nine percent of providers who grant discounts do so to the vulnerable elderly, such as elders living alone, while 29 percent grant discounts on the basis of a visibly poor home. Three providers in the sample cited granting discounts to small households, defined as less than five persons; another demographic category receiving discounts was widows. These categories are not mutually exclusive: sixteen percent of providers granting discounts did so to more than one low-income group. Only one provider interviewed mentioned granting discounts to long term customers (the actual discount amount was not provided).

Table 4.11: Discount categories and amounts (N=14)

Target audience	*Discount type*	*Number (percentage) of providers offering*	*Percentage off of normal price*
Elderly living alone	Free unlimited jerricans	4 (29)	100
Elderly living alone	No administrative fee for private connection	1 (7)	100
Visibly poor households and small households	$8.31 a month / Free unlimited jerricans	1 (7)	33 / 100
Low income widows and small households	$2.49 a month / Free unlimited jerricans	1 (7)	60 / 100
Households smaller than 5 persons	$6.23 a month	1 (7)	25
Visibly poor households and elderly living alone	$8.31 a month	1 (7)	33
Visibly poor households	$0.42 per cubic meter / one free jerrican per week	1 (7)	50 / 100
Elderly living alone and others based on discretionary measures	$4.15 a month	1 (7)	33
Elderly living alone	One free jerrican per day	1 (7)	100
Widows	Free unlimited jerricans	1 (7)	100

4.6 STANDPIPE SALES

Although peri-urban Maputo is considerably poorer than the cement city, variation among household incomes still exists allowing wealthier peri-urban residents to connect their home to a provider's borehole while poorer residents rely on a provider's standpipe or a neighbor. Currently, 68 percent of our sample had at least one standpipe connected to their water source. Of those furnishing a standpipe, 152 cubic meters of water per month is the typical sales volume during both the summer season and rest of the year. This volume accounts for approximately 15 percent of all water sold per month. According to a FIPAG study of 640 peri-urban households, 22 percent of peri-urban residents use AdM standpipes versus 19 percent that use SPSP standpipes. This is not surprising given that a jerrican can cost half as much at an AdM standpipe (Hydroconseil, 2005). Still, unpredictable operating hours, quality, and pressure at AdM standpipes, as well as their relative scarcity, drive many to buy their water from small private providers.

Providers receive a disproportionate amount of their revenue from standpipe sales – the typical provider with a standpipe sells 15 percent of monthly water from standpipes but earns 24 percent of his monthly revenues from standpipes sales. Because 32 percent of providers do not have a standpipe, figures among all providers were correspondingly lower with 12 percent of monthly water sales coming from standpipes and also a disproportionately higher 15 percent of monthly revenues coming from standpipes[29].

Table 4.12: Sales and Revenues from Standpipe operations

		Percentage of all water sold from standpipes in summer / dry season (volume)	*Percentage of revenues from standpipes in summer / dry season*	*Percentage sold from standpipes during rest of the year*	*Percentage of revenues from standpipes during rest of the year*
Among Providers with Standpipes	*N*	22	26	23	26
	Median	17	24	14	24
	Mean	24	31	22	32
	Std. Dev	20	25	20	27
	Min	0	1	0	1
	Max	9	98	90	98

[29] These are calculated figures from self-reported volumes and revenues. The provider calculated estimate had a median of 17.5 percent, lending further confidence to our self-reported figures.

4.7 FINANCIAL PERFORMANCE

One concern researchers share when analyzing business data is the accuracy of self reported revenue figures. SPSPs that operate in the informal sector, often illegally in direct competition with a utility with exclusive selling rights, especially have an incentive to deemphasize revenues. Several strategies were used during the interview process to cross check and verify the revenue and expenditure data supplied by respondents.

We asked each provider how much he or she sold during the dry / summer season and the rest of the year separately for household connections and standpipes. The result is four revenue categories: 1) amount sold from private connections in the summer; 2) amount sold from standpipes in the summer; 3) amount sold from private connections during the rest of the year; and 4) amount sold from standpipes during the rest of the year. The following table shows the Pearson correlation coefficients between the self-reported figures and the calculated revenue figure for the four revenue categories.

Table 4.13: Correlation coefficients of calculated revenues with self-reported revenues (Percentage of ISNOs reporting)

	Summer / Dry season		Rest of the Year	
	Private Connections (N=33)	*Standpipes (N=21)*	*Private connections (N=35)*	*Standpipes (N=23)*
Correlation with self reported revenues	86	83	85	93

The high correlation between calculated revenues and self-reported revenues lends more confidence and support to our self-reported values, which are the figures used in the following financial analyses unless stated otherwise.

The working ratio (WR) is defined as operating costs divided by operating revenues. If WR is less than one then revenues cover the operating costs, and some margin is left over to cover the cost of investment. If WR is greater than one, the financial viability of the ISNO is at stake. The typical ISNO's WR is .41, indicating that revenues are at least twice as much as recurrent costs. Therefore, providers are able to cover their costs well and preserve a margin to cover initial investment costs. Note that system repair and maintenance costs are included in monthly cost figures and therefore incorporated into the WR.

Gross profits – profits that do not include investment payback or asset depreciation – for a typical provider equal $182 per month, or 1.3 times the Mozambican urban household income. Net profits – profits that account for initial capital investment recovery – for a typical provider equal $83 per month, or 60 percent of the Mozambican average urban household income. This estimate is corroborated by providers' household income information. Just over half of our sample, 51 percent, said their water business accounts for between 50 – 75 percent of their household income.

Table 4.14: Working ratio, gross profit, and net profit for Maputo's ISNOs[30]

	N	*Median*	*Mean*	*Std Dev*	*Minimum*	*Maximum*
Monthly Working Ratio	37	0.41	0.44	0.24	0.05	1.24
Monthly Gross profit	37	$266	$516	$671	$(94)	$3420
*Monthly Net profits**	31	$83	$301	$474	$(355)	$2034

*Capital recovery factor assumptions: 1) To maximize our sample size, any of the three measures of capital costs were used – self reported initial costs, calculated initial costs, and self-reported system value today; 2) providers use all private connection administrative fees towards capital recovery; 3) A provider takes 8 years to pay back initial capital after connection fees are accounted for (12.5 percent a year); and 4) depreciation and interest rates are ignored. The sample size is smaller because not all providers furnished infrastructure capital or private connection fee figures and one system whose capital was paid for by a religious institution was excluded from the analysis.

Although Maputo ISNOs have robust WRs and profits, they might experience operating costs not captured in the survey. Almost one out of every two providers (47 percent) used some type of non-revenue funds in the past year to help cover operating costs or maintain their systems. Of those using non-revenue funds, 39 percent used revenues from another business or job and 61 percent used loans from various lending agencies. It would also be safe to say that there were additional providers who would have liked to arrange financing for similar needs but were denied. Thus, in a more accessible financial market, there might have been a greater percentage of providers borrowing funds.

[30] One of our ISNOs is a Mosque that provides water for free to 30 percent of its client base. It also has the highest monthly service costs of any provider (the service category could not be verified post-interview). Although the Mosque claims its operating costs are fully recovered though commercial operations only, in other words, they receive no outside assistance in maintaining daily business operations, it accounts for the sample's highest WR and gross profit losses. Given these figures, the Mosque would not be able to sustain operations. However, they have been in business since 1995. There are several possible explanations: 1) the water system manager is unaware of external funding that actually does aid monthly operations; 2) the high service costs are a very recent phenomenon; 3) the Mosque does cove operating costs through revenues but is less worried about monthly losses because they are part of a larger institution that can save them in the event of bankruptcy. For this reason the Mosque has been excluded from the financial analysis, including the mosque would result in a higher average WR and lower average profits.

A diverse set of financing sources was used but private banks were used most frequently. The typical amount of non-revenue funds used in the last year was $1,142. Since the typical monthly operating cost is $174, these loans were likely used for infrastructure improvements or replacements in addition to covering some operating costs.

4.8 Operational Performance

Most providers have few problems collecting revenues from their customers. Those selling from standpipes either collect payments themselves or hire someone to monitor standpipe sales and collect payments. Thus, the 58 percent of providers reporting late-paying customers are referring to customers with private connections. There is room for collection improvement given that a quarter of providers report that 50 percent or more of their customers pay late. Twenty-three percent of providers penalize late paying customers with either a percentage or flat fee surcharge. Two providers levy a percentage surcharge onto the customer's outstanding bill; one provider charges 10 percent a week and the other charges 20 percent a month. The other five providers in the sample reporting the use of late penalties use a flat fee penalty; the average flat fee is $1.58 a month.

Table 4.15: Percentage of customers paying late (N=38)

	Percentage of providers claiming
More than 75 percent of customers	5
Close to 50 percent of customers	21
Close to 25 percent of customers	32
Very few or no customers	42
Don't know / Not sure	0

Self-reported accounts of non-revenue water due to leakage, theft, or defaulted payments is in the range of 0 to 25 percent, with a typical provider reporting 5 percent non-revenue water and an average non-revenue water rate of 7 percent among our sample. There are several potential drivers for this low rate. First, three-fourths of providers use meters and almost 50 percent meter every single one of their connections. Providers that do not use meters (one out of four) know their customer base very well and are extremely adept at preventing household resale of their water; in a recent peri-urban household survey it was found that all the households that sold water to their neighbors did so from an AdM connection (Hydroconseil, 2005). Second, most ISNOs employ a

standpipe attendant that ensures that water does not unnecessarily leak from standpipes; leakage in the principal network is negligible. Third, providers operate in small geographic areas and can quickly eliminate clandestine connections. Fourth, providers systems are located at their home and therefore theft from the water source is unlikely. Fifth, customers are responsible for their meters and any tampering that results in breakage would require the customer to purchase a new meter or face disconnection. Finally, four out of five providers say they cut late-paying customers' connections, waiting an average of 2 months before disconnecting. The majority are true to their policy with 17 out of 22 providers cutting at least one connection due to late-payment in the past year; the average number of disconnected customers in the past year was 6.

Table 4.16: Approximately what percentage of water is lost due to leakage, theft, or illegal connections that you are unable to charge for?

	N	*Median*	*Mean*	*Std Dev*	*Minimum*	*Maximum*
Percent of non-revenue water reported	27	5	7	7	0	25

All providers in our sample operate seven days a week. Because standpipes are usually located at or adjacent to providers homes and require an attendant they supply water only during daylight hours, regardless of season. On the other hand, the median private connection is supplied 24 hours a day and the average is 19 hours a day; supply hours rarely vary throughout the year. This is the same supply time as Manila's ISNOs (Davis, 2006). Providers that interrupt service often do so late at night and into the early morning hours before sunrise. Some interrupt service for a couple of hours in the early afternoon. Qualitative research indicates that providers interrupt service to replenish water in their tanks, which could be a result of a poorly performing pumps, weak electricity, or high demand; insufficient well water is not a likely reason.

One measure of service quality includes volume of water supplied per connection per day. The typical provider supplies 500 liters per connection per day to his or her privately connected customers. With an average Maputo household size of 6.3, this is 80 lpcd. The typical provider also provides about 250 jerricans (5000 liters) per day from his or her standpipe operation.

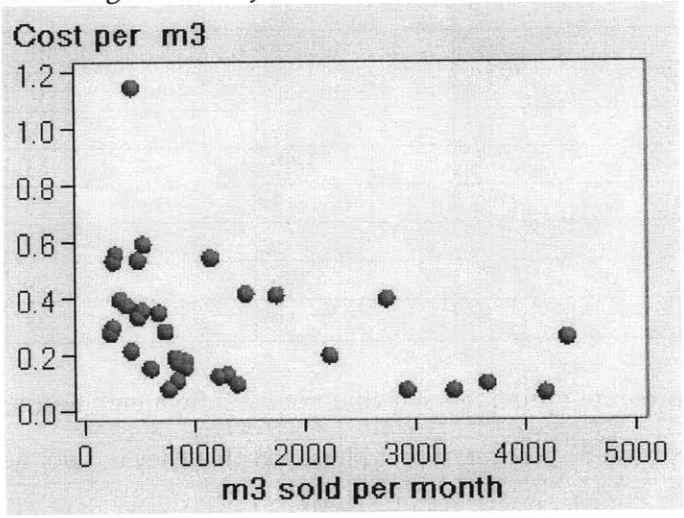
Table 4.17: Daily volume sold from small network systems

	N	*Median*	*Mean*	*Std. Dev*	*Minimum*	*Maximum*
Volume sold to a private connection per day (in liters)	35	500	651	506	95	1,915
Volume sold at standpipes per day (in jerricans)	25	249	326	346	13	1,674

4.9 Economies of Scale

Economies of scale in water supply result when increased sales volumes lead to decreased unit costs. It is important because if increasing volume sold reduces cost there might be an argument for increasing SPSP size or market share to help make water more affordable. There is a statistically significant negative relationship between cubic meters of water sold and cost per cubic meter among Maputo's ISNOs:

Figure 4.1: Scatter plot of natural log of cost per cubic meter in a month (Y-axis) by natural log of monthly sales volume in cubic meters (X-axis)



More specifically, the elasticity of the cost curve demonstrates that for every 2 percent increase in cubic meters sold per month there is a 1 percent decrease in the cost per cubic meter in that month[31].

[31] This is a constant elasticity measurement, which means that if a provider increased his or her sales volume from 1000 to 1200 cubic meters in March, the cost per cubic meter in March would drop by 10 percent; the same holds true if a provider increased his or her sales volume from 2000 to 2400 cubic meters.

4.10 CONSTRAINTS TO SPSP OPERATIONS

When questioned about the constraints that most impede their businesses' operation and growth, providers in the study cited cost of electricity / fuel, weak or unreliable electricity, and lack of access / high cost of financing as a "major constraint" most often. The cost of electricity as a constraint is not surprising given that, on average, electricity accounts for about 50 percent of a provider's monthly costs. Weak electricity frequently disrupts the motorized pump's functioning and is the most prominent reason for unintended business closures that average 4 days per year. Water cannot be pumped into the tanks and there is either a water shortage or weak water pressure to private connections and standpipes. In extreme cases, poorly functioning electricity actually damages the pump and it then needs to be repaired or replaced.

Table 4.18: How much of a constraint is the following issue for the operation and growth of your business? (Percentage of respondents, N=38).

	Major Constraint	*Minor Constraint*	*Not a Constraint*	*Don't know / Not Sure*
Demand	8	34	58	0
Cost of electricity	68	16	16	0
Weak electricity	55	26	18	0
Water quantity	0	8	92	0
Tax amount	8	32	61	0
Bureaucracy	3	8	76	13
Financing	50	16	24	11
Inflation	21	53	24	3
Crime / Theft	16	39	45	0

Among the 71 percent of providers who did not use a financing source in the past year, the most common response, from 37 percent of providers, was that they did not need a loan to maintain their business. Fifteen percent had their loan rejected and another 15 percent said that interest rates were very / too high; Very few or none blamed a lack of lenders, difficulty in repaying a loan, a complicated approval process, or fear of being rejected.

Despite high inflation, not a single provider in the survey raised his or her prices in the last year. However, 10 percent cited that the reason they did not raise prices in the past year was because the price of electricity did not go up, suggesting a direct correlation between electricity prices and water prices in SPSP operations. The main reason providers gave for not raising prices was that their

customer base was low-income / could not afford higher prices. This statement likely represents a combination of providers, some not raising prices because they want to keep prices affordable for their customers, and others just responding to market realities.

Although the typical non-revenue water rate was only 5 percent, we see those reporting crime / threat as a "major constraint" also reporting the highest percentages of water loss, up to 22 percent. Those reporting crime / theft as a "minor constraint" report commensurately lower percentages of water loss. Finally, all providers who said they had zero non-revenue water also said that crime / theft was not a constraint, the opposite however, does not hold.

Bureaucracy, here meant to convey government or informal authorities' involvement in ISNO operations, does not seem to be a constraint at all. The most frequent government involvement in SPSP affairs is water quality monitoring. Over half of all providers, 63 percent, had their water tested and checked by the Ministry of Health of the Government of Mozambique. Most have their water tested twice per year and 16 percent of providers being monitored received warnings related to their water quality. Providers usually respond immediately to these warnings to rectify the situation, which often involves treating their water with chemicals or cleaning their water tanks. Among the providers that were not being monitored, four self-tested their water, often sending samples to a lab or testing it on site. The average cost per test is $16.77 and if providers want to test their water twice per year it would cost them $33.50 – a somewhat hefty cost for providers to bear on their own.

Despite the "major" constraints, such as high electricity costs, weak electricity, lack of / high cost of financing, mentioned by providers, 67 percent of them plan to expand in the next year. They were also very optimistic about their prospects for survival in the near- to long-term. More than 70 percent of providers saw themselves operating up to 10 years from now, with 72 percent believing they will be operating 5 years from now, and 84 percent believing they will be operating at the end of 2006. Close to one-third of providers believed or were not sure that they would be operating 1 or 5 years from now. Interestingly, 100 percent of those providers felt they would be taken over / displaced by the lessee, AdM. In fact, even among those who did not feel that they would be taken over / displaced by AdM in the next 5 years, 50 percent felt that it was possible or highly likely that AdM would be providing water in their area within the next two years.

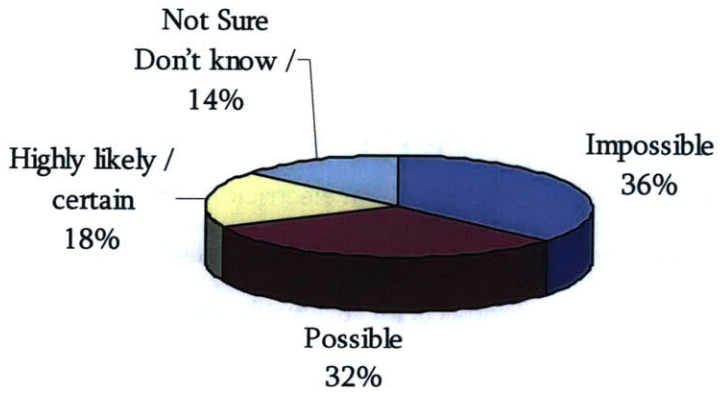
Table 4.19: How are you thinking of expanding (Percentage of ISNOs responding, N= 38)?

	Yes	*No*
Plans to Expand	66	34
How do you plan to expand? (More than one response permitted, N=25)		
Increase quantity of water supplied	16	-
Add meters to existing connections	4	-
Construct new small network system	60	-
Expand household connections	40	-

Table 4:20: Perceptions on business survival in the short-, medium- and long-term (Percentage of ISNOs responding)

	1 year from now (N=38)	*5 years from now (N=36)*	*10 years from now (N=31)*
Believe that business will be operating...	84	72	71

Chart 4.4: How likely do you think it is that, during the next two years, Aguas de Moçambique will begin to provide water in your service area? (Percentage of SPSPs responding, N=28)



The 34 percent of providers who were not thinking of expanding gave a variety of reasons for not wanting to. More providers said they were incapable of expanding (7 providers) than not having a desire or interest in expanding (3 providers); the rest said they were not sure why they were not thinking of expanding (3 providers). The three providers who said they had no desire gave the following reasons: 1) "I cannot control when clients pay, my priority is to get more payments from my current clients"; 2) I am satisfied with my current level of business"; and 3) "Too many providers exist in the area and my expansion is not necessary".

An ISNO's desire to expand or actual business expansion can potentially be influenced by the lessee's decision to expand its operation(s). To see how AdM's expansion might affect Maputo's ISNOs' investment decisions we looked at expansion plans, planned spending on fixed assets, and the desire for financing in the upcoming year by whether a provider felt they would not be operating in the next 1 to 5 years because of AdM expansion. We found that although the percentage of providers wanting to expand and the level of planned fixed asset spending were both lower for those providers that signaled potential AdM takeover / entry, these same providers were more likely to want loans in the upcoming year.

Although planned spending is lower for providers who signaled concerns over AdM, it is not low in absolute terms. This pattern could be signaling an investment phenomenon among Maputo's ISNOs. Providers who are seriously concerned about AdM's arrival are preparing to expand and spend a significant amount of money in the upcoming year, but not on their existing system. Many are planning to invest in an entirely new system in an entirely new area further from the city center and AdM's network. Thus, although a portion of providers may be pulling back their expansion and investment plans for fear of displacement in the near future, another portion is planning to spend more than it would to simply expand its existing system in order to create a whole new business opportunity.

Table 4.21: Planned expansion and spending in the upcoming year

	N	*Percentage Planning to Expand*	*Planned spending on fixed assets in 2006 (Mean / Median)*	*Wants loan in 2006*	*Amount desired (Mean / Median*
ISNOs who feel they will still be in business 10 years later	26	69	$4,409 / $1,578	65	$10,630 / $9,345
ISNOs who feel their current systems will be displaced / taken over by AdM in the next 5 years	11	55	$2,670 / $1,038	73	$7,944 / $9,345

NB: None of the differences were found to be significant at the 95% confidence level

Irrespective of threat of displacement, providers felt that their operations were far better than AdM with respect to quantity of water available per customer, water quality, water pressure, hours of water supply, and customer service. The only metric they felt AdM is competitive on is price, with

an almost equal number of providers feeling that SPSP prices were "more favorable" and "less favorable".

Table 4.22: How would you compare your business to that of AdM's on the following aspects? (Percentage of providers responding, N=29)

	More favorable	*Equal*	*Less Favorable*	*Don't Know*
Quantity of water available per customer	79	3	14	3
Water quality	62	14	7	17
Water pressure	45	24	28	3
Hours of water supply service	72	14	14	0
Quality of customer service	76	14	10	0
Price	31	14	28	28

4.11 Competition and Collaboration

We asked providers to rate what they felt the competition level was in their service area. Seventy percent claimed that competition was "high" or "moderate" while 30 percent claimed that they operated in an area of "low" competition or faced no competition at all. This disproportionate split unfortunately does not bode well for robust statistical tests; it does however indicate that some competition exists in the ISNO market. Qualitative research prior to the study indicated that providers competed with each other on the basis of lower prices and tailored services in terms of hours of water provision. This study confirms that research: among providers claiming to have at least a "low" level of competition, a quarter said they compete with lower prices and a half said they compete with better service.

Table 4.23: Self reported responses to competition (Percentage of providers responding, N=31)

	Do not try to compete	*Lower prices*	*Better service*	*Test water's quality*	*Try to be the first to connect HHs in the area*
Responses to competition	13	26	52	3	3

Competition between providers can, on occasion, become intense with conflicts arising over customers and selling areas. Almost 20 percent of providers (5 out of 28 respondents) who have heard of the SPSP association process in Maputo (Appendix A) would like the association to be involved in resolving conflicts over selling areas; the only types of services more in demand are micro-loans and technical assistance. Also, just over 20 percent of all respondents already collaborate

informally with nearby providers to decide on client bases and / or selling areas. In addition, informal collaboration over price limits is the most frequently cited type of collaboration among all providers.

Table 4.24: Do you informally collaborate regularly with other providers in your area to (N=38)...

	Determine price limits	*Provide technical information / assistance*	*Provide loans or micro-finance*	*Purchase goods or services in bulk together*	*Decide on client base or selling area*
Percent of providers responding	55	45	3	13	21

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CHAPTER 5:

DISCUSSION AND RECOMMENDATIONS: STRATEGIC SMALL SCALE PRIVATE-SECTOR PARTICIPATION

5.1 Sector Goals and Small Private-Sector Providers

Portuguese colonial rule has left Maputo's infrastructure greatly disadvantaged. Biased service provision throughout the 20th century resulted in a city that today has spatially segregated water services distinguishable along racial lines. On the one side, you have a small, relatively well networked cement city; on the other, you have an inadequately served peri-urban expanse where Africans make do with an unreliable, expensive, and sometimes hazardous amalgam of water services.

Neither independence nor large scale private sector participation (PSP) was able to undo this colonial legacy. A centralized, socialist government was unable, and sometimes unwilling, to extend Maputo's water network. The 16 year civil war between 1976 and 1992 wrecked the economy and prevented adequate, sustainable domestic or foreign investment in urban infrastructure. Rapidly escalating poverty alarmed both the Mozambican government and international community, who together, adopted a World Bank and International Monetary Fund (IMF) driven structural adjustment program. A strong component of this program was large scale PSP in state run enterprises.

Mozambique's experience with structural adjustment has had mixed results. Although the country's gross domestic product (GDP) has grown at over 7 percent per year over the last 5 years, largely due to aluminum smelting and exporting in the country's south, other sectors such as cashew processing suffered and led to massive urban unemployment (Rodrik, 2002). Private sector participation in the water sector is too nascent to be fully evaluated; the lease contract was signed in 1999 and devastating floods in 2000 pushed back coverage and service improvement plans until late 2001. However, evidence from the last 4 years indicates that the public investment agency, FIPAG, and private operator, Aguas de Moçambique (AdM), are unable to keep up with Maputo's population growth and demand for services. Currently over 60 percent of Maputo does not have direct access (private connections or standpipe access) to the water network.

The existing situation is in direct conflict with Maputo's water sector goals today. As Mozambique heads into the 21st century a commitment to its own development and international standards, as embodied in the Millennium Development Goals (MDG), compel it to provide a benchmark level of water service. Sector goals include universal coverage with a safe, reliable, and adequate level of service that is financially, environmentally, and technically sustainable. The 2006 Draft National Water Resources Management Strategy (NWRMS), as determined by the Ministry of

Housing and Public Works (MOHP), has four main urban sector objectives[32]: 1) Satisfy the MDGs by achieving 70 coverage for water supply and sanitation in urban areas; 2) in the long term, achieve full coverage in urban and peri-urban areas; 3) increase system efficiency through adequate management programs and financial management; and 4) assure long-run system sustainability (DNA, 2006). In addition to the above objectives, the Policy also calls for satisfying the basic water needs of the population, with specific focus on the poor, and the establishment of urban protection zones to prevent aquifer contamination.

In aiming for the sector's goals of universal coverage; safe, reliable, and affordable service; and system sustainability in water supply, Maputo's small private-sector providers (SPSP) must be evaluated for how they contribute towards or impede these goals. Equipped with a better understanding of SPSP costs, prices, and operating environments, we can evaluate the possible planning options. Three broad categories of options are available to policy makers: 1) actively work to reduce or eliminate SPSP operations in favor of AdM expansion, 2) continue to adopt a laissez faire attitude toward SPSPs while focusing policy development and resources on improvement of AdM, and 3) implement business support services and regulation to make SPSP services safer, more reliable, and more efficient. The NWRMS does mention SPSPs. It calls for the implementation of a SPSP licensing, regulation, and support strategy to maximize positive benefits to SPSP consumers and avoid public health risks. The evidence in this report corroborates the NWRMS – SPSPs should be viewed as an integral part of Maputo's water delivery system, not as a 'problem' for, Maputo's W&S planning and policy despite their often negative portrayal in the literature. Their operations can be made more efficient, affordable, and environmentally sustainable with strategic policy and small business interventions.

5.2 Institutional Responsibilities

There are five main functions for successful modern water delivery: policy making, regulation, asset ownership, corporate oversight, and service provision. Although asset ownership, corporate ownership, and service provision can be public, private, or a combination of the two, policymaking and regulation are always the public sector's purview (Pizarro, 2006). In Mozambique,

[32] The NWRMS is currently a draft and could very possibly change in the near future. It should be read more as a direction policy making in Mozambique is headed rather than a definitive end that has been reached.

the MOHP is responsible for overseeing the sector and setting national policy. FIPAG is the state agency responsible for all infrastructure investment. It is the primary institution responsible for coverage expansion. The private operator, currently AdM, is responsible for providing a safe, reliable, and financially sustainable service while maintaining FIPAG's facilities. CRA, an independent public agency, is responsible for ensuring affordability and, together with the Ministry of Health (MOH), the quality of water delivered to customers.

FIPAG's specific responsibilities include: 1) investment and financial management for rehabilitation and expansion of water supply assets; 2) maximizing efficiency and return on existing assets; and 3) contract management, monitoring, and enforcement of the contractual obligations of the private operator (FIPAG, 2004). As regulator, CRA's specific responsibilities include: 1) evaluating and approving the customer tariff charges as proposed by FIPAG; 2) making recommendations regarding the quality of service and investment programs; 3) mediation between FIPAG and the private operator; and 4) conducting reviews of overall customer tariff levels and their components including raw water, the operator's rate, and the meter rental fee[33] (FIPAG, 2004).

All institutional actors are focused on improving coverage, service levels, and affordability for peri-urban residents while protecting water quality and the environment. However, FIPAG and AdM are *primarily* concerned with coverage expansion and cost-recovery while CRA is *primarily* concerned with environmental protection and reaching the poor. This is likely to lead to a disconnect between the institutions around details of how the poor are served and environmental protection is handled.

Both FIPAG and CRA rely on AdM for part of its revenue. AdM pays FIPAG and CRA $35,000 and $US 33,000 per month to lease the system, respectively. FIPAG has more of an incentive to ensure AdM's financial sustainability because it would be responsible for covering operating costs that AdM is unable to meet; if AdM meets the terms of its contract but still suffers a loss, FIPAG ensure that shareholders do not incur a loss. Because CRA has limited income, it too is vested in AdM's success, but less so than FIPAG. Financially, it would be in both institutions' interests for the

[33] CRA's other duties include 5) the establishment of focus groups of water users and municipalities to evaluate the quality of service and network expansion programs; 6) carrying out customer service audits; and 7) periodic and interim reviews.

private operator – small or large – to be profitable[34]. At the same time, it is theoretically better for customers to pay the costs of regulation *via* CRA than risk the local or national government strong-arming the regulatory agency if the government were to bear the regulatory burden.

5.3 FIPAG AND AdM UNABLE TO MEET GOALS ALONE

Currently AdM is serving approximately 504,530 peri-urban residents while Maputo's independent small network operators are serving between 147,000 and 200,000 residents. These figures suggest that AdM is serving a much larger market than the ISNOs. However, the market is highly segmented with respect to the distance from the network. Some peri-urban bairros closer to the city can be described as inner bairros, or "suburbios", and in these areas AdM is the dominant supplier, providing 47 percent of the water with a direct service; ISNOs only provide 20 percent of the water. However, in the outer bairros, AdM is only able to provide 12 percent of the water with groundwater delivered through standpipes because no network exists. Maputo's ISNOs, on the other hand, provide 66 percent of outer bairro residents with groundwater services, often with a private connection. Residents not using either of these services obtain water from neighbors with an AdM connection or from a variety of wells and natural sources.

Table 5.1: Water provision in inner and outer bairros by provider type

	Aguas de Moçambique		Maputo's ISNOs	
Bairro type	Inner	Outer	Inner	Outer
Customers served	504,530		145,000 – 200,000	
Delivery method	Standpipes and HH connections	Standpipes	Standpipes and household connections	Standpipes and household connections
Water source	River water *via* the network	Groundwater	Groundwater	Groundwater
Service level	Standpipes: 4 to 14 hours; HH connections: 14 hours	Standpipes: 4 to 14 hours	Standpipes: 14 hours; HH connections: 24 hours	Standpipes: 14 hours; HH connections: 24 hours

[34] FIPAG and CRA also have other sources of funding, primarily multilateral aid from agencies like the African Development Bank.

If the government were to eliminate ISNOs, they would have to be able to serve at least an additional 147,000 to 200,000 residents with either 14 hour standpipe service or 24 hour private connections in the near future. Although current projects to increase coverage are underway, including a new distribution center in peri-urban Maputo, the likelihood of AdM reaching most current ISNO customers in the next 10 years, especially in the outer bairros, is low. Over the four year period between 2002 and 2005, AdM was able to extend new service to an average of 31,688 persons per year. Given Maputo's urbanization rate of approximately 3 percent per year[35], an additional 47,300 people will live in peri-urban Maputo in 2006. That is a gap of 15,612 persons from 2006 alone and the gap will likely widen over time. FIPAG estimates that the Umbeluzi treatment plant will be able to handle excess capacity by 2010 - the year peri-urban Maputo's new distribution center can begin delivering water. Once the distribution center is in operation, coverage will expand rapidly. Until then however, the coverage gap will grow by 92,680 people; in 2010 almost one million Maputo residents will not have utility network access. Even once the distribution center is in operation, it is not likely that AdM and FIPAG will be able to meet sector objectives alone.

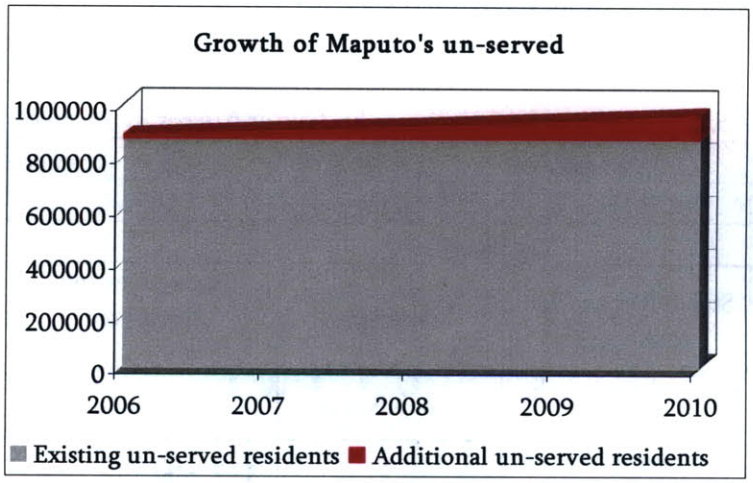

Figure 5.1: Growth of Maputo's un-served residents
Source: *Aguas de Moçambique commercial department data*

[35] Estimates range from between 1.5 and 10 percent. This average of 3 percent is likely to capture the average growth rate of peri-urban Maputo. Population growth numbers are calculated using only the peri-urban population figures, not the entire city.

Aguas de Moçambique faces several challenges in addition to keeping up with population growth. The unaccounted for water (UFW) level is worrying. Unaccounted for water averaged 61 percent between 2002 and 2004, exactly double the African utility average of 30.5 percent (IBNET, 2006). The company's puts most of the blame on illegal connections –50 percent of this UFW is lost during the distribution phase. Another 40 percent is lost through transmission; most of the network is more than 30 years old (Hydroconseil, 2005). Collections are also a problem, and something the company's geographic information system is trying to address. Seventy percent of residential billed water is collected and only 44 percent of standpipe billed water is collected. This could be because clients see the billing system as disassociated from reality – only 14 percent of consumers had the impression that they were being billed for real consumption (DNA, 2004).

Overstaffing, which is a common source of operational inefficiency in developing country water and sanitation utilities, is *not* a problem in Maputo. With a staff of 625, AdM had a staff-connection ratio of 7 to 1000 in 2004, which is well below the African average of 20 staff per 1000 connections (IBNET, 2006). Despite this good ratio, management of per-urban AdM standpipes has been a persistent issue. Different management models, involving the community, private operators of standpipes, and/or local authorities, have been experimented and adapted, but numerous maintenance problems still remain (Thompson, 2005).

The lease contract ensures that AdM never suffers a loss so long as it complies with the terms of its contract. Although there are incentives for good performance – profits above lease payments to FIPAG and the regulator, CRA, are kept by AdM – there is also a subsidy mechanism built into the contract. In quarters or months where the payment to FIPAG or CRA results in a net negative account for AdM, that is, its net working ratio is larger than one, FIPAG will compensate AdM so that it does not suffer a loss. In short, if AdM follows contract rules, often loosely defined, it will never incur a financial loss. If AdM continues to face high UFW rates, illegal connections, collection difficulties, and management problems it could lead to increased public spending.

Aguas de Moçambique and FIPAG's expected coverage gap and significant performance issues, especially with respect to UFW, lead to outright admittance that the two cannot meet sector goals alone. A number of projects are underway to help alleviate some of the sector's ills. However, they will take at least 5 to 10 years to become fully beneficial and policy makers are aware that the challenges are significant enough to warrant concern. FIPAG officials claim that in order to meet the

80 percent coverage goal for Maputo, FIPAG would have to double the existing infrastructure and it is not capable of doing so alone, "SPSPs will have to be used". Recommendations from external consultants also encourage capitalizing on the work SPSPs have already done and the infrastructure they have built (Hydroconseil, 2005).

5.4 What Not to Do: A Laissez-Faire Approach

Mozambique is one of the world's poorest countries. A lack of financial and human resources makes management, monitoring, or regulation a difficult task. Private sector enthusiasts point to market discipline *via* competition as a way to indirectly regulate prices, water quality, and service. Since ISNOs demonstrate entrepreneurialism, an ability to effectively respond to demand, and decent service, adopting a laissez faire policy towards their operations presents an attractive option. However, continued ISNO growth in an unregulated sector would help achieve certain sector goals, particularly reliable service and financial and technical sustainability, but would fall short on service to the poorest residents and ensuring water quality. If a large portion of the peri-urban population continues to go un-served it will pose a substantial health risk for everyone. Illnesses plaguing the city's poor can actually migrate across geographic boundaries, potentially creating a public health calamity for the whole city.

Maputo's peri-urban water situation looks very much like most of Europe's water delivery during the 1700s. The establishment of European water systems was largely based on private initiatives (Juuti, 2005). In England small, private, unauthorized companies began supplying piped water to households. In the city of Leeds wealthy households had piped water supply while the remaining residents continued to rely on wells, boreholes, water carriers, and the River Aire (De la Motte, 2005).

Figure 5.2: Water haulers in Pest-Buda, Hungary in the 1800s.
Source: *Water, Time, and European Cities (Juuti, 2005).*

Although many European governments did get involved in water supply as the 1800s approached, the private sector continued to play a major role; In Italy private sector participation was prevalent until full municipalization began in 1900 (Juuti, 2005). Prior to government control of local water systems, Europe, particularly England, allowed private companies to operate under parliamentary decree and a regulatory regime. This was a response to increasing industrial water needs and a failed *laissez-faire* approach. The private sector was not meeting England's industrial water needs and public health crises were fueled by widespread cholera outbreaks in the 1830s and 1840s. Government intervention was needed (Hassan, 1985). Although municipalization was better than the amalgam of private services, if history is any lesson, overall responsibility and safeguarding of supplies through strategic policy interventions was a necessary interim step for overall sector success.

5.5 ISNOs' Contributions to Sector Goals in an Illegal Environment

Despite ISNO operations' illegality, they have been positively contributing to sector goals such as increased coverage, safe and reliable service, and financial and technical sustainability. However, their operations are not perfect. Namely, the nature of their business and operating environment does not provide incentives for serving the poorest of the poor or for internalizing environmental externalities. Still, there are significant costs associated with dismantling their operations while there are significant benefits from strategic policy and business support

interventions. Dismantling current ISNO operations will leave many peri-urban residents much worse off until the utility network can reach them, which is not for at least another 10- 15 years. On the other hand, helping to increase ISNOs' productive efficiency and reduce their operating costs, which would also provide incentives to meet sector standards, can lead to ISNOs positively contributing to all sector goals. Although there are some challenges to providing ISNOs with support and getting them to meet sector standards, they will come from political and institutional constraints and not necessarily the providers themselves.

Currently, only a handful of providers have a groundwater extraction permit. Although the municipality has control over what is deemed "urban land", it has to obey national laws, including the 1991 Water Law that regulates the management and use of water resources. Technically, groundwater is state property and its extraction requires a permit from the South Region Water Administration (ARA-Sul). The reason only a handful of providers have this permit is two fold. First, a fee is required for the license[36]. Second, and the more dominant reason, is because groundwater resources are poorly controlled and lack specific regulation. This is understandable since the many peri-urban residents without network access must access water somehow and groundwater is the most convenient and reliable source in the area; prohibiting groundwater extraction outright would be equivalent to spurring a crisis or calamity.

An ISNO's more precarious act is selling water in AdM's lease area. According to contract rules, AdM is the only operator legally authorized to sell water in Maputo. Although the lease area does not cover every square kilometer of the city, it covers the majority of the most settled bairros. There is a clause in the contract that allows FIPAG to authorize a third party seller in the lease area[37]. FIPAG, however, has not yet authorized any ISNOs. Illegally operating in AdM's lease area is grounds for ceasing ISNO operations. The other infringement – extracting groundwater – applies to too many peri-urban residents and prohibition is likely to be viewed as illegitimate.

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[36] This is usually a one time payment made at the time of borehole drilling. The one provider in our sample who got the permit paid US $114.

[37] FIPAG can authorize a system or infrastructure to provide water supply to areas not already served by the existing network. FIPAG has to 1) give AdM at least 30 days prior notice before deciding to do so; 2)consult the operator with respect to the possible impact of the proposed authorization on raw water sources' protection from pollution and the network's protection; 3) approve AdM's bulk water charge the third party's network use that AdM may levy if it desires.

Although technically illegal, over the last 10 years Maputo's ISNOs have been able to reach between 147,000 and 200,000 customers through 16,000 private connections and over 230 standpipes. This is equivalent to at least 10 percent of all of Maputo's non-Cement city residents and 23 percent of all Maputo residents served by AdM through private connections or standpipes. The response to demand was rapid. The typical provider tripled his household connections over the lifetime of his business (typically 5.5 years with an absolute increase of 39 connections). In addition, aside from the main utility they are the only other source of household connections in Maputo. According to recent studies, water supply is the number one public service priority (David, 2006; DNA, 2004) and a private connection is the most desired service level (DNA, 2004; Hydroconseil, 2005) among peri-urban households.

The Ministry of Health (MOH) ensures that the majority of ISNOs' water is safe to drink. Currently the agency monitors 63 percent of interviewed providers' water at least twice a year[38]. Ideally 100 percent of providers would be monitored but this gap could simply be due to lag in information sharing between FIPAG and the MOH. Among those ISNOs not being monitored, 11 percent monitor their own water to ensure safety for their customers. Thus, about three out of four providers' distributed water is deemed potable. Informational interviews with households demonstrated a high level of satisfaction with ISNO water among peri-urban residents in bairros Hulene A and Hulene B.

ISNO services with respect to hours of supply, minimization of service interruptions, and quantity supplied are very reliable. Maputo's ISNOs provide water a median of 24 hours a day and an average supply time of 19 hours a day; over 50 percent of providers supply private connections with water 24 hours a day. Standpipes furnish water all day long and only close at sundown. This seems to be normal practice in Africa (Collignon, 2000). About 40 percent of providers interviewed had to close for some period of time during 2005, but the break was only 4 days on average. Providers showed concern for their service levels and they often felt great discomfort if they had to close operations because of a pump failure or if electricity was insufficient and they could not replenish water in their tanks. Service interruptions are not by choice and providers make every effort to restart as soon as possible. The typical ISNO provides 80 liters per capita per day to a household

[38] A report by Hydroconseil also recorded instances of SPSP water being monitored by MOH, but their evidence was not quantified.

connection. Additionally, providers responded most positively to the category "Quality of customer service" (response time to complaints and connection repairs) than any other when asked to rank themselves in comparison to AdM.

ISNOs' overall financial sustainability is one of their strongest assets. They self-finance their systems with their own capital and in some cases the capital of family and friends. Still, when accounting for capital recovery at a rate of 12.5 percent of system value per year (payback period of 8 years), only 5 providers in our sample are at risk of financial collapse. This is because providers recover recurrent costs well – the typical working ratio is .41 – and do so by maintaining low UFW rates. They keep a typical UFW of 5 percent by preventing water theft and resale, using meters, enforcing collection from the majority of customers through potential service disconnections, and using locally appropriate infrastructure, such as malleable rubber pipes, to minimize water leakage. Standpipe attendants ensure customers pay for their jerricans and water is not left running.

Providers strive for technical sustainability of their systems. Among those planning on maintaining or expanding their current system, the average planned spending in 2006 is $1,290. Maintenance usually involves repairing damaged pumps, fixing leaks in pipes or tanks, repairing standpipes, or cleaning the insides of tanks. Expansion of existing systems involves increasing water holding capacity (stronger pumps, larger tanks) and increasing the number of private connections.

5.6 ISNOs' Operational Challenges and Market Disincentives

ISNOs ability to increase coverage and provide safe, reliable service in a financially and technically sustainable manner is somewhat clouded by operational challenges and market disincentives. The typical provider has difficulty always maintaining adequate pressure in his customers' private connections. All providers, responding to market demand and striving to recover operating costs without government assistance, target wealthy households, charge high connection fees, and have water prices that exceed nationally and internationally recommended limits. No provider has the incentive to limit the amount of water abstracted from the public aquifer; an ISNO does not receive a price signal for the scarcity value of abstracted water. Also, no provider has the incentive to limit the number of boreholes drilled; licenses are not required and those furnished are illegitimate at formal administrative levels.

ISNOs exhibit less confidence is water pressure than other service measures. Pressure is directly correlated with a water tank's capacity and height off the ground. Providers face three financial challenges to creating greater pressure: 1) larger tanks are more costly; 2) building higher elevated structures for tanks to sit on is costly because of materials and labor costs; and 3) pumping water to greater heights requires stronger pumps and more electricity, both of which already account for providers' high investment and recurrent costs. Unlike service quality, where 90 percent of providers felt their service was on par with or better than AdM's, only 69 percent of providers felt they were on par with or better with respect to water pressure. Providers openly admitted that their customers' largest complaint was water pressure in *private connections*; standpipe pressure is fine. Improving pressure is dependent on the cost of infrastructure and electricity, type of technology employed, and providers' profits.

Despite strong, rapid growth ISNOs will only serve between 55 and 70 percent of Maputo's peri-urban household market with private connections. According to willingness-to-pay studies, at least 64 percent of the population would be willing to pay $84.00 to obtain a private connection (DNA, 2004; Hydroconseil, 2005). This is above the median connection fee of $77.00 that ISNOs charge. However, only 55 percent of peri-urban residents are willing to pay the ISNO median monthly fee of $8.30 for 10 cubic meters of water (DNA, 2004). These are conservative estimates and with financing packages for connection fees that about 50 percent of ISNOs provide, the percentage of residents wanting to private connections will rise slightly. Still, this study estimates that no more than 70 percent of households will want private connections from ISNOs at current median prices.

Two-thirds of those who cannot afford to connect to an ISNO network can purchase one cubic meter for $1.04 at ISNO standpipes. Using current standpipe users' average consumption levels of 26.5 lpcd, the average peri-urban standpipe dependent household spends $5.08 a month, or 5.5 percent of two minimum Mozambican monthly wages; the legal limit is 4 percent[39]. The remaining third who cannot afford ISNO standpipes will have to rely on AdM standpipes, private and public shallow wells, or neighbors' private connections. These sources are less safe and less reliable than ISNO standpipes. ISNOs may decide to add standpipes to their systems to meet demand, but several

[39] Note that this price would be very close to acceptable according to PAHO international standards of 5 percent of monthly household income. Since a few providers offer a bulk discount to all users at standpipes, many families get their monthly quantities at 3.6 instead of 5.5 percent of monthly household income.

cite low profits and large inconveniences as reasons for closing standpipes in the past. Providers find standpipes inconvenient because they usually have to be located in front of their homes where the borehole is to ensure proper management.

Families willing to pay for ISNO water are paying more than Mozambican and international standards for monthly household water consumption. Mozambican policy states that no family should spend more than 4 percent of two monthly minimum wages on household consumption per month. International guidelines set by the Pan American Health Organization (PAHO) state that no household should have to pay more than 5 percent of its monthly income (Gomez-Lobo, 2001) on consumption per month[40]. Given ISNO median prices and these expenditure guidelines, the average Maputo household would only be consuming 24 lpcd and 44 lpcd at these limits, respectively, lower than WHO recommended consumption levels of 50 lpcd.

Table 5.2: Monthly fees, resulting consumption, and expenditure guidelines.

	Monthly fee...	Results in Lpcd
Actual Consumption level in Maputo: private connections	$7.88	50
Actual Consumption level in Maputo: standpipes	$5.11	26.5
PAHO recommended expenditure limit	$6.95	44
Government of Mozambique's recommended limit	$3.72	24

Despite this, peri-urban households exhibit strong demand for ISNO services. As long as demand remains as high as it is now, there is little incentive for providers to drop prices in the future.

The regulatory agency expressed a number of reasons why ISNO operations can be potentially harmful to the environment and consumers' health. Although most of Maputo has plentiful groundwater, extensive abstraction can lead to rapid aquifer depletion and eventually saline intrusion, rendering groundwater un-potable. By using and potentially harming a public resource, groundwater, for private gain in the form of revenues from water sales, ISNOs are producing a negative externality. Their current input costs do not reflect the full cost they impose on society. The government thus far has not sent this price signal to providers. If ISNOs had to pay to extract groundwater, only those who continue to find it profitable to abstract water will continue to do so.

[40] Official statistics do put Maputo's income higher than anywhere else in the country but they fail to distinguish which percent of the sample was from the cement city and the peri-urban areas. For that reason, the average national urban household income is used in this report, which could be understating Maputo's purchasing power.

The lack of regulation around borehole construction leaves groundwater highly susceptible to microbiological or nitrate contamination. The large number of latrines in use in peri-urban Maputo causes pathogens and nitrates to seep into the soil, which, if not kept distant enough from a borewell, can eventually reach the water source. Consuming pathogens can lead to diarrhea, cholera, or other water-borne diseases. Consuming too many nitrates can lead to sickness and even death, especially among young children. Although none of the above potential threats are currently a serious problem for Maputo's ISNOs[41] (David, 2006), AdM boreholes have experienced high contamination rates (Hydroconseil, 2005). The regulatory agency believes increased ISNO drilling could reduce groundwater quality in the near future. The negative externality from borehole contamination is very high – a single contaminated ISNO borehole can spoil the entire aquifer – and hence so is the impetus for cooperation – a spoiled aquifer detracts from every ISNO's commercial prospects.

SPSPs are burgeoning at an incredible rate. The illegality of SPSPs' operations does not seem to be deterring their investment; the survey shows that projected investment levels among ISNOs for 2006 are high. The 15 ISNOs that said they planned on expanding by constructing a new small network system plan on spending a total of $105,000 ($7000 each on average) on fixed assets in 2006. From the survey results, we can safely expect at least 60 new borehole systems in Maputo in 2006[42]. If fifteen systems use $105,000, sixty new systems would use approximately $420,000 of infrastructure investment. Expected investment in 2006 can then be considered to be 25 percent of total existing investment (US $1.5 million). Given that it took ten to twelve years to build up the existing infrastructure base, a 25 percent climb in one year, or at least a desired 25 percent climb, demonstrates strong, rapid growth in the sector.

5.7 The Benefits of Strategic Policy and Business Support Interventions

[41] Of the 22 providers who get their water checked, four did receive a written warning for water quality. I spoke with two of the providers who reported getting warnings, one had to have his water depositories cleaned and the other had to treat his water. Given these two requests, it does not seem that nitrates or salinity were cause for concern.

[42] These 15 ISNOs represent 40 percent of our entire sample. If we consider our sample statistically representative, we could say that 40 percent of all ISNOs would like to expand next year by building a new small system network. That would mean approximately 70 new systems in Maputo next year alone. Of course many of those planning to build may eventually fail to do so, but we can safely expect 60 new systems next year alone.

ISNOs' rapid growth rate demands policymakers' attention and action. This action should consist of strategic policy and business support interventions for ISNOs rather than their forced removal. Focusing on ISNOs' shortcomings and actively dismantling their operations comes with substantive transaction costs that would be counterproductive to sector goals. More valuable are initiatives that capitalize on their ability to increase coverage, encourage their productive efficiency, reduce their operating costs, and improve their service quality, "The problem which we face in dealing with actions which have harmful effects is not simply one of restraining those responsible for them. What has to be decided is whether the gain from preventing the harm is greater than the loss which would be suffered elsewhere as a result of stopping the action which produces the harm" (Coase, 1960). Engaging in supportive activities also creates scope for environmental regulation *via* incentive measures and reciprocity agreements.

5.7.1 The Challenges and Costs of Forced ISNO Removal

Eliminating the typical ISNO means forcing 442 peri-urban residents to fend for other, often less desirable, water sources. Even if another source is provided for these residents, like an extension of AdM's network, ceasing an ISNO operation would not be easy. Despite being illegal, many ISNOs consider their operations to be a public service with unspoken legitimacy. This sentiment is likely a result of institutional discordance and the utility's failure to serve peri-urban Maputo for so many years. Some ISNOs are registered with their local districts and are given 'authority' to operate by their district or bairro secretaries[43]; some, though not all of these providers know that this "license" will not protect them from higher authorities such as the municipality or CRA. Yet, CRA has allowed them to operate without interference since its inception in 1999. Two out of every three providers in our sample report that they are having their water tested, almost all by the MOH. This 'legitimizes' ISNO operations further. Although water quality is being tested, there are no solid regulatory mechanisms coming from CRA – ISNOs may perceive the regulatory agency to be

[43] The variation in registration practices highlights the discontinuity between the official institutions that would require registration – DNA, the municipality, or CRA – and local bairro and district governing authorities. Even more puzzling is the registration variation within local districts and bairros; some providers are registered and some are not within the same bairro. Bairros where ISNOs are registered include Hulene A, Hulene B, Khongolote, Mahotas, Mavalane A, Mavalane, Ndlavela, Tsalala, and Zimpeto.

uninterested, especially when FIPAG is the agency actively trying to partner with them. The informal, discordant institutional framework around ISNO operations could pose as a barrier to forced closure.

ISNOs feel they have local support and are bolstered to continue serving their community. Local political pressure to keep systems running should not be dismissed. When AdM attempted to shut down standpipes because either managers were not presenting bills or the local committees were not collecting them, they faced immediate local pressure to reopen them (Thompson, 2005); ISNOs' private connections serve wealthier residents – including bairro chiefs and district secretaries – and will likely result in superior pressure. Some of this sentiment is reflected in ISNOs' low opinion of AdM; very few consider AdM to be superior to them on any metric of service or water quality.

There is also the financial cost of compensating ISNOs for their existing assets. There is a debate within the sector on whether ISNOs should be compensated for their existing investment. Some say that ISNOs have profited for too long from State water resources and deserve no compensation while ISNOs feel that they have been providing a public service when the government could not. Realistically, given that some SPSPs have political weight and most have been long entrenched in their respective communities, some compensation will likely have to be provided. The current replacement value of water supply infrastructure managed by ISNOs throughout Maputo is roughly $1.5 million[44] in 2005 figures, equivalent to 17 state-of-the-art small systems that could extend a utility's network and serve 85,000 people through 2,550 private connections and 119 standpipes (Hydroconseil, 2005).

5.7.2 Increasing ISNOs' Productive Efficiency

There is scope to increase productive efficiency among ISNOs. Whereas the typical ISNO is financially sustainable, a marked decline in unit production cost was documented once a provider exceeds 75 private connections or 1000 cubic meters of water sales per month. Prices between

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[44] The current total system value of our sampled providers equals $448,000 and our sample represents between 20 and 25 percent of all Maputo's operators. Thus, we multiplied the current system value by 5.53 and depreciated this figure by 9.5 percent (IMF, 2006) over five years, the average ISNO years in operation, to arrive at the current figure. The total, however, is closer to US $2 million if we consider materials for private connections contributed by households and repairs made by ISNOs on their systems.

providers who have more than 75 connections and those that have 75 connections or less are very similar, but profits are not. Providers with more connections have considerably higher profits as a percentage of revenues. Although the median cost per cubic meter is very similar between the two cohorts, there is a ten cent difference in our sample between their *average* cost per cubic meter.

Table 5.3: Key financial indicators for smaller ISNOs versus larger ISNOs as defined by number of household connections.

	Smaller ISNOs			*Larger ISNOs*		
ISNO defined by number of household connections (Larger > 75)	*N*	*Median*	*Mean*	*N*	*Median*	*Mean*
Self reported start-up costs	20	$11,243	$12,924	9	14,665	18,128
Working Ratio	27	0.47	0.56	11	0.36	0.32
Net monthly profits as percentage of total revenues	23	12%	5%	9	55%	55%
Cost per cubic meter	24	$0.28	$0.38	11	$0.26	$0.28
Price per cubic meter	18	$0.83	$0.90	8	$0.83	$0.87
Fixed monthly water fee	14	$10.38	$9.94	6	$8.31	$8.65

The gains from scale are more pronounced when looking at providers defined by their monthly volume sales. Again, prices are similar between the two cohorts. However, not surprisingly, when comparing with sales volume we see that gains from increased volume sales result in very large cost per cubic meter reductions.

Table 5.4: Key financial indicators for smaller ISNOs versus larger ISNOs as defined by cubic meters of water sold per month.

	Smaller ISNOs			*Larger ISNOs*		
ISNO defined by cubic meters sold per month (Larger > 1000)	*N*	*Median*	*Mean*	*N*	*Median*	*Mean*
Self reported start-up costs	19	11,281	$12,828	8	$15,882	$19,502
Working Ratio	22	0.46	0.55	13	0.36	0.40
Net monthly profits as percentage of total revenues	22	24%	7%	9	47%	45%
Cost per cubic meter	22	$0.31	$0.42	13	$0.13	$0.22
Price per cubic meter	15	$0.83	$0.92	11	$0.83	$0.86
Fixed monthly water fee	8	$10.38	$9.86	9	$8.31	$9.23

Although the differences between larger and smaller cohorts as defined by the cutoffs above are most pronounced, any increase in sales volume reduces costs (Chapter 4, figure 4.1) and increases profits[45].

Prices between the two cohorts in our sample are very similar, with larger providers actually consistently demonstrating slightly lower prices[46]. Thus, profits are derived from scale and cost savings. There are three principal ways policymakers can encourage larger ISNOs and in the process improve sector efficiency. First, the government can encourage larger providers to buy out smaller ones. Increasing access to capital from banks like *Novo Banco*, which have more funds available than micro-credit organizations like *Socremo*, would be most appropriate. Second, it can support robust small SPSPs who are looking to grow larger and expand their customer base. Third, it can regulate prices. A price cap would retain only the most financially sustainable providers, which happen to be the larger, more cost efficient ones. Small providers would be unable to internalize this regulatory cost[47]. Larger providers could internalize this cost and survive in the short term. In the medium term they would take over their neighboring smaller providers' market share.

5.7.3 Increasing Coverage, Reducing Costs, and Improving Service *via* Universal Metering

There is also scope to reduce ISNO costs and improve ISNO service quality. One of the simplest and most effective ways to simultaneously reduce household expenditure on water, increase coverage, and reduce an ISNO's labor costs is to encourage wider, preferably universal, meter use among ISNOs. Metered ISNO customers pay 20 percent less than flat fee customers for 10 cubic meters of water; if a household consumes less it saves even more. A combination of misconceptions around water usage and costs creates this discrepancy. Providers assume large families benefit from a flat fee so they can consume copious amounts of water when in reality few Maputo households

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[45] A constant elasticity function demonstrates that a 1 percent increase in sales volume increases net profits by 1 percent. Although *gross* profits are high (the largest providers make gross profits as high as $3000 a month) *net* profits are much more muted because of capital recovery. The typical provider earns only earns 60 percent of the average urban household income from his water sales. Since our sample shows strong positive correlations between sales volume and net profits, in the long term, larger providers will have the capital to further expand their existing or build new systems.

[46] Providers that are defined as larger according to monthly sales volume also have lower private connection fees ($65 versus $80).

[47] The typical provider's break even price, where the working ratio = 1, not taking into account capital recovery is $0.56 (13,500 MT) for a cubic meter with a monthly fee of $5.61 (135,000 MT) and a jerrican price of $0.01 (250 MT).

consume more than 10 cubic meters a month. Households avoid paying the up-front meter cost of 17 dollars, perhaps as a savings measure, but end up typically paying $25 dollars extra a year for a flat fee. Even with meters, families can safely consume 12.5 cubic meters a month at the current median flat fee. Field research showed that at least the majority of providers are not aggressively pushing the flat fee. Although 1 in 4 providers in our sample used only a flat fee, interviews showed that the remaining providers that use a combination of the two tariffs often decide to use a meter based on the customer's preference.

ISNOs strongly monitor resale of their water among flat fee customers but are much more relaxed with respect to metered customers. Customers with flat fees who resell water often have their connection cut. Providers are less concerned if metered customers resell because resold water is still being accounted for. Also, meters are located at providers' homes and cannot be tampered with. Thus, if all connections are metered, household resale could become a widespread practice.

Household resale presents benefits to all parties involved. Customers with private connections pay 400 Mozambican Metical (MT) for 20 liters of water, or one jerrican. Many poorer households currently fetch water from provider standpipes at 500 MT per jerrican. Therefore, if households with private connections resell to their neighbors for 500 MT a jerrican, they make a 20 percent profit (the difference between 500 MT and 400 MT) while the neighbor avoids having to make multiple trips to the standpipe. If the practice becomes widespread it could out-compete standpipes. The savings to the ISNO will depend on the monthly salaries he pays his standpipe operators[48].

Increasing the number of meters in ISNO operations can be done in a number of ways. It would likely be more affordable for customers if providers either: 1) bought meters for their customers and charged them modest monthly meter fee; or 2) allowed customers to pay the meter cost in installments at about $1.60 a month for 12 months. The public sector can help by educating ISNOs on the benefits meters bestow on their operations, such as lower non-revenue water[49], and on

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[48] The most costly form of labor – full-time paid labor – is used to manage standpipes. The typical provider pays $58 a month in salaries to regular employees (full and part time). The typical provider will also lose $32 a month in sales at standpipes from household resale[48]. As long as an ISNO's labor costs are higher than his loss from household resale he will welcome the cost savings. Providers using free familial labor, however, might find household resale less beneficial and may dissuade their customers from practicing it.

[49] Providers in our sample that used meters self-reported lower non-revenue water rates than providers that did not.

their customers, such as lower volumetric fees. Also, the government could offer micro-credit to providers or households to purchase meters at the time of connection. Finally, the government could directly subsidize the cost of meters for providers or households like the city of Jakarta, Indonesia did, as a pro-poor measure to increase coverage (Crane, 1994).

If household resale does not out-compete standpipes there are still ways the government can help reduce expensive full-time labor costs or help providers free up their family members' time. Labor costs account for a quarter of all monthly costs. It appears that a large opportunity cost to operators is driving the use of full-time labor. Operators have other income generating activities that they would be reluctant to give up to save on labor expenses (i.e. monitor standpipes themselves); labor expenses are a fraction of what some providers earn from other income sources. However, there may be room to use coin-operated standpipes. In Uganda, a company called Kalebu limited has invented coin operated standpipes that deliver a fixed quantity of water to customers[50]. This would pose a further investment cost but might save money in the long run. Aguas de Moçambique has a similar type of "pre-paid" technology that it tried to employ with its peri-urban standpipes in 2001 but the project failed because of institutional disinterest and unaccountable community management systems (Thompson, 2005). There might be room for an agreement whereby ISNOs purchase this technology from AdM, providing both parties with an incentive – AdM makes a profit on its technology and ISNOs save on recurrent labor costs.

5.7.4 Linkages Between the Electricity and Water Sectors: The Burden of Broken Pumps

Policy reform, market development and/or technology innovation with respect to water pumps could substantially lower costs, further improve service reliability, and increase pressure. Currently pumps are made in South Africa and bought in Mbabane, Swaziland or Johannesburg, South Africa at a cost of $465 or $620, depending on the pump's power level. There are only a handful of sellers in Maputo and pumps come in two types: electrical submersible and subversive. According to one seller, custom duties equal 60 percent of the pump cost. Thus, a pump costing $465 in Johannesburg will cost a Mozambican buyer $744. This pump sells to ISNOs for $1,038. There

[50] One problem with this is the lowest monetary denomination in Mozambique, the 500 MT coin, is higher than what the average jerrican price should be. One option would be to provide two jerricans worth of water for every 500 MT coin, but that could pose problems for filling and carrying.

must be other associated costs because although this amounts to a 40 percent profit, the seller who gave this information stopped selling pumps in December 2005. He stated unreasonably high prices in South Africa, very high customs duties, and cumbersome bureaucracy as reasons for exiting the business – it was no longer profitable enough to warrant his time and effort. Reducing customs duties and bureaucratic procedures would significantly reduce pump prices and increase competition in pump sales. If pump salespersons continue to decline there will likely be longer or more ISNO service outages and perhaps an increase in water prices.

Peri-urban electricity and water are strongly linked – improving electricity will improve water supply. Electricity is both expensive and unreliable; currents fluctuate frequently. ISNOs' service interruptions are the direct cause of either electricity outages or current fluctuations that damage the pump's motor. Damaged motors prevent providers from bringing water up to their storage tanks. This interaction between electricity and pump malfunctioning is important for both lowering costs and improving service levels.

Pump maintenance, repair, and replacement is not necessary every month, but some providers have to replace this costly infrastructure almost annually; the typical pump costs US $1,558 and is a significant part of total system cost. For those unfortunate providers who do replace pumps, it can become their highest cost per cubic meter, trumping what they pay for electricity that year. If an ISNO only has to repair his pump, it will cost him anywhere between $85 and $125 per job. Repair and replacement is a frequent occurrence for a few providers in our sample and field research indicated that it was more of a problem in the outer bairros. Also, the pumps ISNOs are currently relying on are of inferior quality and are unable to prevent damage from electricity fluctuations.

There are four types of water pumps: water, electric, fuel, and hand driven. Water pumps, or hydraulic ram pumps are not ideal for the Maputo ISNOs because they focus on delivering smaller quantities of water to modest heights; providers' tanks are too high for this pump type. There is also a lot of wasted water. Electric run motorized pumps are ideal in a setting where a large quantity of water needs to be efficiently pumped to great heights. Electric pumps' usage is cautioned against in areas with poor reliability of electricity and/or a low level of skills for maintenance and repair (Skinner, 2003). Unfortunately, there is little redress – fuel driven pumps might malfunction as

often, perhaps even more, than electric pumps. Also, the cost of fuel is very high[51]. The remaining alternative is the borehole hand pump. This is not a realistic strategy for large providers[52]. However, small providers for whom electricity is a substantial portion of monthly costs and borehole depth is permissible at 45 meters might be able to save money by hiring someone to pump water for jerrican customers and / or fill a 5000 liter tank overnight for private connections.

Larger providers will have to continue relying on motor driven pumps. The government should reduce or eliminate tariffs on pumps used by ISNOs. Better yet, it could help foster a domestic pump manufacturing industry. One support option would be to increase micro-credit to help with repair and replacement. Another option is for the government to acquire more powerful pump motors with circuit breakers and subsidize the cost for ISNOs. Finally, the government could supply or finance generators and reduce a pump's reliance on the electricity grid. This could reduce outages from broken pump motors. If the government cannot buy every provider a generator – the generators used by providers in our survey cost on average $1,125 – it should at least provide a generator leasing service with rapid deployment that could reduce service interruptions due to electricity outages. However, an added benefit to ISNOs owning generators is the possibility of increased electricity to peri-urban households. It is telling that three out of four peri-urban households do not have electricity (David, 2006). This may be due to low monthly income, but lack of coverage – similar to the W&S infrastructure history – must also play a role. If a generator is used for supplying electricity service to households that lack access to the grid, it could present revenue generating activities for SPSPs like it did in Vietnam and distribute water supply costs[53] (Pollard, 2005).

Lowering SPSP costs may require monitoring. Some academics suggest that prices may respond more to cost increases than decreases, that is, if input costs go up price will respond more commensurately than it would if input costs decreased (Kuran, 1986). This becomes more important in the ISNO market, where among our sample it seemed as if though prices were determined after

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[51] One liter of diesel fuel is US $1.00 in Maputo which means that the typical provider would have to spend US $20-$25 on fuel a day, enormously more than the US $3.00 a day he or she spends on electricity now, to sell the same amount of water.

[52] The manpower required to raise water with a manual pump is significant[52]. A new pump in Nicaragua requires 1 minute to lift 8 liters of water (Lifewater, 2006)

[53] It is not recommended that a generator be used to regularly provide electricity for an electrical pump. The costs to operate the generator would be greater than the cost to operate a fuel driven water pump (Lifewater, 2006).

informal collaboration between providers. Some providers cited that the reason they did not raise prices in the last year was because they had not consulted their colleagues first. There might be strong price determinants in Maputo beyond input costs.

The public sector is often called upon to improve financing for private sector entrepreneurs. In Africa, entrepreneurs' access to credit is a particularly pervasive problem (Mehta, 2003). In Maputo most ISNOs would use a loan to build a new small water network. This does not mean, however, that providers do not use loans for other purposes. Almost a quarter of all providers interviewed in Maputo did take out a loan in the last year to cover business related expenses and most paid them off in less than a year. Therefore, if credit is provided, the government must consider its regulatory capacity to limit new borehole sinking. If regulatory capacities are absent, policy makers might want to cap the amount of credit available at significantly less than the cost to start a small system. This way, those looking to maintain current systems can still access some form of capital and move towards technical sustainability; maintenance loans often need not exceed US $2,000. This strategy, however, will limit larger providers from buying out smaller ones, which should be encouraged. In the end, the public sector may want to offer credit directly to providers with conditions attached.

Interestingly, the small-scale food processing sector in Mozambique faces constraints similar to the peri-urban water sector. A study surveying 23 companies in the food processing sector found that electricity was a major constraint. In Maputo and the rest of southern Mozambique constant power cuts and current fluctuations created problems. Lack of financing was mentioned as a barrier to purchasing essential raw materials, which disrupted food production, as did the breakdown of equipment and unavailability of spare parts (Cardoso, 2000). These three constraints – weak or unpredictable electricity, lack of financing, and unreliable parts – could plague small industry in southern Mozambique in general. The government might address these problems more broadly as a strategy to bolster small-scale enterprises in Maputo province. They are a significant source of employment in Africa with a third of new entrants in the labor force finding work in small enterprises. The number of people employed in African small enterprises grows as these businesses grown in scale and number (Mead, 1998).

5.7.5 Taxation and Regulation can Help Ensure a Safe Peri-Urban Water Supply

The business support interventions described above will harness a great deal of goodwill from ISNOs who stand ready to work with the government. Not only will water supply become cheaper, improved relations between the government and providers will increase the scope for improved environmental regulation. ISNOs should not be exempt from standards that will ensure a safe service level. By waiving regulations informal entrepreneurs pay no costs and politicians increase political support. However, social welfare is reduced because the firms are discouraged from meeting regulatory standards they would have been willing or able to absent political support, "Focusing on the difficulties small and informal firms face in meeting the costs of environmental standards distracts our attention from pursuing opportunities for firms to, indeed, rise to the occasion and meet these standards, rather than be exempt from them...there are many cases in which small firms have actually met those costs and, contrary to the burden-relieving scenario, have been better off for it" (Tendler, 2002).

Hydrological assessments cite risk for saline intrusion into Maputo's groundwater sources if the aquifer is over-abstracted (Hydroconseil, 2005). Because Maputo's groundwater is protected for the benefit of all Mozambicans, ISNOs should pay a price for capitalizing on it. Pigovian taxes[54] are the appropriate way to avoid saline intrusion because the alternative, regulation, is viewed as having a higher cost to society. Pigovian taxes raise revenue while with direct regulation an ISNO has no incentive to abstract any less than what is allowable (Mankiw, 2001). The exact tax necessary will vary depending on the ISNO's operating area, Maputo's groundwater replenishment rate, and the sector's household water consumption targets.

The existing *ad-hoc* licensing scheme should be expanded and formalized to serve as a means to regulate new provider entry. Indiscriminant borehole sinking can lead to groundwater contamination. Contamination is a very serious threat because a single contaminated borehole can potentially damage an entire aquifer, destabilizing numerous ISNOs and endangering thousands of residents. The more boreholes that are sunk the greater the probability of contamination. For these reasons taxation is not adequate. A combination of government oversight and fees must be used to ensure that proper site selection takes place and indiscriminant drilling does not occur. The

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[54] A Pigovian tax is a tax levied to correct the negative externality of an activity.

commercial license fee can vary to serve as an instrument of distortion – bairros with higher license fees will attract fewer ISNOs. ISNOs should be prohibited from drilling without a commercial license and appropriately punished if they choose to do otherwise. Regardless, for the license to be effective it must cost more than the current rate of 2 percent of an ISNO's monthly profit.

If regulation of all ISNOs proves too burdensome or costly, an alternative might be to regulate the drilling company. One such popular Mozambican company, GEOMOC, does surveying and borehole drilling for a number of private individuals in peri-urban Maputo. Restricting its activities is one route the government might want to take to reduce the transaction costs associated with regulating numerous ISNOs. The feasibility, costs, and benefits of this type of regulation, however, is beyond the scope of this study.

Both Pigovian taxes and licensing fees create productive efficiency in the market and raise revenue for the sector. For the smallest ISNOs, implementing a tax or requiring a license would put their businesses in financial jeopardy. Larger providers, however, can absorb such costs, particularly if the efficiency gain and cost-savings strategies described above are provided. This would result in larger providers dominating the market through eventual acquisition of smaller providers' previous market share.

A market share agglomeration among current large providers should occur only in conjunction with the government's ability to monitor or regulate prices if necessary. A large market dominated by a few large providers would create an oligopoly situation where prices could be agreed upon and customers would have fewer options to switch providers. There was some evidence during informal conversations that currently prices did respond to competition. Two cases in one neighborhood showed that when one provider changed his or her price structures, several other providers followed. In one case a provider began to offer 3 jerricans for $0.04 instead of 2 at his standpipe and neighboring providers with standpipes followed. In another case, one provider complained that a nearby resident opened up a borehole and began offering water to private connections at fixed monthly prices lower than hers – she had to lower her monthly fees to keep pace. Because networks are currently small (median number of private connections equals 50) there is competition at a network's edge; there were accounts of a couple of households switching private connection service to a new ISNO. Opportunities for switching will diminish along with the number of ISNOs.

Fees collected from both taxes and licenses could contribute towards water resource management efforts and /or ensuring supply for the poorest families that cannot access improved sources with their own financial means. Historically, one of the greatest determinants of improved public health was not only improved water and sanitation but education around hygiene (Juuti, 2005). Hygiene education programs as well as borehole protection[55] could both be feasibly financed through tax and license revenues. Private connections and meters could be subsidized for the poorest families.

An alternative to groundwater regulation is to encourage or require ISNOs to transition to AdM supplied water. This will be hard to achieve *via* regulation unless similar restrictions are also placed on households. This will largely depend on the political challenges cited earlier and relations between and water administration, ARA-Sul, and FIPAG. If ARA-Sul has no formal mandate to cooperate with FIPAG or AdM, a situation similar to Jakarta, Indonesia could result where attempts to limit access to private boreholes were unsuccessful (Bakker, 2005). It will also be costly to purchase infrastructure for SPSPs. A modern small system that connects to a larger utility's network serving 5000 people can cost $88,000 (Hydroconseil, 2005). There is also the compensation cost to a provider, which if provided, would typically cost $6,500 per system (serving 442 people).

5.8 Politics, Not Providers, Will Pose Challenges to Institutional Action

Neo-classical economists believe private sector actors dislike taxation because it distorts behavior by reducing incentives for investment. Scholars of the informal economy believe that informal entrepreneurs are by definition those that avoid formal taxation, regulation, and licensing (Portes, 1995). Some firms choose their optimal degree of participation in formal institutions because enforcement is lax (Maloney, 2004). None of these is the case with Maputo's ISNOs. Field research showed that ISNOs, similar to a case of Peruvian street vendors (De Soto, 1989), were highly willing to: 1) be part of a formalized licensing system; 2) adhere to government regulations; and 3) pay taxes. Although enthusiasm for paying taxes was lower than being licensed or following rules, only 2 providers out of the 15 interviewed did not want to pay taxes. Providers felt being formalized and having a license would confer several benefits. They would like to be able to operate outside their

[55] A borehole that has well protected walls and is fenced in has a lower probability of being contaminated.

current bairro, obtain credit more easily, and have greater 'legitimacy' and 'recognition' in the eyes of formal institutions. In fact, one ISNO in our sample got a license to drill his borehole because "all public services must have legal backing". The challenges to strategic policy and regulatory interventions will not come from the providers but existing political and institutional challenges in Maputo that could affect any water provider, private or public.

Peri-urban Maputo operates in a political sphere very different from its cement neighbor. Despite peri-urban areas' inclusion in the administrative structure, they went unrepresented in political decisions during both pre- and post-independence periods. The colonial regime defined the administrative structure in the 1960s by breaking the city down into 5 districts, and if adjoining Matola is considered, 8 districts[56]. During colonialism the cement city (district 1) fell under the municipal council, or *Câmara Municipal*, which was highly centralized; municipal legislation came from Lisbon (Grest, 1995). Peri urban Maputo (districts 2 through 8) was under a separate administration, the rural or special "2nd administration", and was not considered a fundamental part of Maputo. In fact, the *Câmara Municipal* was not designed to have the capacity or knowledge to deal with peri-urban services and was only intended for the cement city (Pinsky, 1982). Although intentions improved post-independence under Frelimo, the situation did not. The *Câmara Municipal* was replaced by the City Executive Council, but it was in effect 'captured', becoming a local arm of the central state, a form of de-concentrated central administration at the local level (Grest, 1995). Attempts were still made in the peri-urban areas to mobilize residents through "dynamizing groups" to take charge of their bairro's welfare. However, the challenges were enormous and bairro residents felt increasingly disregarded by the Frelimo party.

Peri-urban Maputo's political marginalization resulted in governance through social relations. For example, socially based systems of land occupation have existed in urban areas of Mozambique since the early period of colonial occupation. Although all land in Mozambique is currently nationalized and the state's property, buying and selling in the land market takes place within a network, often under a bairro chief's guidance; private ownership of land cannot be imposed from the "top down" (Jenkins, 2001). Power in the hands of local chiefs without accountability has created its own problems, namely corruption (Boucher, 1995). However, local elections in 1998 intended to

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[56] Districts are unofficially broken down into neighborhoods, or *bairros*, and bairros are broken down into block groups, or quarteirão, but districts are the smallest official administrative unit.

restructure government and create local level autonomy are not likely to solve Maputo's problems. As of 2000, limited direct responsibilities and fiscal bases have been decentralized and local chiefs remain the implicit neighborhood authorities (Jenkins, 2000).

5.9 Challenges to Increasing Coverage in Maputo

Since per unit cost of water is cheaper through a connection than at the standpipe it would come as a surprise that poor households would choose not to connect to the network. However, this is exactly what we see in many developing country cities worldwide. Capital for the connection fee, fixed annual charges such as the meter fee, the need for a water holding device, and lack of flexible payment mechanisms all create incentives for the poorest households to *not* connect (Bakker, 2005). Another challenge often cited in the literature is property rights. Tenants, more than owners, find it difficult to make infrastructure improvements on land that is not theirs. This could be a potential problem for coverage in Maputo.

Many poor households are not landholders; they rent property. Renters have historically had limited property rights in peri-urban Maputo. Although the government could not stop informal settlements, it encouraged the use of straw and tin for housing construction so when settlements were cleared for urban planning initiatives in the future, it could be done with ease and less waste (Pinsky, 1982). This policy demonstrated that the government did not see these settlements as being permanent, or even semi-permanent, and were reluctant to make costly investments like piped water networks in these areas. Policy has changed since and taken a more positive tone with the Ministry of Housing and Public Works (MOHP) attempting to "cope with informality and illegality" and turn "the legitimate into the legal" (Jenkins, 2001).

Valuable improvements, such as a private water connection, complicate property rights in an informal property market and weaken the landholder's ability to evict tenants, a common desire when the housing market tightens (Boucher, 1995). Local leaders may be able to mediate disputes between tenants and landlords, but corruption is a possibility and has been witnessed before (Boucher, 1995). If tenants or providers have to pay bribes to local leaders or landlords, the cost of a connection will rise considerably for households. However, according to our survey, up till now ISNOs have not had to pay any formal or informal authority a bribe.

Tenancy challenges coupled with FIPAG and AdM's de-emphasis of standpipes could indirectly decrease coverage to the poorest residents. In the past, ISNOs have abandoned standpipes because they were inconvenient or did not generate adequate *absolute* revenues – a typical provider only generated 24 percent of monthly revenues from standpipe sales. However, standpipes are profitable in *relative* terms – the 24 percent of revenue only came from 15 percent of all water sold[57]. If the government encourages private connections and deemphasize standpipes it could lead to ISNOs concentrating on profits from connections and mismanaging standpipes. Since the most expensive labor cost – full-time paid labor – is reserved for standpipe management and labor costs currently account for over 25 percent of recurrent costs, the incentives to cut corners around standpipes is high[58].

CRA is a relatively weak institution in Maputo's water sector. Interim reviews of AdM are possible but only under "exceptional circumstances"[59]. CRA lacks effective penalty tools because calling for an interim review is like citing a breach of contract, the equivalent of "launching a missile'. According to one CRA official, "CRA must create a partnership environment with AdM; a strict regulatory environment would create a breach of contract every month".

CRA faces three major challenges in regulating ISNOs in peri-urban Maputo. First, CRA has limited human and financial resources capacity to deal with additional responsibilities, especially those surrounding a new topic like SPSPs that it has no experience with; CRA was designed for global regulation of the AdM contract, not the monitoring of multiple, daily operations (Thompson, 2005); Second, CRA has little legitimacy in the peri-urban bairros where local chiefs are viewed as the only legitimate authorities; this is rooted in the both city's history of colonial segregation (Jenkins, 1999) and the current municipality's tacit acceptance of local chiefs' authority. Third, CRA is not very confident about ISNOs' abilities to positively contribute towards sector goals. Despite these challenges CRA acknowledges that the ISNO issue needs addressing and is moving ahead with a pilot

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[57] This revenue was calculated using the current price which is $0.06 for three jerricans. The difference between the two figures narrows slightly when the price is changed to $0.04 cents for three jerricans like the partnership proposes, but the revenue to sales volume ratio is still greater than 1.

[58] This is yet another advantage to universal ISNO metering of private connections.

[59] These exceptional circumstances can include 1) a change in the rate with respect to cost increases that cause AdM's operating ratio to change by 30 percent or more. 2) Failure by FIPAG to invest properly in the capital investment program that in turns causes AdM's operating revenue to fall by 2.5 percent or more.

decentralized regulatory model in one peri-urban district (For a summary of the pilot project please see Appendix C).

5.10 Conclusion and Issues for Further Research

Portuguese colonial rule has left Maputo's water and sanitation infrastructure greatly disadvantaged. A newly independent Mozambique lacked the financial and human resources necessary to extend the utility network to peri-urban residents. Water coverage rates and service levels could not keep up with population growth. Despite receiving a great deal of attention from donor agencies and policymakers, large scale-private sector participation was unable to overcome Maputo's infrastructure challenges. Today, less than 40 percent of Maputo residents have access to the utility network through private connections or standpipes. Maputo's 'other private sector' – small private-sector providers – serve over 150,000 residents with reliable standpipes and private connections and have contributed significantly to coverage goals. Less was known, however, about their cost and price structures, investment profiles, operational features, and how, if at all, they could contribute to future sector goals.

We find that Maputo's SPSPs already contribute significantly to the sector's coverage, service, and financial sustainability goals. They should be viewed as an integral part of Maputo's water delivery system and not 'a problem' like much of the literature brands them. Their operations can be made more efficient, affordable, and environmentally sustainable with the appropriate policy and business interventions. We recommend actively promoting larger SPSPs, universal metering, improved electricity supply, reducing costs associated with water pumps, and taxation and regulatory measures so ISNOs can contribute to all sector goals as planning moves forward.

This study's recommendations raise new questions for Maputo's policymakers. Answers to these questions could go a long way in contributing to sector goals. This study cited evidence that larger ISNOs were more capable of reducing costs than smaller ISNOs. One recommendation given was for one ISNO to buy out another (or several) ISNO's market share. This would increase overall sector efficiency. However, it is still unknown how this process would occur. How many smaller providers are open to being bought out? Can the buyout occur between two negotiating parties using market prices? Will the buyout process need the government's guidance to reduce transaction costs? A new ISNO association process began in Maputo in the spring of 2005. Can this association take the

lead in arranging mergers? Answering these questions will help determine what exact role the public sector should plan in the buyout process.

This report recommends that ISNOs meter all their private connections. All parties stand to gain from this service improvement. However, one study showed that those currently using neighbors' connections were the most eager to have their own private connections (Hydroconseil, 2005). It needs to be determined whether this was a 'wealth effect', that is, are poorer residents who use neighbors' connections more able to appreciate the benefits of a private connection and at the same time unable to afford one? Or, are poorer residents bitter about having to use neighbors' connections because of unfavorable neighborly or community relations? One study showed that when peri-urban residents were asked if they thought their bairros were 'divided', Costa do Sol residents felt that their bairro was more 'divided' than Hulene residents did (David, 2006). Understanding community and neighborly relations in particular bairros can help determine which bairros might pose greater challenges to the household resale strategy.

This study was unable to undertake a detailed market study of water pumps and pump motors in Maputo. It is clear now that pumps pose burdensome costs on some providers operations. Reducing these costs would be best achieved by understanding which company manufactures ISNOs' pumps, why there is a high tariff on imported pumps when no Mozambican pump manufacturers exist, why ISNOs are not buying pump motors with circuit breakers attached when such motors are available, and if pump repair persons, which are plentiful, can also become pump salespersons, which are in limited quantity.

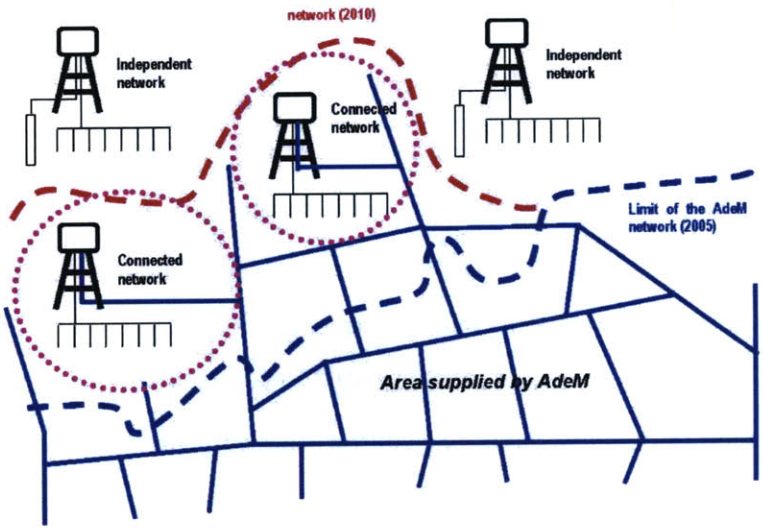
One of the biggest challenges environmental economists face is determining a Pigovian tax rate that will effectively curb an externality to an equilibrium point where both social welfare and productive output are maximized. Determining the exact tax necessary will require a thorough understanding of different areas' groundwater levels, the groundwater replenishment rate, sector targets for household water consumption, and the capacity of ISNOs' to internalize the tax; in short, the costs of saline intrusion versus the benefits of increased coverage and consumption.

APPENDIX A:
A PROPOSED PUBLIC-PRIVATE PARTNERSHIP IN PERI-URBAN MAPUTO

In recent years policymakers have come to realize the potential benefits of small water providers. Their self-financed, financially sustainable operations quickly respond to demand and tailor services to the poor. The poor are often the last to be served by urban utilities and policy makers are under pressure to meet their own sector goals as well as the MDGs for water and sanitation (W&S). At the same time policymakers often have to: 1) retain certain sector standards with respect to water quality, service, and price and SPSPs may not currently be meeting them; and 2) if a lease or concession is involved, navigate a contract that stipulates only one seller within a pre-negotiated selling area. One potential way to both reach the poor while maintaining sector or contract requirements is to partner SPSPs with the existing utility. In the past this has involved the utility selling water at a bulk rate to SPSPs who then deliver water onward to their customer base. By requiring SPSPs to use utility water the government can better monitor water quality and satisfy the utility. By formalizing SPSPs *via* a partnership policymakers can regulate price, service standards, and impacts on the environment. Partnerships with SPSPs are a very recent phenomenon and it is too early to draw concrete conclusions. Still, FIPAG has outlined a plan to partner ISNOs with AdM in an effort to meet sector goals.

In 2004 FIPAG proposed a way to link AdM's network with the ISNOs to increase coverage and service provision to peri-urban residents. There are two parts to the proposal, one for the current edge of the utility network and one for areas where FIPAG/AdM do not envision themselves serving for the next 10 to 15 years. At the network's edge, FIPAG will finance a new small network system designed to modern standards that allow it to connect to a utility network and then lease the system to an ISNO to connect customers, operate daily, and maintain. The small providers would purchase utility water in bulk and resell it to households *via* a distribution network or standpipes. For those areas where AdM does not foresee servicing in the near future, groundwater will be pumped into tanks and then delivered with a mini grid like it is now. Leases would operate on five year contracts where the ISNO would pay FIPAG a lease fee per cubic meter sold. ISNOs would be responsible for financing new private connections and covering system depreciation. However, sales prices would be set and enforced by the regulator.

Figure A.1: The proposed FIPAG / SPSP lease arrangement



Source: *Courtesy of Hydroconseil (2005)*

Proposal documents indicate that small systems at the network's edge will result in increased coverage, an affordable, safe, and reliable service, within a financially, environmentally, and technically sustainable model. An output based aid (OBA) mechanism will help cover costs so that households are only responsible for $41.50 of the connection cost, over 40 and 10 percent off a current ISNO and AdM's connection cost, respectively; the remainder will be covered by African Development Bank funds. Households demonstrated strong willingness to pay for a private connection at this price. The OBA mechanism is intended as an incentive to providers to rapidly increase coverage. Privately connected customers would receive water at a rate close to AdM's current rate, which is 4 percent of two minimum monthly wages. Prices at standpipes would be $0.69 a cubic meter, again within nationally recommended price limits. System infrastructure at the network's edge will meet modern specifications, be able to source water from AdM's network, and have a slated life expectancy of 20 years. Since "partners" would buy bulk water from AdM and sell it onward, water quality will be equal to what current AdM customers receive. Providers with extensive water system management experience are being sought out to manage the 60 small systems with the hope that they will continue 24 hour service, responding rapidly to connection requests, and provide attentive customer service. They are expected to manage close to 150 connections per system at the start, with a standpipe connection ratio of 1 to 50. Where FIPAG does not see itself extending

the network in at least the next ten years, ISNOs will be built a small system similar to the kind they have now and made responsible for connecting clients and continuing to deliver water while adhering to price and quality regulations by CRA.

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APPENDIX B:
A COMPETITION SIMULATION MODEL BETWEEN MAPUTO'S ISNOS AND THE UTILITY

If independent small network operators (ISNO) decide to compete with Aguas de Moçambique (AdM) rather than enter a partnership, they could reduce their prices and as a group present formidable competition to the large, private operator. In a simulated model we find that: 1) ISNOs can compete with AdM on price; 2) if service quality does not suffer as a result of lower prices then the service they provide will be as favorable as AdM's; 3) ISNOs will retain their existing customer base but will not gain new households because the cost to connect to their system is 60 percent higher than the cost to connect to AdM's; and 4) lower ISNO profits due to lower prices will make the market unattractive to new entrepreneurs resulting in slower ISNO growth. Because AdM's prices are lower than ISNOs', many believe customers will naturally shift towards AdM. However, if ISNOs are left to their own devices, they may be able to compete with AdM as it begins to distribute water in peri-urban Maputo towards the end of the decade.

Currently the AdM price for 10 cubic meters of water, including the meter rental fee, is less than half of what ISNOs charge ($3.55 versus $8.30); The price for a 20 liter jerrican is anywhere between being equal to a half. However, there is a transaction cost associated with switching to AdM. Currently SPSP customers walk a few blocks and pay at the provider's home. With AdM service, as a worst case scenario, there is the cost of travel and of having to take time out of income generating activities to pay the monthly bill. Many customers would have to travel to the AdM office downtown to pay. The current minimum wage in Mozambique is $40.00 a month. Assuming it takes half a day to pay the bill (long lines have been witnessed outside the AdM building), the transaction would cost an additional $1.66 per month, $0.62 in travel and $1.04 in lost income / time. There is also the cost of a new connection that is about $48.00. Because of uncertainty surrounding the connection charge and to keep the model simple, this switching cost will be ignored; in reality this is likely to favor the ISNO. The above specifications and assumptions result in a final AdM monthly charge of $5.21.

If ISNOs want to compete with AdM their monthly water treatment costs will have to rise. Although customers are satisfied with ISNO water now, they may lose households to AdM if it can guarantee their families a safe water supply. Therefore, ISNOs will have to spend an additional $9.40

a month on chemicals[60] to treat their water. Everything else is assumed to remain as it was at the time of the survey, including all other recurrent costs, sales volume of water, number of customers served, location, etc. Taking into account the extra chemical treatment costs, we reanalyze the ISNOs' working ratios using AdM prices.

The model sets the ISNO's price equal to the AdM price that includes the transaction cost assumptions made above. The new provider price for 1 cubic meter of water is $0.52 ($5.21 / 10), the new flat monthly fee is set equal to $5.20, and all providers adopt the bulk jerrican discount of 3 jerricans for $0.04. If providers adopt these prices and their monthly chemical costs increase by $9.40, all else equal, the new average working ratio becomes 0.59. On average the model increased ISNOs' working ratio by 34 percent but the new ratio is still well under the break-even point of 1.00. When considering actual prices and costs, 3 percent of providers have a working ratio of 1.00 or higher and are in danger of failing versus a slightly higher 9 percent of providers when we consider lower prices and increased chemical costs.

If providers are still paying their capital costs back the working ratio becomes .94 and 35 percent of providers are in danger of failing. However, this is not considered to be realistic because of our 8 year capital pay back assumption. AdM will begin selling by 2009 at which point the majority of providers will have existed for 9 years; they will have paid their capital back by the time they lower prices to compete with AdM. In fact, one external source cites providers paying capital costs back as quickly as two years after an operation has begun (Hydroconseil, 2005).

This experiment has limitations but it has demonstrated that SPSPs will not necessarily rapidly lose their customer base in the face AdM's lower prices alone. The model is based on self-reported figures of volume sales averaged across the dry season and rest of the year. We asked providers to estimate their volume sales for these two seasons, however, the survey was conducted in January when demand is high and providers may be recalling their most recent volume sales data. However, this is potentially offset by the model's use of conservative assumptions that do not take into account the new AdM connection cost deterrent and the fact that peri-urban families may prefer

[60] This is the current sample average for monthly spending on chemicals.

the per cubic meter charge of SPSPs to the minimum 10 cubic meter charge levied by AdM[61]. Although providers may have a difficult time increasing their customer base because connecting to an ISNO is more costly than connecting to AdM, they very well may retain their existing customer base and continue operating if they make the proper price adjustments. This would give operating advantage to the largest ISNOs, who make $395 more per month on average than small providers[62].

[61] See the following for a more detailed discussion on this topic: Ehrhardt, David. (2000). Impact of Market Structure on Service Options for the Poor. *Conference on Infrastructure for Development: Private Solutions and the Poor.* London, UK.

[62] Results are significant at the 95 percent confidence level based on net monthly profits; a large provider is defined as 50 household connections or more.

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APPENDIX C:
A MICRO-REGULATORY PILOT PROJECT IN PERI-URBAN MAPUTO

CRA is moving forward with a "micro" or "decentralized" regulatory plan that uses local chiefs and community organizations in conjunction with CRA's office to regulate ISNOs at the local level. Existing community based organizations will be the indirect regulators of ISNOs and the voice of the poor to local existing Water Committees (WC) who have historically overseen W&S issues in the bairros. These water committees will then report to CRA:

Complaints: Customers → Community orgs → WCs (with bairro chiefs) → CRA

One problem with this model is it was built off an existing standpipe management pilot project that has had multiple failures including lack of interest from AdM. AdM showed little interest because standpipes were one of its tertiary concerns; since it was the key player the project was delayed for close to a year. FIPAG was preoccupied with contract renegotiation following SAUR International's departure in 2000 and could not enforce AdM's compliance (Thompson, 2005). This is not likely to repeat itself with ISNOs because all parties have a strong interest in ISNO issues. However, perhaps too much faith was put into the water committees who could not fulfill their role as institutional liaison and local regulator.

Maputo's municipality created water committees about 15 years ago and thus they make for attractive social capital to build projects around. However, this may be preventing CRA and other institutions from exploring alternative regulatory or monitoring mechanisms. In the standpipe management pilot program, WCs did not function well as communicators, were not tied closely to CRA – some have not even heard of the agency, and were barely held accountable by the municipality. This could be because some, like the dynamizing groups of the 1980s, fell inactive for periods of time. Because of the weak information flow from WCs to CRA, policymakers might consider restricting ISNO activity through another existing institution – bairro and district level licensing schemes.

In the standpipe model, WCs were ineffective because they had weak linkages with CRA and were unable to communicate with institutional agencies properly. However, if they restricted their activity to within the bairro they might be more effective. Water committees could enforce that 1) taxes are collected by the bairro administration; and 2) use their comparative advantage in voicing community concerns to ensure that collected taxes go directly towards borehole protection to avoid nitrate and microbial contamination or community education around water quality and environmental safety. Water committees then could become accountable to CRA, instead of the municipality who has shown little interest in enforcement in the past and continues to be a weak institutional actor. This would reverse the flow of responsibility, putting the onus on CRA to ensure that WCs are monitoring the bairro administration and ensuring that public revenues are targeted properly.

Monitoring: CRA → WCs → Bairro administrations → ISNOs

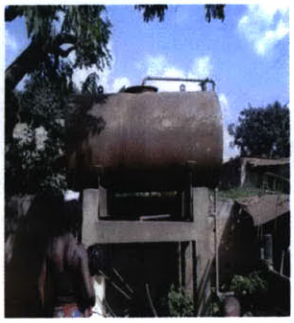
APPENDIX D:
ADDITIONAL INDEPENDENT SMALL NETWORK PHOTOGRAPHS









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