Reforming Urban Water Supply Systems in Developing Countries: A Case Study of Conakry, Guinea

by

Brandt Witte

B.A. Philosophy, Pennsylvania State University
(1981)

Submitted to the Department of Urban Studies and Planning
in Partial Fulfillment of the Requirements
for the Degree of

Master in City Planning

at the

Massachusetts Institute of Technology

September 1995

Signature of the Author _____
Department of Urban Studies and Planning

Certified by _____
Professor Judith Tendler
Thesis Supervisor

Accepted by _____
Professor Langley C. Keyes
Chairman, Master in City Planning Committee
Department of Urban Studies and Planning

ACKNOWLEDGMENTS

I would like to thank my advisor, Professor Judith Tendler. for her patience, guidance, helpful criticisms, and support while writing this thesis. Without her expert guidance and support I would never have finished this project.

I would also like to thank the many officials at SONEG and SEEG who granted me interviews while in Guinea. Before I left for Guinea I was warned not to be too disappointed if officials were reluctant to talk to me. When I arrived in Guinea I found the opposite was true. Officials at both SEEG and SONEG went out of their way to make my stay in Guinea as pleasant and informative as possible. Many of these officials took time out of their demanding schedules to show me around and explain the details of how Guinea's newly restructured urban water supply sector worked. It was clear from my interviews that officials at both SEEG and SONEG were proud of the achievements they have made since 1989. I believe they have a right to be proud.

Finally, I would like to thank my wife, Sandra, who made it possible for me to spend two years at MIT working toward a Master in City Planning. Without her financial and moral support none of this would have been possible.

TABLE OF CONTENTS

Reforming Urban Water Supply Systems in Developing Countries: A Case Study of Conakry, Guinea

by
Brandt Witte

Submitted to the Department of Urban Studies and Planning in Partial Fulfillment of the Requirements for the Degree of Master In City Planning

ABSTRACT

This thesis focuses on the urban water supply sector in Conakry, the capital of the Republic of Guinea, a small West African country with a population of roughly 7 million people Before it restructured its urban water supply sector in 1989, Guinea had one of the least developed water supply systems in West Africa. About 60% of Conakry's population of 1 million people lived in areas served by the piped distribution system, but less than 12% of the households that had the option of obtaining a house connection were actually connected. Due in part to supply constraints and the extremely low or zero cost of water in Conakry, Guinea's water supply company was forced to ration water by zone, pressure in the system was weak, and water treatment was often bypassed increasing the risk of households contacting waterborne diseases.

Since Guinea restructured its urban water supply sector in 1989 the quality of water supply services in Conakry has greatly improved. By creating a new national water authority and entering into a lease contract with a semi-private, commercial water company, the Guinean government hoped to create a self-supporting urban water supply sector and improve the quality and reliability of urban water supply services. Guinea has come a long way toward achieving these objectives. All water connections are now metered and tariff rates are close to covering the full cost of producing and distributing water (including treatment, billing and collections costs). Pressure in the piped system is now adequate and customers receive treated water 24 hours a day. Furthermore, due to a new program that provides low-cost, partially subsidized house connections, the number of households with piped connections in Conakry increased by 53% in just one year from 13,065 in February 1994 to about 20,000 in February 1995.

This thesis argues that despite these impressive achievements, many low-income households are adversely affected by the water company's connection policy. I argue that poor households less likely to connect to the system than middle or upper income households because the down payment required to connect represents a large percentage of a poor household's monthly budget. Consequently, mostly middle and high income families benefit from Guinea' subsidized connection program. The thesis argues that providing loans so that poor families can spread the connection cost over time will allow more low-income households to connect to the system. With greater access to the piped distribution system, more low-income families will save money by having a less costly supply of water and enjoy the health benefits derived from greater water consumption.

Thesis Supervisor: Professor Judith Tendler

LIST OF FIGURES

Chapter One
Introduction

Despite a concerted effort on the part of aid donors and developing country governments, the number of people without access to an adequate supply of water at the end of the 1980s (the U.N. Water Supply and Sanitation Decade) remained about the same as at the beginning of the decade (Briscoe 1992:16). More than one billion people in developing countries, about 18% of the world's population, are still without access to a clean supply of water for drinking and bathing (Feder and Le Moigne 1994: 24).

This thesis focuses on the Republic of Guinea's struggle to provide a safe, affordable, and reliable supply of water to the residents of its rapidly growing capital city of Conakry. The Republic of Guinea is located on the Atlantic coast of West Africa. Guinea's population totals about seven million, and is roughly equivalent in size (246,000 square kilometers) to the United Kingdom (245,000 square kilometers). At 44 years, life expectancy at birth in Guinea is among the lowest in West Africa, and the under five mortality rate is 237 per 1,000 live births. Guinea's per capita GNP of US $510 is similar to that of its neighboring countries; Sierra Leone (US$ 160), Guinea-Bissau (US$ 220), Mali (US$ 310), Cote d'Ivoire (US$ 670), and Senegal (US$ 780).[1]

Before the Guinean government restructured the urban water supply sector in 1989, Guinea had one of the least developed urban water supply systems in West Africa (World Bank 1994: 62). Less than 40% of Guinea's urban population of 2.3 million had access to piped water through standpipes or house connections (Triche 1990: 10). The rest of the population bought expensive water from water vendors who sell water by the container from door-to-door or from one of their neighbors with a household connection.[2]

Background

Guniea's capital, Conakry, is built on a long, narrow peninsula that juts south from the main land into the Atlantic Ocean. The peninsula is about 30 kilometers in length and

---

[1] Dollars ($) are U.S. dollars throughout. Unless noted otherwise, I use the exchange rate in effect in January 1995, and $1.00 = 981.0238 GF.

[2] See (Zaroff and Okun 1984), (Fass 1988), (Whittington et al. 1990), (Whittington et al. 1991), and (Katko 1991) for detailed accounts of water vending systems in various developing countries.

it gradually widens from 1 to 8 kilometers in width as it meets the main land. In 1989, Conakry had an estimated population 1 million people. Today Conakry's population is estimated at between 1.3 and 1.5 million people.

The French built Conakry's first piped distribution system in 1903 while Guinea was still a French colony. This system is still in use today although it is slowly being upgraded and replaced. The original piped network transported water by gravity flow from Kakoulima Springs, about 15 kilometers due east of Conakry. Kakoulima Springs produced 2,000 cubic meters of raw untreated per day (m3/day). Soon after Guinea received its independence from France in 1958, capacity of the original water supply that feeds Conakry was augmented by 45,000 m3/day through the Grandes Chutes/Yessoulou/Conakry scheme.[3] This new supply of water originated at the Grandes Chutes dam on the Samou river located 45 kilometers east of Conakry. The Grandes Chutes dam diverts water from the Samou river to both the Grandes Chutes electric power plant, which supplies Guinea's capital with electricity, and to Conakry's water supply. Raw water diverted from the Samou river is transported and stored at the Yessoulou treatment facility where it is chemically treated and distributed to Conakry about 30 kilometers away. The capacity of the system increased by another 7,000 m3/day of raw untreated water again in 1982, by drawing on water from the Kakimbon well field just 5 kilometers east of Conakry.

In 1989, about 60% of Conakry's population of one million people had access to the piped water supply (World Bank 1989: 77).[4] Out of the 60% of the population served by the piped supply, only about 12% of all households were actually connected to the system.. Those households that actually had piped connections received low-quality, unreliable service.

---

[3] In 1958, France held a referendum giving its African colonies the option to vote for independence or French Union. Led by Sékou Toure, Guinea was alone in voting for independence. France immediately severed all political and economic ties with Guinea. After independence, Sékou Toure established a one party state and became president of Guinea's First Republic Government. On April 3, 1984 Guinea's armed forces took power from Toure in a bloodless coup, and named Colonel Lasana Conté head of state (Clapp 1994).

[4] Conakry is divided into five zones: Kaloum, Dixinn, Ratoma, Matam, and Matoto. Since 1984, most of the growth in Conakry's population occurred in the zones of Matam and Matoto. Households in Matam and Matoto do not have access to the piped water supply system.

The quality of Conakry's water supply service was poor for a number of reasons. First, Conakry's tariff rate was one of the lowest in West Africa. At $0.02 per cubic meter ($0.02/m3) the tariff in Conakry was roughly 3% of the rates charged in countries with comparable urban water supply sectors, like Benin and Togo, where the tariff rate was $0.70/m3.[5] Second, Guinea's national water company, the Entreprise Nationale des Eaux de Guinée (DEG), only collected between 10 and 15% of the money it charged customers for water each year.[6] Between 1961 and 1989, DEG's revenues averaged between just 32 to 36% of its annual operating expenses. Due to the low tariff rate and its poor collection performance, DEG continually ran at a loss. The central government covered DE's yearly operating deficits by transferring funds from the central budget to the water company's account. Unable to collect enough revenue to meet its yearly operating expenses, and dependent on the central government to make up the difference, DEG lacked the money needed to maintain Conakry's water supply infrastructure, increase capacity, and extend the supply network. Due to the lack of maintenance and the age of the original distribution network, water losses consistently amounted to 50% of the water distributed.[7]

With the price of water low or close to zero, and population growth of 5.8 % per year, the demand for water in Conakry exceeded the system's capacity by 1985 (World Bank 1989). Due to the excess demand for water, water pressure in the system was weak, and service was frequently shut off for extended periods of time. The shortage of water was particularly acute in the dry season when demand was at its peak and the supply of water was at its lowest. With the productive capacity of the system stretched beyond its limit, DEG had to ration water by zone, with each zone receiving water for only a few hours each day, if at all. Furthermore, due to the limited capacity of Conakry's water

---

[5] These figures are derived from the (World Bank 1989: 20) and are expressed in constant 1989 prices.

[6] DEG was created in 1961 and was responsible for all urban water supply services until the urban water supply sector was restructured in 1989. Figure 1 of Appendix 1 provides an organizational chart showing the structure of Guinea's urban water supply sector from 1961, the year DEG was created, to 1989, the year the urban water supply sector was restructured.

[7] Water losses are defined as the percentage of total supply lost through leaks, pipe breaks, faulty meters, illegal connections, and uses such as fire fighting which are often not metered. (Serageldin 1994: 11) reports that water losses in Bombay, India of 33% of total supply. In Manila, water losses were as high as 58%.

treatment plant, DEG frequently distributed untreated water, thereby increasing the risk of contacting waterborne diseases.

In 1987, the World Bank appraised a water and sanitation project for Conakry that involved restructuring the urban water supply sector. Co-financed by the World Bank ($40 million), the African Development Bank ($23 million), the European Investment Bank ($11 million), and the Caisse Centrale de Cooperation Economique of France ($17 million), the project got underway in 1989. The main objectives of the project were to (1) establish an urban water supply sector that was capable of supporting itself on the revenue it collected from customers; and, (2) to accustom Guinea's population to paying the full cost of providing water services. To achieve these objectives, the Guinean government created a new, autonomous water authority called the Sociéte Nationale des Euax de Guinée (SONEG).[8] DEG, the old national water company, was replaced by a semi-private, "mixed-enterprise" management company called the Sociéte d'Exploitation des Eaux de Guinée (SEEG).[9] Guinea's new national water authority, SONEG, identifies, plans, finances, and implements all new urban water supply projects. SEEG, the semi-private, mixed-enterprise, management company is responsible for all commercial activity. SEEG produces and distributes water, maintains the infrastructure, and is responsible for billing and collection. In 1989 SEEG entered into a ten year lease contract with SONEG. The lease contract gives SEEG the right to use the water supply infrastructure to distribute and sell water to Guinea's urban residents. SEEG operates at its own commercial risk in that its only source of revenue is the fees it collects from its customers. The Guinean government is not responsible for any losses that SEEG may incur from its operations. SEEG pays SONEG a rental fee for the use of the water supply infrastructure out of the fee that it collects from its customers.

---

[8] Figure 2 of Appendix 2 provides an organizational chart showing the structure of Guinea's urban water supply sector after 1989.

[9] SEEG is called a "mixed enterprise" management company because the state owns 49% of the company and a private Foreign-Investor Manager (FIM) owns 51% of the company. SEEG's Foreign-Investor Manager is a joint venture of Compagnie Generale des Euax, France's largest private water distribution company and SAUR, France's third largest private water distribution company. SAUR is also a main shareholder in the Cote d'Ivoire's water company, SODECI (Triche 1990: 12-13). See appendix one for organizational charts showing the organization of the water supply sector before and after the 1989 rearrangement.

Since the lease contract between SEEG and SONEG took effect in October of 1989, the quality of water supply services in Conakry markedly improved. Customers with piped connections receive treated water twenty-four hours a day, and pressure in the network is always satisfactory. Production capacity has almost doubled since 1985 (from 52,000m3/day to 100,000m3/day), and a new water treatment plant with the capacity to treat 38,000m3/day came on line in 1992. The old reticulation system, built in 1903 by the French under colonial rule, is being replaced, and SONEG is overseeing a project to extend the original trunk network by 60 kilometers into several zones of Conakry that do not have access to the piped supply system.

In line with its goal to establish a self-sustaining water supply sector, the Guinean government raised water tariffs steadily since 1989.[10] By August of 1995 the tariff rate will cover the full cost of producing and distributing water.[11] The collection of water fees from private customers also significantly improved. Today SEEG collects between 72 and 75 % of the fees it charges its customers. As a result, the central government no longer needs to make large cash infusions to cover sector operating losses.

Service coverage in Conakry is also expanding. In October of 1993, SEEG and SONEG launched a program called Operation 15,000 Social Connections which partially subsidizes the next 15,000 private connections over a three year period. Only private households are eligible to participate in the program. Businesses, government administrative units, and industries are excluded. Under the new program, SEEG and SONEG subsidize approximately 80 percent of the capital cost of all new household connections. The total cost of a "complete" hookup, including labor and materials, is $296. The new customer is required to make a non-refundable, cash down payment of $89 to contribute to the total cost of the hook-up. SEEG and SONEG make up the difference between the customer's down payment and the total cost of a new connection

[10] In 1989 the tariff rate in Conakry was raised by 150% from $0.12/m3 to $0.30/m3. In 1991, SEEG switched from charging a uniform tariff to an increasing block rate. Today the lowest block in the increasing block schedule is equivalent to $0.69/m3, the second block is equivalent to $0.87/m3, and the highest block is equivalent to $0.94/m3.

[11] Project planning documents use the long-run marginal cost of producing and distributing a cubic meter of water to estimate the full cost of water supply service in Conakry. According to a tariff study conducted in 1987, the long-run marginal cost of producing and distributing water in Conakry between 1989 and 1998 is $0.82/m3. The middle block of the increasing block schedule in effect in January 1995 was $0.87/m3.

from a joint fund managed by SEEG. SONEG pays about 62% of the cost of the complete hookup by contributing $183 per connection to the joint fund. SEEG finances about 17% of the cost of the hook-up by contributing $51 per connection to the joint fund. The joint fund is replenished by SEEG and SONEG every two months (Republique de Guinée 1993: Article 3.4).[12]

Since Operation 15,000 Social Connections got under way in October of 1993, the number of private connections increased by 53% from 13,065 to 20,000 in January of 1995, and there are about 7,000 customers on the waiting list for new house connections. If SEEG completes all 7,000 connections by the end of 1995, the number of households served by pipe connections in Conakry will increase from about 12% in 1989 to about 25% by December 1995.

Although the improvements noted above are impressive, this thesis shows that poor households do not share the benefits of the improvements in water supply service because they are discouraged from connecting to the piped system. My thesis argues that even though low income households in Conakry can afford to pay the full cost of water and stand to benefit the most from having a household connection. they are less likely to connect to the piped supply system than middle or upper income families because the cash down payment required to hook up to the system represents a relatively large percentage of a low-income family's monthly budget. My data indicate that households in the bottom 10% of the expenditure distribution must currently spend 13% of their monthly budget to buy water from vendors or neighbors. If these households had piped connections they would only need to spend about 1.7% of their monthly budget for the same amount of water. On the other hand, under SEEG's current policy, households in the bottom 30% of the expenditure distribution must spend between 39 and 53 % of their monthly budget to make the $89 cash down payment required to obtain a house connection. This implies that connection charges play a more important role than consumption charges when low-income families decide whether to connect to the piped

[12] Both SEEG and SONEG contribute to the connection fund because SEEG cannot afford to cover a significant portion of the total connection cost on its own. The amount that SEEG and SONEG contribute to the joint fund was arrived at pragmatically by determining how much SEEG could afford to contribute and how much SONEG could afford to contribute (personal communication with Mr. Richard Verspyck of the World Bank).

distribution system, and that middle and high income households are capturing most of the benefits of Guinea's subsidized connection program and improved service delivery. Blocked from connecting to the piped supply system low-income households are forced to continue to meet their water needs by buying expensive water from their neighbors or water vendors.

Urban Water Supply and the Poor

The circumstances described above are not unique to Guinea. Similar situations exist in other cities throughout the developing world. Even though poor families stand to benefit the most from a safe, affordable, water supply, they are often, intentionally or unintentionally, neglected when it comes to water supply and sanitation services. When poor households are denied access to a safe and affordable water supply, they face a greater risk of contacting water-related diseases such as diarrhea, typhoid, cholera, and round worm because they use less than the amount deemed necessary to meet the requirements for good health and because the quality of the water they use may be questionable . It is estimated that if everyone had access to an adequate supply of water and sanitation services the number of deaths of children under five caused by diarrhea alone (3 million) could be reduced by about 66% (World Bank 1992: 49).

Poor households in other developing county cities are also adversely affected by water supply service shortfalls in economic terms. Studies in other cities throughout the developing world confirm that without access to the piped water supply system, the poor are often forced to meet their water needs by buying expensive water from their neighbors or from water vendors. Households that buy water from vendors or neighbors often pay more than ten times the price charged by the formal system for the same amount of water. In Jakarta, Indonesia water vendors charge a 300% markup over the cost of water from the piped distribution system (Crane 1994: 72). In Tegucigalpa, Honduras, households that buy water from trucks pay 25 times the rate charged by the formal system for the same quantity of water (Friedlander 1990: 35). In Nouakchott, Mauritania, and Port-au Prince, Haiti, vendors charge more than 100 times the price of the public utility (World Bank 1994: 49).

Because water from vendors or neighbors is usually more expensive than water from the piped distribution system, the amount of money that a family without a connection spends on water can add up to a large percentage of the household's monthly income. In Ukunda, Kenya and Onitsha, Nigeria households spend 10% or more of their monthly income on water from vendors while households that are connected to the piped distribution system only spend 2 to 3% of their monthly income on water (See Whittington et al. 1991 & Whittington and et al. 1990). In Port-of-Prince, Haiti, households that are not connected to the piped supply system spend 20% or more of their monthly budget to purchase water from vendors while households with piped connections spend between 1.5 to 5% of their monthly income on water (Fass 1988: 347).

If the poor often benefit the most from improvements in water supply services and increased coverage, how can developing country governments and water supply companies make sure that poor families get their share of the benefits? In the past, two paradigms dominated water supply planners' thinking about how to improve urban water supply delivery in developing countries while including the poor. The first paradigm is best summed up by the United Nations' policy formula of "some for all rather than more for some" (United Nations General Assembly Resolution: A/RES/45/181). According to this paradigm, governments should attempt to provide the level of service that reaches the largest number of households possible given the amount of funds available. For low-income countries, where the level of urban poverty is often extremely high, this means that providing a high level of service such as house taps instead of communal standpipes is generally not feasible. Providing such a high level of service would entail subsidizing poor households that can not afford house taps, and in many low-income countries government funds are already stretched thin. Consequently, a more equitable strategy is for the government to provide a lower, less costly level of service, like public standpipes. Providing a lower level of service makes the best use of scarce public funds and the largest number of households possible receive a safe supply of water.[13]

The second paradigm maintains that households can and are willing to pay up to 5% of their income for improved water services. According to this paradigm, developing

[13] See (Brookshire and Whittington 1993) for a critique of this paradigm.

country governments should provide urban neighborhoods with the highest level of service possible so long as it doesn't cost households more than 5% of their income to use the service. This rule of thumb assumes that the demand for improved water supply services is very inelastic so long as the cost of the improved service falls below 5% of the household's income and very elastic if the cost of the service is more than 5% of the household's income.[14]

Recently, a new strategy for improving the adequacy and quality of urban water supply services has emerged.[15] Proponents of the new strategy argue that many of the water supply systems designed according to the two paradigms are failures because they are no longer functioning, or provide a low-quality of service to fewer people than was anticipated. Advocates of the new strategy claim that systems designed according to the first two paradigms fail because they focus solely on the supply side of the water service delivery equation. By focusing only on the supply side of water supply provision, planners fail to recognize that many households, including poor households, want and are willing to pay for a higher level of service.

The new strategy for planning urban water supply systems claims that water supply companies can, and should, charge the full economic cost of providing water supply services and on the principle that the cost of supplying a good should be paid for by those who benefit.[16] Since most of the benefits of urban water supply systems accrue to households, advocates of the new paradigm argue that households should bear most of the cost of water supply delivery.[17]

---

[14] See (McPhail 1993) for empirical evidence that provides a counterexample to this paradigm.

[15] For a complete discussion of the new paradigm see (World Bank 1993), (Brookshire and Whittington 1993), and (World Bank 1994). For empirical evidence that water systems designed according to the two dominant paradigms have failed see (World Bank 1992).

[16] The economic cost of urban water supply services includes; (a) abstracting the water from the ground or a surface source; (b) transporting the water to where it will be used or stored; (c) storing the water until it can be used; (d) distributing the water to those who pay for it; (e) billing customers for the sale of the water; (f) reading meters and collecting bills; and, (g) maintaining, and expanding the system to meet new demand. The economic cost (or opportunity cost) of water in urban water supply sector is equivalent to the value of the most valuable alternative use that is given up when it is used for urban water supply. For instance, the decision to use the water for urban water supply means that the water can not be used by rural farmers, etc.

[17] Some of the benefits a household receives from an improved water supply may include health benefits, time savings, cost savings, and increased consumption.

Critics of the new paradigm charge that the poor cannot afford to pay the full economic cost of urban water supply (Green and Baden 1995). Planners who adhere to the new paradigm respond to this claim by arguing that charging the full economic cost of water will help rather than hurt the poor. Charging the full economic cost of water can help the poor because it permits water supply agencies to escape from the low-level equilibrium traps created by water supply systems based on the old paradigms. Water systems designed according to the old paradigms fall into a low-level equilibrium trap when they provide a level of service that households do not value and are not willing to pay for. Households react to the low-quality of water services by not using the system or supplementing it with substitutes such as water vendors or private wells. As a result, the supply agency fails to collect the revenue it needs to improve the quality of service, increase capacity, and extend the system into new areas. As the service agency's financial situation deteriorates, the central government is often forced to transfer funds from the central budget just to maintain the status quo of poor quality water services. In the end, these transfers subsidize the lucky few who can afford to pay for a higher quality of service. Advocates of the demand driven paradigm point out that the lucky few who benefit from subsidized water services usually turn out to be the rich or the middle class. Household surveys conducted throughout the developing world show that it is the poor who most often suffer from the poor quality or lack of urban water supply services.

According to the new paradigm, the recipe for escaping from a low-level equilibrium trap starts with collecting household level information so that water supply planners can determine what level of service households in urban communities want and what they are willing to pay for. This demand driven strategy allows urban water supply planners to offer households a menu of the different levels of service households want (house connections, yard taps, standpipes etc.) at prices they are willing to pay. Individual households are free to choose the level of service they prefer at the price they can afford, and charging the full economic cost for each level of service provides water supply agencies with the revenue they need to improve and extend the system.

I believe that my research findings are interesting by themselves, however, the urban water supply sector in the Republic of Guinea also provides an interesting case

study for testing the new demand driven paradigm's claim that charging the full economic cost of water supply services helps rather than hurts the poor. While the findings of my field work in Conakry confirm the new paradigm's claim that the poor households stand to benefit the most and can afford to pay the full cost of water from improved water supply services they also suggest that, in some cities, connection costs play a more important role than consumption charges in influencing a families decision about whether to connect to the supply system.

My review of the literature on the new demand side approach to urban water supply revealed that most of the empirical work conducted by the proponents of the new strategy focuses on consumption charges to the neglect of access charges.[18] My research findings from Conakry show that it is just as important to get access charges right as it is to get consumption charges right. The fact that poor households in Conakry are discouraged from connecting to the piped supply system because of the relatively large up-front access charge is important because all new household connections in Conakry are partially subsidized by the water authority and the commercial distribution company. If poor households can not afford to connect to the piped supply, then middle and upper income families are probably reaping most of the benefits of the low-cost connection program, even though low-income households can afford to pay the full cost of water from a house connection; an outcome that I presume is unacceptable to advocates of the new demand driven approach to urban water supply.

The remainder of my thesis is organized as follows. Chapter two presents the main findings of my field work in Guinea, and recommends a change in policy that would allow SEEG and SONEG to improve low-income household's access to the piped supply system. Chapter three concludes the thesis with a summary of what I have learned and raises questions for further research.

[18] See (McPhail 1994), (Singh et al. 1994), and (World Bank Water Demand Research Team 1993) for exceptions.

Methodology

The research for this thesis is based on the field work I carried out over a four week period between December 1994 and January 1995. During this period I interviewed 14 staff members from SONEG, SEEG, the World Bank, and the Ministry of Natural Resources and the Environment. Cooperation from all of these organizations was excellent and no one refused to be interviewed. These open-ended interviews lasted from one to two hours and in many cases I interviewed the same official more than once. Some of the interviews were taped, but most were not. I also reviewed the literature on public finance, the provision of physical infrastructure in developing countries, and infrastructure economics and public policy.

Since many of the people who work for SEEG and SONEG work for DEG at one time, I was able to get information on past performance in the urban water supply sector. SEEG officials showed me projects in progress and allowed me access to their records, including financial statements, billing and collection information, and data from Operation 15,000 Social Connections. My findings are also based on informal interviews carried out with 28 families scattered throughout Conakry. I asked these families open-ended questions about their current water use behavior, the size of their household, and the occupations of different household members. I did not ask any questions regarding a household's income or assets. These interviews provided information on the price of water from water vendors and neighbors and the household's perception of the quality and cost of service provided by SEEG.

In the United States I interviewed three officials at the World Bank who worked on or are familiar with the Guinea Water Supply Project. I was able to interview both the task manager for both the First Guinea Water Supply Project, Mr. Richard Verspyck. and the task manager for the Second Guinea Water Supply Project, Mr. Yao Badjo. I was also allowed access to confidential Staff Appraisal Reports and Project Completion Reports concerning both the first and second Guinea water supply projects.

Chapter 2
The Demand for Private Water Connections In Conakry

The chapter argues that: (1) most households in Conakry can afford to pay the monthly consumption charge when water is priced at its full economic cost; (2) many low-income households are adversely impacted by the large cash down payment charged to connect to the system and, as a consequence, are probably unable to connect to the piped distribution system; (3) given the high level of poverty in Conakry, the size of the cash down payment required to hook up to the system negatively affects a significant number of households; and, (4) since low-income households are less likely to connect to the system, mostly middle and upper income households benefit from connection subsidies.

Operation 15,000 Social Connections' Impact on the Poor

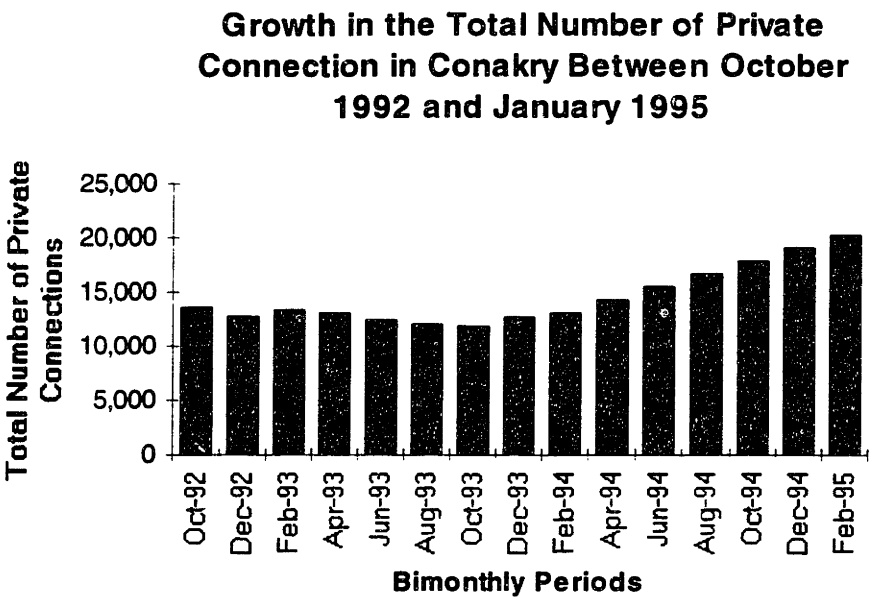
Figure 1 shows that the number of household connections began to increase steadily after October of 1993, when SEEG and SONEG launched Operation 15,000 Social Connections, the new program designed to provide low-cost, partially subsidized house connections. Between February 1994 and February of 1995, the total number of household connections increased by 53% from 13,065 to approximately 20,000.[19] Whereas only about 12% of all households living in areas served by the piped distribution system had connections in February of 1994, by February of 1995, 18% of all households were connected.[20] Furthermore, as of March 1995 about 7,000 households are on the waiting list for new connections.[21]

---

[19] I was unable to obtain bimonthly data from February 1994 to December 1994. However, SEEG and SONEG officials stated in personal interviews that the total number of connections in Conakry and all secondary centers as of January 1, 1995 was about 31,000 (Mr. Jean-Claude Neff, Directeur d'Exploitation, SEEG, and Mr. Mamady Tatidouh Dabo, Directeur Technique, SONEG, personal interviews, January 1995). One of Conakry's local newspapers, Horoya, also confirms this figure (Horoya 1995). The task Manager for the Second Guinea Water Supply and Sanitation Project confirmed this figure (Mr. Yao Badjo, World Bank, personal interview, May 1995). About 10,000 of these connections are in secondary cities and there are about 21,000 connections in Conakry. About 1,000 of the 21,000 connections in Conakry are commercial or industrial connections. These are approximate figures because the numbers change by a small amount each day. People with illegal connections or who don't pay their bills are shut-off from the service at the same time that illegal connections are being regularized and new connections installed.

[20] This figure is derived based on the following information and calculations. The World Bank estimates that in 1989, about 60% of Conakry's population of 1 million people lived in areas served by the piped distribution system (World Bank 1989). Since 1989, Conakry's population has grown and officials at SEEG and SONEG claim that the population is now between 1.3 and 1.5 million. Officials at SEEG claim

Figure 1.



Sources: SEEG Financial Reports 1992-1994, personal interviews with SEEG staff, Mr. Yao Badjo of the World Bank, and Horoya newspaper.

If SEEG can complete all 7,000 connections by December of 1995, about 25% of all households living in areas with access to the piped system will be connected. World Bank estimates confirm these figures.[22] According to the World Bank, about 25% of all

---

that the two zones without access to piped water connections, Matam and Matoto, are growing faster than the zones with access to piped connections. In fact, there seems to be a consensus among SEEG officials that more than 50 percent of Conakry's population lives in these two zones. If SEEG officials are right, as of 1994, only about 50 percent of the population lives in areas with access to piped house connections. I stick with the World Bank estimate of 60% in the calculations below because it is difficult to verify the SEEG estimates and using the World Bank figure does not affect my argument. Assuming that only 60% of Conakry's population of roughly 1.3 million have access to the piped water supply, then about 780,000 people live in areas where household connections are an option. Estimates of the average household size in Conakry range from six to nine household members. Compromising between these two extremes and using a figure of seven for average household size gives a rough estimate of the number of households that live in areas served by the piped supply system. Dividing the total number of people living in areas served by the piped water supply by the average household size shows that roughly 111,430 households live in areas with access to household connections. Dividing the number of private connections billed in February of 1994 (13,065), by the number of households with access to the piped water supply (111,430) reveals that as of February 1994, only about 12% of all households with the option to connect to the piped system were legally connected.

[21]Richard Verspyck, Principal Water and Sanitation Specialist, Infrastructure Division, the World Bank, personal interview, March 21, 1995.

[22] These figures were confirmed by Mr. Yao Badjo of the World Bank in a personal communication dated May 12, 1995.

households living in areas of Conakry served by the piped supply system have house connections. This estimate includes the 7,000 families on SEEG's waiting list for new connections.

While it is clear that service coverage in Conakry is expanding rapidly due to the partially subsidized, low cost connection program, does Operation 15,000 Social Connections reach low-income households or do mainly middle and upper income households benefit from subsidized connections?

Unfortunately, it is difficult to give a conclusive answer to this question because SEEG and SONEG do not collect household level data on the socioeconomic and demographic characteristics of households living in areas where connecting to the piped supply is a possibility.[23] Without household level data, it is difficult to get a clear picture of whether low income households gain from expanded coverage and service improvements or whether only better off households benefit. However, the results of my field work in Conakry, and the limited household level data available, indicate that: (1) low-income households can afford to pay for the full cost of water from a piped household connection because they already spend a relatively large percentage of their monthly budget to buy water from vendors or neighbors; and, (2) poor families would save money and consume more water if they connected to the piped supply system. Nevertheless, my data also suggest that low-income households are less likely to connect to the piped supply than middle and upper income households because they cannot afford to make the large cash down payment required to receive a house connection.

To determine whether Operation 15,000 Social Connections reaches low-income households it is necessary to get an idea of where the poor live. Between 50 and 60% of Conakry's total population of 1.3 million people live in areas where house connections are an option and, according to the World Bank, most poor households are concentrated in the densely populated areas of Conakry served by the piped distribution system (World Bank 1989: 28). Given that only about 25% of all households living in areas served by

[23] SEEG does not collect socioeconomic or demographic information from households connecting to the system for reasons of privacy. SEEG also fears that collecting such information may discourage new applications for service (Mr. Jean-Claude Neff, Directeur d'Exploitation, SEEG, personal interview, January 1995).

the piped system were actually connected in February 1995, a large number of households must rely on some other means of obtaining water. These options include (1) buying water from street vendors; (2) buying water from a neighbor(s) with a legal connection: (3) drawing water for free from a public standpipe; and/or, (4) drawing water from a private or communal well.[24] Recent estimates indicate that about 25% of those households with access to piped house connections buy water from their neighbors while the remaining 50% buy water from water vendors or uses public standpipes (World Bank 1995). Since such a large percentage of the population with access to the piped distribution system depends on either neighbors or vendors for water, comparing the price of water for each of these options to the price of water from a household connection and the average income of poor families will help determine whether low-income households benefit from and can afford to pay for water from the public system.

As in many other developing country cities, water vendors are a common sight in Conakry.[25] Buying water from a neighbor with a connection to the piped water supply is another common method of obtaining water. The typical water vendor fills a wooden or metal hand cart with plastic containers called bidons, and sells the water by the bidon from door-to-door. Each bidon holds 20 liters of water. Vendors typically fill their bidons from their own piped house connection, or pay a neighbor with a piped house

---

[24] Personal interviews with SEEG officials and individual households revealed that well water is generally not used for drinking because it tastes salty. Consequently, well water is most often used for construction (making mud bricks, mixing cement etc.), bathing, or watering gardens. Although public heath organizations and officials in Guinea's Ministry of Health attribute the outbreak of a cholera epidemic in Conakry in June of 1994 the lack of adequate sanitation facilities, many households attribute the outbreak to the use of contaminated well water. According to the Ministry of Health, about 5,000 people in Conakry caught the disease and about 100 died. I should also point out that connecting to the piped supply system illegally is another option for obtaining water. I do not list this option because it is impossible to tell how many households are connected to the system illegally. SEEG has a team of workers that search for illegal connections each day (the Equipe Clandesteau). On average, about twenty illegal connections are discovered and dismantled each day. Once the connection is dismantled, the household receives a notice explaining how to obtain a legal connection. Other than cutting off the households service, there is no penalty for having an illegal connection. To reconnect to the system, the household has to follow the procedures of Operation 15,000 Social connections. Since 7,000 households are on the waiting list for new connections, the disconnected household may go without service for a few months (Mr. Diallo Mamadou, Chief, Equipe Clandesteau, personal interview, January 1995).

[25] (Zaroff and Okun 1984) and (Katko 1991) provide an overview of water vending practices in many developing countries. For a more detailed description of water vending in specific cities see (Fass 1993) on Port-au-Price, Haiti, (Crane 1994) and (Lovei and Whittington 1993) on Jakarta, Indonesia, (Whittington, Lauria, and Mu 1991) on Onitsha, Nigeria, and (Whittington, Mu, and Roche 1990) on Ukunda, Kenya.

connection to fill their bidons. It is illegal for water vendors to fill their bidons at public standpipes where water is free.

One 20 liter bidon of water from a water vendor in Conakry costs $0.10 or $0.005 per liter.[26] The per liter cost of water from a vendor in other developing country cities is similar. A liter of water from a water vendor in Boundiali, Ivory Coast also costs $0.005, a liter of water from a water vendor in Guidan Rouondji, Niger goes for $0.007, and the going price for a liter of water from a water vendor in Diourbel, Senegal is $0.008.[27]

The specific arrangements for buying water from neighbors vary from neighborhood to neighborhood. However, most of the households that I spoke that bought water from their neighbors paid a flat fee per 20 liter bidon. At the end of 1994, buying a 20 liter bidon of water from a neighbor cost between $0.08 and $0.06 or between $0.004 and $0.003 per liter.[28] As one would expect, buying water from a vendor is more expensive than buying water from a neighbor. Water from vendors is more expensive than water from neighbors mostly because vendors often have to pay a neighbor for the water they sell and because more labor is involved in selling water from door-to-door than in selling water to your neighbors. The vendors that I spoke with in Conakry were self-employed and they did not hire any additional labor to help them sell water. The typical water vendor's capital costs include the 20 liter bidons used to sell the water and the vendor's push cart. While selling water to your neighbors may involve some administrative costs like monitoring how much water is being taken from the water connection, the amount of labor involved is minimal compared to selling water from door-to-door.

Comparing the cost of water from neighbors and vendors to household expenditure data shows how much households pay for water from these substitutes for the piped water supply. Column 2 of Table 2 provides a breakdown of average monthly

---

[26] This information comes from informal interview with 28 households living in the three zones of Conakry that had access to piped water in January 1995. Informal interviews with eight households living in the two zones that did not have access to the piped system indicated that a 20 liter bidon from a water vendor cost between $0.17 and $0.20.

[27] The per liters prices for vended water in other developing countries are from (Zaroff and Okun 1994).

[28] This information comes from informal interviews with 28 households in the three zones of Conakry where connecting to the piped supply is possible.

household expenditures by decile. Columns three and four show the percentage of total monthly expenditure a household of seven would need to buy 20 liters per capita per day from water vendors or neighbors respectively.[29]

Table 1. Percentage of Monthly Household Expenditure Spent on Water from Vendors or Neighbors (in 1994 GF) by Decile.

Expenditure By Decile	Average Monthly Expenditure In 1994 GF	% of Monthly Expenditure Needed to Purchase 20 lpcd from Vendor	% of Monthly Expenditure Needed to Purchase 20 lpcd from Neighbor
1	164,790	13	10
2	198,275	11	8
3	225,093	9	7
4	235,796	9	7
5	257,071	8	6
6	273,174	8	6
7	275,568	8	6
8	353,548	6	4
9	355,760	6	4
10	519,857	4	3
Average:	285,893	8	6

Sources: (del Ninno 1993) and informal interviews with 28 households in Conakry.
a] Average monthly expenditures were converted from GF 1990 to GF 1993 using the CPI from (International Labor Office 1994).[30]
b] A price GF 65 per 20 liter bidon is used for purchases from neighbors.

Table 2 shows that households in the bottom 40 percent of the expenditure distribution are hit the hardest whether they purchase water from vendors or neighbors. Households in the bottom 40% of the expenditure distribution must devote between 7 and 10% of their total monthly budget to buy water from a neighbor and between 9 and 13% of their monthly budget to buy water from vendors.

These percentages may seem high but households in other developing country cities spend a similar or higher percentage of their monthly income to buy water from vendors or neighbors. In Onitsha, Nigeria households spend an average of 10% of their monthly income to buy water from vendors (Whittington, Lauria and Mu 1991). Families

[29] Between 1.5 and 2.0 liters per capita per day (lpcd) are required for human survival (World Bank 1992). (Kalbermatten et al., 1982) argues that between 20-50 lpcd is necessary to meet all basic requirements for good health.

[30] Since the latest CPI published for Guinea is for December of 1993 and all water prices are in 1994 GF these figures probably slightly underestimate the percentage of total monthly expenditure needed to purchase water from vendors and neighbors.

in Lima, Peru also spend an average of 10% of their monthly income to obtain water from water vendors (Briscoe 1992). In Tegucigalpa, Honduras, however, the average household spends about 20% of their income to buy water from vendors (Friedlander 1990).

How do the prices of water from water vendors and neighbors compare with the price of water from a piped connection from SEEG? The price of water for customers with legal hook-ups in January 1995 is shown in the increasing block schedule shown below.

Water Tariff Schedule

0 - 20m3	680 GF/m3
21- 60m3	850 GF/m3
61m3 and over	925/m3

The water tariff schedule shows that a cubic meter of water from SEEG costs about $0.70 (GF 680/m3). A cubic meter of water from a water vendor costs about $5.10, and cubic meter of water from a neighbor costs between $3.82 and $3.31. These calculations show that purchasing a cubic meter of water from a water vendor is about seven times more expensive than purchasing a cubic meter of water from SEEG, and that purchasing a cubic meter of water from a neighbor is between five and one-half to five times more expensive than purchasing a cubic meter of water from SEEG. Using the prices of the different alternatives for buying water it is possible to get a rough estimate of how much a family could save by connecting to the piped water supply. By comparing the price of water from vendors, neighbors, and SEEG, it is obvious that poor families can save a great deal of money by buying water from SEEG rather than from vendors or their neighbors. Based on these cost savings alone, one would expect that the demand for household connections would be high even for low-income households.

Table 3 gives an idea of how much money a household can save by connecting to the piped supply system. Table 3 shows how large a percentage of its total monthly budget a household of seven must spend to buy 20 liters of water per capita per day from water vendors neighbors, or SEEG. The last column of Table 3 shows that water

purchased from the piped system costs substantially less than water from vendors or neighbors.

Table 2. Comparison of Percentage of Total Monthly Expenditure A Household of 7 Needs to Purchase 20 lpcd from Vendors, Neighbors, and SEEG

Distribution By Decile	% of Monthly Expenditure Needed to Purchase 20 lpcd from Vendor	% of Monthly Expenditure Needed to Purchase 20 lpcd from Neighbor	% of Monthly Expenditure Needed to Purchase 20 lpcd from SEEG
1	13	10	1.7
2	11	8	1.4
3	9	7	1.3
4	9	7	1.2
5	8	6	1.1
6	8	6	1.0
7	8	6	1.0
8	6	4	0.8
9	6	4	0.8
10	4	3	0.5
Average:	8	6	0.1

Sources: SEEG 1994 and personal interviews.

a] The percentage of total monthly expenditure needed to purchased 20 lpcd from neighbors is based on the price of GF 65 per 20 liter bidon even though the price of a 20 liter bidon from a neighbor ranges from GF 65 to GF 75.

Clearly, households at the bottom of the expenditure distribution benefit the most in terms of reducing the percentage of the monthly budget they spend on water if they buy water from the piped distribution system instead of neighbors or water vendors. If a household in the bottom 10% of the distribution connected to the piped system instead of buying water from a vendor it would save about 11% of its monthly budget or $18.47 (GF 18,127) per month.

Another way to view the benefits a low-income household can expect to gain by connecting to the piped distribution system instead of buying water from neighbors or vendors system is to look at how much money a poor household spends on food and water combined. For instance, households in the bottom 10% of the income distribution already spend 56% of their monthly budget on food.[31] If these households also bought their water from vendors they would spend about 70% of their monthly budget on food

[31] (del Ninno 1993) provides a breakdown of household expenditure on food by decile for Conakry.

and water. A household in the bottom 10% of the income distribution with a house connection, on the other hand, would spend just 58% of its monthly budget for food and water.

Can the Poor Afford House Connections?

The last section presented evidence to show that even poor households can afford to pay the monthly consumption charge for a household connection, and that the potential cost savings involved in switching from buying water from vendors or neighbors to the piped system are substantial. However, a household's decision about whether to connect to the piped supply will also be influenced by the cost of connecting to the system and not just the monthly cost of water consumption. This section shows that even though Operation 15,000 Social Connections subsidizes about 80% of the cost of all new private connections, the initial cash down payment needed to connect to the piped supply can still present an obstacle to families near the bottom of the expenditure distribution.

Each household that wants to participate in Operation 15,000 Social Connections must make a non refundable cash down payment equivalent to about $89. This cash down payment entitles the new customer to what SEEG calls a "complete connection". A complete connection consists of a connection to the branch network using a pipe eight meters in length and 15 millimeters in diameter. If the household needs more than 8 meters of pipe to connect to the branch network, every meter over 8 meters costs an extra $6.33/meter (GF 6,210). The new customer's property must be no further than thirty meters away from the branch network, and the new connection must extend at least two meters onto the customer's property. The complete connection includes a water meter, a faucet on the end of a galvanized, swan-neck pipe, and a shut-off valve just outside the customer's property.

Table 4 provides a breakdown of the connection fee charged for each complete connection in Guinean Francs and dollars.

Table 3. Composition of Connection Fee in GFs and $s.

Customer's Total Fee	87,200	$89
- Capital Cost	60,000	$61
- Advance on Consumption	27,200	$28
SEEG's Payment of Capital Cost	50,000	$51
SONEG's Payment of Capital Cost	180,000	$183
Total Cost of New Connection:	290,000	$296

Source: Republic of Guinea 1993.

The customer's portion of the connection fee, $89.00, is broken into two parts, an advance on the first forty cubic meters of water consumed ($28), and a payment toward the capital cost of the connection ($61). Although the customer's down payment ($89) only accounts for about 30% of the total connection cost ($296), this cash down payment represent a substantial percentage of a poor household's monthly budget.

Table 5 shows the percentage of a family's total monthly budget needed to make the cash down payment required to connect to the supply system by expenditure decile.

Table 4. Connection Cost as % of Monthly Budget

Expenditure By Decile	Average Monthly Expenditure In 1994 GF	% of Monthly Expenditure Needed To Connect
1	164,790	53
2	198,275	44
3	225,093	39
4	235,796	37
5	257,071	32
6	273,174	32
7	275,568	32
8	353,548	25
9	355,760	25
10	519,857	17
Average:	285,893	33

Sources: (del Ninno 1993) and (The Republic of Guinea 1993).

Households in the bottom 40% of the expenditure distribution must devote between 37% and 53% of their total monthly budget to make the cash down payment required to hook-up to the piped water supply. Setting aside between 37% and 53% of total monthly budget needed to connect to the piped water supply system represents a substantial

burden to the household because household's in the bottom 40% of the income distribution already spend between 56 to 27% of their monthly budget on food.[32] Furthermore, the $89 non refundable cash down payment only entitles the customer to a standard, "complete connection" to the water system. If a household lives more than eight meters away from the secondary distribution network, the household's cash down payment of $89.00 increases by $6.24 for every meter over eight meters. If a household in the bottom 10% of the expenditure distribution must purchase just three additional meters of pipe in order to connect to the secondary distribution network, then the cash down payment required to connect to the system increases to 64% of its monthly budget or $107.50.

The finding that access charges can play a more important role than consumption charges in a poor household's decision about whether to connect to the piped supply system is not new. Studies in several other developing country cities show that charging a large cash down payment to connect to the piped water supply system impedes many households from connecting to the system. In Tunis, Tunisia, the cash down payment needed to connect to the piped supply system represents about 50% of the average household's total monthly expenditures. A willingness to pay survey carried out in Tunis revealed that the large cash down payment was the main reason that households were not connecting to the piped distribution system (McPhail 1994). Studies in the state of Kerala, India, and Brazil also indicate that high connection costs can present a significant barrier to connecting to the piped distribution system.[33] In Kerala, India 58% of the respondents to a household survey cited the large up-front connection fee as the main reason they did not connect to the piped distribution system.

The information on connection costs in Guinea and the two studies cited above show that connection costs can impede poor families from connecting to the piped distribution system. However, instead of helping the poor gain <u>access</u> to the piped supply

---

[32] Household standard of living surveys conducted in Conakry in 1990 and 1991 indicate that more than 50% of all households devote more than 50% of their total monthly expenditures for food (del Ninno 1993).

[33] See (Singh et al. 1993) for the case study of Kerala, India, and (Briscoe et al. 1990) for a case study of Brazil.

system, efforts to accommodate the needs of low-income households are often based on price schemes like increasing block tariffs.

Increasing block tariffs link the price of water to the volume consumed by charging a low-rate for the first block of water consumed and then higher rates for additional blocks. The price of water in the first block is sometimes called the "lifeline rate" because it is set low enough to ensure that poor households can afford to use the amount of water considered essential for human health requirements. The increasing block tariff in Conakry is a good example. The customer pays GF 680 for the first 20 cubic meters of water consumed, GF 820 for the next 39 cubic meters consumed, and GF 925 for every cubic meter of water over 61 consumed. Many water supply planners argue that increasing block tariffs are a more equitable way of allocating the costs of water production and distribution because they raise the marginal cost of consumption to the customer, and thus result in higher average costs for customers who consume a relatively large amount of water. This argument assumes that high income families use more water than low-income families, and that the poor have a piped water connection. However, the data on connection fees in Guinea presented above shows that the poor have difficulty gaining access to piped connections in Conakry because of the large cash down payment the family must to pay to connect to the system is too large relative to their monthly budget. Without access to a piped connection, poor households in Conakry must buy more expensive water from their neighbors, water vendors or take water from a public standpipe. (Whittington 1992) shows that increasing block tariffs can have an adverse impact on the poor when they do not have their own metered household connection and are forced to buy water from vendors or neighbors.

To see how increasing block tariffs can have an adverse impact on low-income households it is helpful to examine a hypothetical example based on the tariff system used in Conakry.[34] Suppose that a family of seven living in Conakry has its own metered connection to the piped distribution system and that this family consumes 20 lpcd. Suppose also that this family sells water to a neighboring family made up of seven members who each consume 20 lpcd. Then these two families together consume about

[34] This example adapted from an example in (Whittington 1992).

8,400 liters or 8.4 cubic meters of water per month. assuming that the two families split the bill evenly, and using the increasing block rate charged in Conakry it is easy to calculate the two household's monthly water bill. Since the first 20 cubic meters consumed cost of $0.70/m3, the monthly water bill comes to $5.82 or $2.91 per family per month.

Now suppose that the same family with the piped connection decides to sell water to ten other families and that each of these ten families has seven members who consume 20 lpcd. The eleven families together consume 46,200 liters per month or 46.2 cubic meters of water. According to SEEG's increasing block schedule, the first 20 cubic meters cost $0.70 for a total of $14.00. The next 26.2 cubic meters cost $0.86 for a total of $22.53 Adding the two together brings the monthly water bill to a total of $36.53 or $3.32 per household per month. This simple example shows that as the number of households that buy water from a given neighbor increases, so does each household's monthly water bill. However, the negative effects of increasing block tariffs are probably underestimated in the simulated example because most households will charge a mark-up when they sell water to their neighbors. Furthermore, while the simple example only considers the effects of increasing block tariffs on households that buy water from neighbors, it also applies to households that buy water from vendors.

Does the increasing block tariff in Conakry negatively affect the poor? Since low-income families in Conakry are less likely to have a piped connection than better-off households, they are more likely to buy water from neighbors or vendors. In addition, most low-income families are located in the densely populated areas of Conakry where piped house connections are available; precisely the conditions where increasing block tariffs can have an adverse impact on the poor. As I noted above only 25% of the households living in areas served with piped water actually have household connections (World Bank 1989: 28). The World Bank estimates that another 25% buy water from neighbors and the remaining 50% buy water from vendors or rely on standpipes. These figures suggest that the well intentioned policy of charging increasing block tariffs probably negatively affects Conakry's low-income population.

The argument presented above shows that when access charges play a more important role than consumption fees in a household's decision about whether to connect to the piped system, simply charging increasing block tariffs is not an effective way of reaching the poor. This argument implies that a more effective way of reaching the poor is to remove the barriers that block poor household's access to the piped supply system.

Since the greatest barrier poor households face in acquiring a household connection in Conakry is the large up-front connection fee, one obvious proposal for improving low-income household's access to house connections is to provide loans to help families finance the connection fee over time. Providing loans to help finance the cost of a household connection has several advantages. First, a loan scheme for financing connection charges would not increase the amount of subsidy SEEG and SONEG already provide. Second, it would allow low-income households to spread the cost of connecting over time by adding the principal and interest payments on the loan to their monthly water bill. Studies in India, Morocco, and several cities in Latin America show that providing credit to families so that they can spread the cost of connecting up over time can substantially increase the number of low-income households that connect to the piped supply system. Third, providing credit to finance connection charges may raise the total revenue collected by the water company if enough households are induced to connect (World Bank 1994). In response to a household survey in Kerala, India, 58% of the households that are not connected to the piped supply system stated that the high connection fee as the main deterrent to connecting to the system. Simulations using the responses of both the connected and unconnected households in Kerala show that increasing the tariff rate, decreasing the connection cost, and providing credit for piped household connections would result in an increase of 3 times as many household connections and increase the amount of money the water supply company collects each month by 50% (Singh et al. 1993: 1938-1939). This scenario leaves both consumers and the water supply company better off. [35]

[35] Given the limited amount of information available on household water use behavior in Conakry it is impossible to tell whether increasing the tariff rate, decreasing connection fees, and providing loans to finance connection charges would produce a win-win situation like that found in Kerala. However, the possibility seems worth exploring.

Studies from other countries show that a variety of institutions are willing to provide loans to help poor families gain access to water and sanitation infrastructure services. In Guinea, loans could be provided through SEEG and SONEG, through private lenders, or NGOs. The Grameen Bank, an NGO in Bangladesh, has successfully lent $18 million to poor households in rural areas for private suction tubewells for household use since 1992 (Serageldin 1994: 29). The Grameen Bank also provides loans at market rates to households to improve sanitation. Under this program the household receives a $14 loan repayable over one year to pay for an improved ventilated pit (VIP) latrine (Hogrewe, Joyce, and Perez 1993). The Grameen Bank has already successfully financed over 100,000 VIP latrines in rural areas of Bangladesh. In Honduras, UNICEF and a local NGO called the Cooperative Housing Foundation also run a program that provides credit to low-income households to build shower stalls, roof-top rainwater catchment systems, and water storage tanks.

While local or international NGOs, are one possible source of credit for household connections in Conakry, it would probably be administratively simpler for SEEG or SONEG to provide the loans because regular billing and collection procedures could be used to recoup the loans by adding the principal and interest payments to the household's monthly water bill. For example, suppose that SEEG loans the total amount needed to connect to the piped system (GF 87,200) to a household of seven under the condition that the principle and interest on the loan be repaid over a five year period in monthly installments added to the families water bill at the current interest rate of 14%. Under these terms the family's monthly water bill would increase by $2.07. If this same family continued to use 20 lpcd, its monthly water bill would increase from $4.28 per month without the loan, to $6.35 with the payment on the loan added to the borrower's monthly bill. Although adding the monthly payment on the loan increases the household's monthly water bill by 48 percent, it only represents a small increase in the percent of the total monthly budget that a household of seven needs to buy 20 lpcd. Adding the loan payment to the monthly water bill increases the total monthly budget needed to buy 20 lpcd from SEEG from 1.7% to just 3.8% for a family in the bottom 10% of the expenditure distribution.

Finally, even if the very poor cannot benefit from a credit program for household connections, they may benefit indirectly by having more neighbors with piped connections. Reducing the number of families that buy water from a given neighbor (or vendor) reduces the volume of water consumed from that neighbors tap and, therefore, results in average costs for every household that buys water from that neighbor. Consequently, increasing the number of household connections in a community may provide poor families with more outlets for purchasing water and thereby decrease the number of low-income households that purchase water from a single household. Thus, providing credit to finance the cost of household connections over time may not only induce more low-income households to connect to the piped system, it may also indirectly counteract the negative affects that increasing block tariffs have on poor families without household connections.

The Extent of Poverty in Conakry

If most households in Conakry were in the top or the middle of the expenditure distribution, it would be safe to assume that the majority of Conakry's population would benefit from increases in service coverage by connecting to the distribution system On the other hand, a large number of households near the bottom of the expenditure distribution would raise concerns that a significant proportion of the families who stand to benefit the most from an improved water supply are unable to take advantage of increased service coverage by connecting to the piped supply system.

How widespread is poverty in Conakry? [36] The World Bank estimates that in 1987, about 40% of Conakry's population fell below the urban poverty level of $90.00 (World Bank 1989: 75). The Task Force on Social Policy of the Guinean Ministry of Planning estimated that 75% of all households in Conakry lived in poverty in 1987 (World Bank 1989: 75). A third, more recent, estimate of the extent of poverty in

[36] The World Bank estimate is based on a poverty threshold of 50% of the mean GDP for a household of six. (World Bank 1989: 75). The Task Force on Social Policy of the Guinean Ministry of Planning assessment is based on the minimum monthly budget a household of nine needs to purchase a market basket that meets the family's basic needs (World Bank 1989: 75). The estimate from (del Ninno 1993) was calculated using the same method as the Ministry of Planning's Social Task Force, but it assumes an average household size of six.

Conakry estimates that approximately 36% of the population lives in poverty (del Ninno 1993). These estimates indicate that the incidence of poverty in Conakry high in comparison to other cities in Africa and the average for Sub-Saharan Africa overall.[37]

While project planning documents for the Guinea Water Supply Project attempt to forecast the impact of increasing tariff rates on poor households in Conakry, they do not attempt to evaluate the impact of the connection fee.[38] This thesis has shown that even poor households can afford SEEG's monthly water charges. Raising the cash down payment required to connect to the water distribution system is a major obstacle for low-income families.[39] If between 36% and 40% of all households in Conakry fall below the poverty level, then a substantial portion of the city's population is adversely affected by the large connection fee and will have a difficult time connecting to the piped supply system.

Due to the high level of poverty in Conakry , the current policy of charging an $89 cash down payment to connect to the system probably has an adverse impact on a large number of low-income households. Without access to a piped connection, poor households must buy water from vendors, their neighbors. When the poor are concentrated in densely populated areas, as they are in Conakry, the well intentioned policy of charging increasing block tariffs may also adversely impact low-income families. As a result of these policies, middle and upper-income families probably benefit the most from the connection subsidies offered by Operation 15,000 Social Connections. Obviously, once they are connected, the better-off also benefit the most from service improvements.[40]

---

[37] (Leechor 1994: 184) estimates that 4% of the population in Accra, Ghana falls below the poverty level, while (Kakwani 1993: 51) estimates that 27% of the population in Abidjan, Cote d'Ivoire falls below the poverty level. The average for Sub-Saharan overall is 30% (Kakwani 1993: 51)

[38] See (World Bank 1989).

[39] The World Bank used its own poverty estimate (40% of all households) and the Ministry of Planning's estimate (75% of all households) to forecast the impact of proposed water rate increases on households that fall below the two different poverty levels. The World Bank estimate assumes that a family of six consumes 25 lpcd. The Ministry of Planning assumes that a family of nine must consume 40 lpcd to meet its basic needs. The effects of water tariff increases were then measured as a percent of monthly household revenue in the case of the World Bank poverty measure and as a percent of the household's minimum monthly budget in the case of the basic needs poverty measure. Both measures show that poor households can afford the monthly consumption charge for water.

[40] Once connected better-off families can also benefit by selling water to the poor at a mark-up.

Chapter 3
Conclusion

Since Guinea restructured its urban water supply sector in 1989, the quality of urban water supply services in Conakry improved and service coverage is expanding. By creating a new national water authority (SONEG) and entering into a lease contract with a semi-private, commercial water company (SEEG), the Guinean government hoped to create a self-supporting urban water supply sector and improve the quality and reliability of urban water supply services. Guinea has come a long way toward achieving these objectives. To make the urban water supply sector self-supporting, water tariffs have increased steadily and are now close to covering the full cost of producing and distributing water. All domestic water connections are metered, and SEEG has instituted stringent billing, collection, and cut-off procedures in an effort to improve the collection ratio. In addition, the capacity of Conakry's water system more than doubled since the lease arrangement took effect. These improvements in financial performance helped improve the quality of water services in Conakry. All customers now receive treated water at adequate pressure twenty-four hours a day. Service coverage in Conakry is also expanding. Since Operation 15,000 Social Connections began in October of 1993, service coverage increased dramatically by about 53 percent from 13,065 household connections in February 1994 to 20,000 household connections in February 1995.

This thesis argued that, despite the impressive improvements in the quality of water supply services and growing service coverage, many poor households cannot connect up to the supply system because they are adversely impacted by the relatively large cash down payment that SEEG charges each household to obtain a house connection. My research findings show that: (1) even poor households in Conakry can afford to pay the full cost of water a house connection because in many cases they are already paying between nine to eleven times more to buy water from vendors or their neighbors; and (2) low-income households stand to benefit the most from having a house connection and access to improved water services because they would save a relatively large percentage of their monthly budget by buying water from the formal system instead of vendors or neighbors. My data show that households in the bottom 10 percent of the

income that buy water from neighbors or vendors currently spend about 13 percent of their monthly budget on water. If these same households had a piped connection they would only spend 1.7 percent of their monthly budget for the same amount of water, which would amount to a significant savings for them and, hence a real increase of about 11% in their monthly income.

These findings imply that the poor suffer disproportionately from the large down payment required to connect to the system, and that the tariff rate, although it has increased dramatically since 1989, is not the problem. In contrast to the monthly water charge, the $89 cash down payment that SEEG charges to obtain a house connection represents a substantial percentage of a low-income household's monthly budget. Even though 80% of the total cost of connecting to the system is subsidized, households in the bottom 30% of the expenditure distribution still have to spend between 37 and 52 percent of their monthly budget to make the cash down payment needed to pay the connection charge. My thesis argued that this relatively large cash down payment discourages poor households from connecting to the piped supply system. Because poor families cannot afford to pay such a large cash down payment, middle and upper income families receive most of the benefits of the subsidized connection program which is certainly contrary to the objectives of the water authority and the Guinean government. Once better-off families are connected to the piped supply, they obviously also enjoy the benefits of lower water prices and improved service.

My thesis also argues that without access to piped metered water connections, the poor are adversely affected by increasing block tariffs. Increasing block tariffs have an adverse impact on the poor when they do not have their own metered connection and are forced to buy water from vendors or neighbors. This is ironic given that one of the main arguments for using increasing block tariffs is that they allow for a more equitable allocation of the cost of water supply services because they link the price of water to the volume consumed. Increasing block tariffs link the price of water to the volume consumed by charging a low-rate for the first block of water consumed and then higher rates for additional blocks. Many water supply planners argue that increasing block tariffs area more equitable way of allocating the costs of water production and

distribution because they raise the marginal cost of consumption to the customer, and thus result higher average costs for those who use a relatively large amount of water. On the other hand, the price of water in the fist block is sometimes called the "lifeline rate" because it is set low enough to ensure that poor households can afford to use the amount of water considered essential for human health requirements. My thesis argues that increasing block tariffs have an adverse impact on the poor when they do not have their own metered household connection and are forced to buy water from vendors or neighbors. As the number of poor households that buy water from a given neighbor increases, so does the volume of water sold by that neighbor. As the volume of water sold by the neighbor increases, the price of water is pushed up into the higher priced blocks of the tariff scheme, thereby increasing the average cost of water for every household that buys water from that neighbor.

Since the evidence presented in my thesis indicates that the connection charge in Conakry play a more important role than consumption charges in a low-income households decision about whether to obtain a house connection. I argue the SEEG and SONEG can be more effective at reaching the poor by providing credit to low-income families so that they can amortize the connection cost over time. My thesis points out that there are three advantages to a credit scheme that allows low-income families to spread the cost of a house connection over time. (1) providing loans to families so they can finance the cost of connecting to the piped supply over time will allow more low-income households to connect to the piped supply system; (2) providing loans to cover the cost of connection would not increase the amount of subsidy SEEG and SONEG already provide and the principle and interest payments on the loan can be added to the borrower's monthly water bill; (3) allowing households to finance connection cost over time may increase the amount of money the water supply company collects each month if a substantial number of new households are induced to connect to the system.

Loans could be provided through SEEG and SONEG, through private lenders or NGOs. Studies in other developing countries show that providing loans that allow families to spread the cost of connection over time can substantially increase the number of low-income households that connect to the piped supply system.

My research findings should not be controversial because they conform what several studies in other developing countries have found. My finding that poor households in Conakry stand to benefit and can afford to pay the full cost of water from household connections with similar findings in other developing country cities. My finding that poor households in Conakry are adversely impacted by the up-front cash down payment required to connect to system is also similar to that of several water demand studies carried out recently in Tunisia, Morocco, and Pakistan which show that connection charges can play a important a role than consumption charges in a household's decision about whether to connect to the piped supply system because they often represent a much higher percentage of a families monthly income.

If my findings are not new, the question remains as to why Guinea's water supply authorities have not heeded them. Both findings raise important equity concerns that could be addressed by a credit program that allows low-income households to amortize the cost of a household connection over time.

Appendix 1.

The Structure of Guinea's Urban Water Supply Sector (1961- 1989)

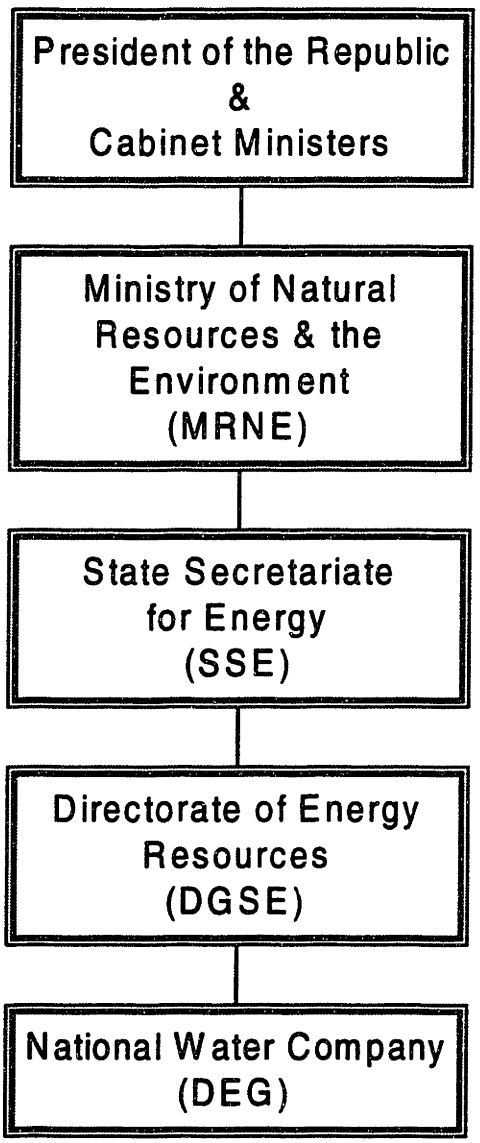


Figure 2.

Appendix 2.

The Structure of Guinea's Urban Water Supply Sector 1989 - Present

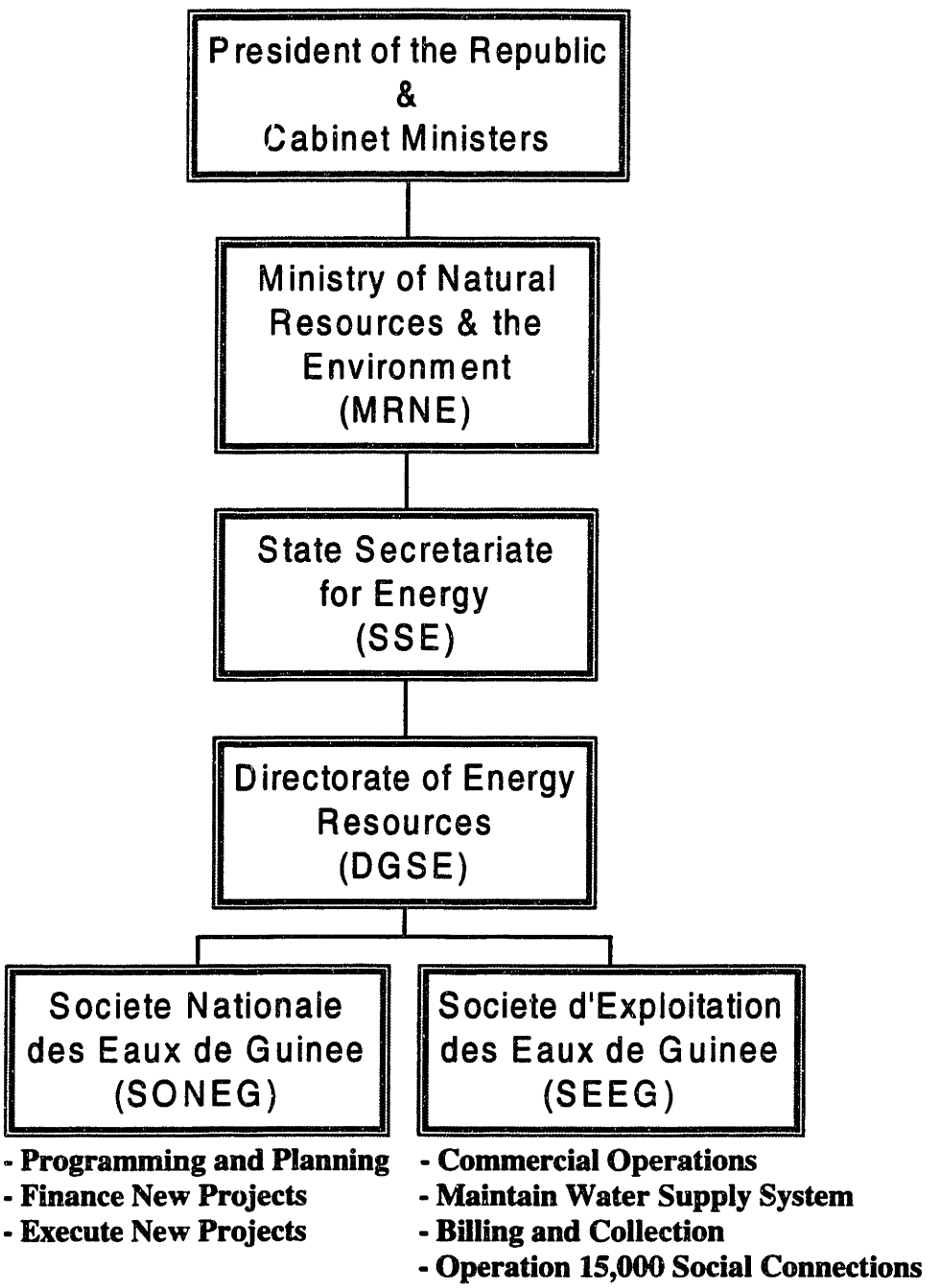


Figure 3.

Bibliography

Altaf, Mir Anjum (1994). "The Economics of Household Response to Inadequate Water Supplies: Evidence from Pakistan." Third World Policy Review, 16(1):41-53.

Briscoe, John, Paulo F. de Castro, Charles Griffen, J. North, and O. Nelson (1990). "Toward Equitable and Sustainable Water Supplies: A Contingent Valuation Study in Brazil." World Bank Economic Review 4(2):115-134.

Briscoe, John (1992). "Poverty and Water Supply: How to Move Forward." Finance and Development 29(4):16-19.

Brookshire, David S., and Dale Whittington (1993). "Water Resource Issues in Developing Countries." Water Resources Research 29(7):1883-1888.

Clapp, Jennifer A. (1994). "Explaining Policy Reform Implementation in Guinea: The Role of Both External and Internal Factors." Journal of International Development 6(3):307-326.

Crane, Randall (1994). "Water Markets, Market Reform and the Urban Poor: Results from Jakarta, Indonesia." World Development, 22(1):71-83.

Fass, S.M. (1993). "Water and Poverty: Implications for Water Planning." Water Resources Research 29(7):1975-1981.

Feder, Gershon and Guy Le Moigne (1994). "Managing Water in a Sustainable Manner." Finance and Development 30(5):24-27.

Friedlander, Paul (1990). "Marginal Support." World Water and Environmental Engineering. October:35-36.

Green, Cathy, and Sally Baden (1995). "Integrated Water Resources Management: A Gender Prespective." IDS Bulletin 26(1):92-100.

Hogrewe, William, Steven D. Joyce, and Eduardo A. Perez (1993). The Unique Challenges of Improving Peri-Urban Sanitation. Wash Technical Report No. 86, Water and Sanitation for Health Project. Washington, D.C.: U.S. Agency for International Development.

Horoya (1995). "Un troisieme 'Project eau' en perspective." Special Number 4047, Sunday, January 1, p. 7.

Hubble, Kenneth L. (1977). "The Residential Demand for Water and Sewerage Services in Developing Countries: A Case Study of Nairobi." Urban and Regional Report 71-14, World Bank Economics Department. Washington, D.C.: The World Bank.

International Labor Office Geneva (1994). Bulletin of Labor Statistics: 1994-4. Geneva, Switzerland: The International Labor Office.

Kalbermatten, John M., DeAnne Julius, and Charles Gunnerson (1982). Appropriate Sanitation Alternatives: A Technical and Economic Appraisal. Baltimore, MD: Johns Hopkins University Press.

Kakwani, N. (1993). "Measuring Poverty: Definitions and Significance Tests with Application to Cote d'Ivoire," in Including the Poor: Proceedings of a Symposium Organized by the World Bank and the International Food Policy Research Institute. Edited by Michael Lipton and Jacques Van Der Gaag. Washington, D.C.: The World Bank.

Katko, Tapio S. (1991). "Reselling and Vending Water." Journal of the American Water Works Association, 83(6):63-69.

Katzman, Martain T. (1977). "Income and Price Elasticities of Demand for Water in Developing Countries." Water Resources Bulletin 13(1):47-55.

Khadam, Mohamed A., Nazih Kh. Shammas, and Yousef Al-Feraiheedi (1991). "Water Losses from Municipal Utilities and their Impacts." Water International 16(4)254-261.

Leechor, Chad (1994). "Ghana: frontrunner in adjustment." In Adjustment in Africa: Lessons from Country Case Studies, edited by Ishrat Husain and Rashid Faruquee. Washington, D.C.: The World Bank.

Lovei, Laszlo, and Dale Whittington (1993). "Rent-Extracting Behavior by Multiple Agents in the Provision of Municipal Water Supply: A Study of Jakarta, Indonesia." Water Resources Research 29(7):1965-1974.

McPhail, Alexander A. (1993). "The 'Five Percent Rule' For Improved Water Service: Can Households Afford More?" World Development 21(6):963-973.

McPhail, Alexandar A. (1994). "Why Don't Households Connect to the Piped Water System? Observations from Tunis, Tunisia." Land Economics 70(2):189-196.

Mu, Xinming, Dale Whittington, and Johm Briscoe (1990). "Modeling Village Water Demand Behavior: A Discrete Choice Approach." Water Resources Research 26(4):521-529.

Ninno, Carlo del (1993). Welfare and Poverty in Conakry: Assessments and Determinants. ENCOMEC Findings, Bulletin No. 11. Washington, D.C., Cornell Food and Nutrition Policy Program.

République de Guinée (1993). Renforcement de L'Alimentation En Eau Potable De Conakry 2eme Project Eau: Marche De Realisation De Branchment Completes. Conakry, Guinée: The Republique de Guinée.

Schneider, Michael L. and E. Earl Whittlatch (1991). "User-Specific Water Demand Elasticities." Journal of Water Resources Planning and Management 117(1):52-73.

Serageldin, Ismail (1994). Water Supply, Sanitation, and Environmental Sustainability: The Financing Challenge. Washington, D.C.: The World Bank.

Singh, Bhanwar, Radhika Ramasubban, Ramesh Bhatia, John Briscoe, Charles C. Griffin, and Chongchun Kim (1993). "Rural Water Supply in Kerala, India: How to Emerge from a Low-Level Equilibrium Trap." Water Resources Research 29(7):1931-1942.

Triche, Thelma A. (1990). "Private Participation in the Delivery of Guinea's Water Supply Services." World Bank Policy, Research, and External Affairs Working Paper 477. Washington, D.C.: The World Bank.

United Nations General Assembly Resolution: A/RES/45/181 (1991). Water International 16(3):19-20.

Whittington, Dale (1992). "Possible Adverse Effects of Increasing Block Water Tariffs in Developing Countries." Economic Development and Cultural Change 41(1):75-87.

Whittington, Dale, Xinming Mu, and Robert Roche (1990). "Calculating the Value of Time Spent Collecting Water: Some Estimates for Ukunda, Kenya." World Development 18(2):269-280.

Whittington, Dale, Donald T. Lauria, and Xinming Mu (1991). "A Study of Water Vending and Willingness to Pay for Water in Onitsha, Nigeria." World Development 19(2/3):179-198.

Whittington, Dale, John Briscoe, Xinming Mu, and William Barron (1991). "Contingent Valuation - Estimating the willingness to pay for housing services: a case study of water supply in southern Haiti." Chapter 11 in, Housing the Poor in the Developing World: Methods of analysis, case studies and policy. Edited by A Graham Tipple and Kenneth G. Willis. London and New York: Routledge, pp. 189-207.

World Bank (1989). Staff Appraisal Report: Republic of Guinea Second Water Supply Project. World Bank Staff Appraisal Report Number 7304-GUI. Washington, D.C.: The World Bank.

World Bank (1992). World Development Report 1992: Development and the Environment. New York, N.Y.: Oxford University Press, Inc.

World Bank (1994). World Development Report 1994: Infrastructure for Development. New York, N.Y.: Oxford University Press, Inc.

World Bank (1995). "Guinea-Third Water Supply and Sanitation Sector Project." Project Information Document No.3GUIPA058/GNPA1075. Washington, D.C.: The World Bank.

World Bank Water Demand Research Team (1993). "The Demand for Water in Rural Areas: Determinants and Policy Implications". The World Bank Research Observer, 8(1):47-70.

Zaroff, Barbara, and Daniel A. Okun (1984). "Water Vending in Developing Countries." Aqua, 5, pp. 289-295.

THESIS PROCESSING SLIP

FIXED FIELD: ill. _____ name _____

index _____ biblio _____

▶ COPIES: Archives Aero Dewey Eng Hum

Lindgren Music Rotch Science

TITLE VARIES ▶☐ _____

_____

_____

NAME VARIES: ▶☑ Taylor

_____

IMPRINT: (COPYRIGHT) _____

▶ COLLATION: 44 l

_____

▶ ADD. DEGREE: _____ ▶ DEPT.: _____

SUPERVISORS: _____

_____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

NOTES:

cat'r: date:

page: 526

▶ DEPT: Urb. Stud

▶ YEAR: 1995 ▶ DEGREE: M.C.P.

▶ NAME: WITTE, Brandt

_____