

## CASE STUDY

Cuddalore and  
Nagapattinam, India

Palm Bay, Oldsmar, and  
Port Orange, Florida

# Improved Water Supply Services in India

CityLinks Partnership between Cuddalore and  
Nagapattinam, India, and Palm Bay, Oldsmar, and  
Port Orange, Florida





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**OVERVIEW:** In December 2004, the Indian coastline experienced the most devastating tsunami in the area's recorded history. Triggered by an earthquake off the coast of Sumatra in the Indonesian Archipelago, the tsunami affected almost all the countries situated around the Bay of Bengal. In India, nearly 80 percent of deaths along the country's southern coast were centered in Tamil Nadu, which also suffered approximately two-thirds of the property damage. Within Tamil Nadu, the districts of Nagapattinam and Cuddalore incurred particularly severe damage and loss of life. Both districts are home to cities of the same names that serve as their administrative centers.

In 2005, USAID/India and ICMA initiated the Post Tsunami Recovery Program to help these two cities redevelop damaged areas, reestablish municipal services, and design disaster preparedness and response plans for the future. The program was carried out using the CityLinks model, employing a partnership in which officials from cities in Florida shared their experience and expertise with Nagapattinam and Cuddalore. Like Tamil Nadu, Florida must continuously prepare for natural disasters, particularly hurricanes. Local and regional government officials are on the front lines of disaster recovery, and these cities have first-hand disaster response experience.

The present case study describes one facet of the Post Tsunami Recovery Program: the improvement of municipal water supply services in the two Indian municipalities. A CityLinks team, including partners from Port Orange, Palm Bay, and Oldsmar, Florida, surveyed citizens to obtain their views of municipal water services, assessed the water distribution system, tested water quality, and helped Cuddalore and Nagapattinam implement sustainable improvements in the system itself and in citizen access to water services.



## Introduction

The municipalities of Cuddalore and Nagapattinam, India, both provide water services to their communities, but they were unable to provide an adequate volume of potable water to all residents. In 2005, USAID/India enlisted the help of ICMA to establish a partnership between these two cities and the Florida cities of Palm Bay, Oldsmar, and Port Orange. The partnership was established for the primary purpose of helping the Indian towns rebuild following the tsunami of December 2004, drawing on the disaster management experience of ICMA and the three U.S. jurisdictions.

One of the objectives of the CityLinks program was to understand the services provided by the municipality and provide technical assistance to help the municipalities improve those services. Because provision of drinking water is a basic municipal service, it became a significant focus of the program, and the team helped the cities assess their water storage and distribution systems.

The team used a multifaceted approach to the drinking water issue in Cuddalore and Nagapattinam: assessing public views and behaviors,



### The CityLinks Model

Through the CityLinks program, ICMA seeks to empower local governments, nongovernmental organizations, the private sector, and citizens to put sustainable local solutions into place. The program does this by establishing relationships between professionals working in local government entities in the United States and their counterparts in developing and transitioning countries. Experience has shown the value of peer exchange in the transfer and adaptation of skills and tools that will help meet the challenges of delivering local government services.

To build the capacities of local governments, ICMA and the U.S. Agency for International Development (USAID) developed a program that has partnered U.S. local government practitioners, their skills, and their creativity with the needs of local government leaders from Eastern Europe, Russia, Asia, Latin America, the Middle East, and Africa. ICMA's current CityLinks activities grew out of the earlier Resource Cities Program, which USAID and ICMA launched in May 1997. Since their inception, these programs have involved some 75 partnership arrangements.

improving the supply itself, and encouraging residents to become knowledgeable about the water services provided by their cities. After diligently surveying citizen needs, studying the water supply system, testing the water, and reviewing improvement options, the CityLinks team installed pressure gauges to monitor water flow and chlorinators to decrease the fecal coliform and *E. coli* contamination in the water in both places. Chlorination is a low-cost, sustainable, effective way to treat water and is a proven means for decreasing disease among citizens. Pressure gauges allow a city to determine when the flow of water has been interrupted, thus ensuring more rapid restoration of service. The installation of chlorinators and pressure gauges increased access to pure drinking water for over 65,000 beneficiaries and showed concrete efforts by Cuddalore and Nagapattinam to improve both the volume and the quality of water.

Once the chlorinators were installed, the CityLinks team, in partnership with the cities, implemented a public relations campaign to encourage citizens to hook up to the municipal water supply and to pay for household connections. Citizens had previously refused to hook up because they were wary of the water quality and questioned the regularity with which water was provided. The campaign publicized the improvements in service delivery and educated citizens about the improved quality of the water.

### The Cities

In both Nagapattinam and Cuddalore, the municipal water system covers much, but not all, of the city. At the start of the project, the municipality of Cuddalore released two hours of piped water to customers each day, and Nagapattinam released two hours of piped water to customers every

### Cuddalore Facts

**Location:** Situated on the Bay of Bengal in Tamil Nadu state, near the junction of the Ponnaiyar River with its tributary, the Gadilam

**Population:** Approximately 159,000

**CityLinks Partners:** Palm Bay, Port Orange, and Oldsmar, Florida

**Partnership Dates:** April 2005 to September 2007

### Nagapattinam Facts

**Location:** A coastal city in the southern state of Tamil Nadu, situated along the Bay of Bengal

**Population:** Approximately 93,000

**CityLinks Partners:** Palm Bay, Port Orange, and Oldsmar, Florida

**Partnership Dates:** April 2005 to September 2007



other day. In addition, service varied within each city, and some water customers received less than others.

Cuddalore is a town of approximately 159,000 residents with 20,700 households in the municipal property tax assessment register. Of these households, 61 percent did not have house connections to the municipal water system, and only 22 percent paid their water bills regularly (defined as paying at least 75 percent of their bills). The Below Poverty Level Survey conducted by the Cuddalore Municipality in 2003-2004 estimated that there were about 34,300 households in Cuddalore, 68 percent of which were lower income, 22 percent of which were middle income, and 10 percent of which were higher income. (Note that this survey identified additional households that were not registered to pay property taxes.)

Nagapattinam is a town of approximately 93,000 people with 16,500 households in the municipal property tax assessment register. Of these households, 63 percent were not connected to the piped water supply system, and only 14 percent paid their water bills regularly. The Below Poverty Level Survey estimated that there were about 20,626 households in Nagapattinam. Of these, 74 percent were lower income, 19 percent middle income, and 7 percent higher income.

### Program Objectives

The overall objectives of the CityLinks water improvement program in Cuddalore and Nagapattinam were as follows:

- To improve the quality and quantity of water delivered through the existing water supply system in each municipality
- To improve access to information for citizens
- To increase transparency in urban governance for better service delivery.



Surveying citizens about municipal services

To further these objectives, the CityLinks team conducted a citizen survey in the two cities, undertook a detailed study of the water supply system, tested the water, installed pressure gauges and chlorinators, and conducted an outreach campaign for city residents about the water supply and how to connect to it.

### Citizen Survey

The first initiative undertaken by the CityLinks team was a survey of citizens of the two municipalities. The central purposes of the survey were to determine why some residents of both cities did not connect to the municipal water system, why some connected residents did not pay their water bills in full, what would motivate residents to connect and pay, and how much residents would be willing to pay for improved water service. Secondary purposes included a general evaluation of municipal services and exploration of reasons why some residents did not pay their property taxes.

The CityLinks team sought technical assistance from the National Research Center (NRC), a U.S.-based organization that conducts citizen surveys for local governments. After detailed discussions, the program team and the NRC team selected appropriate instruments and finalized the mode of conducting the surveys.

Mothertouch, a local firm from Tamil Nadu, was given the job of actually conducting the surveys. A group of men and women who were fluent in Tamil, the local language, were chosen as surveyors, and NRC provided a two-day training session to familiarize them with the survey instrument, the mode of asking questions, and the correct way to complete the survey form. The total sample size for each city was 612 households, stratified by income level (low-income, middle-income, and high-income neighborhoods) payment history (non-customers, customers who paid at least 25 percent of their water bill, and customers who paid less than 25 percent of their water bill). The key findings of the survey were as follows:

**Water Quality** In both cities the vast majority of water customers rated the taste, odor, turbidity, and color of the water that was piped into their homes as fair or poor. Those who bought water from vendors or pumped it from private bore wells rated the water supply better than did water customers who paid to receive water through municipal water pipes connected to their homes.

**Paying for Water** Some residents in both communities chose not to hook into the municipal water system, even though they lived in areas served by the underground pipe system bringing water to neighborhoods. Other residents did subscribe to the in-home water pipe but chose not to pay their monthly water bills in full. The survey team explored the barriers to connecting among non-customers and the reasons some customers chose not to pay their bills.



For most non-customers, the price of connection was the biggest barrier to hooking into the municipal water system, especially for low-income residents. Just 10 percent of the low-income residents surveyed in Cuddalore and 30 percent of those in Nagapattinam said that they could afford the connection fee of 4,000 rupees (Rs), the equivalent of about \$100.00. When asked the amount they would be willing to pay to connect to an improved system, the highest amount offered was by the high-income group, and they offered only about half the current connection fee. The low-income residents said they could pay only about a fifth of the amount currently charged for connection.

The monthly fee for water delivery was less prohibitive. High-income non-customers were willing to pay an amount about equal to the current 40 Rs (\$1.00) per month, and paying customers in both cities reported that they would pay monthly amounts higher than the current fee. Low-income residents in both cities, however, were willing to pay only 60 to 75 percent of the current monthly fee.

Not surprisingly, the greatest level of concern about fees came from the low-income groups in both cities. This has significant consequences, as low-income residents (those earning less than 3,000 Rs, or about \$75, per month) account for about 70 percent of the populations in both Cuddalore and Nagapattinam.

In addition to concern over the size of the fees, respondents cited poor water quality and unreliable service as reasons for not connecting, particularly in Nagapattinam.

**Converting Non-Payers to Payers** Most of the non-paying respondents in Nagapattinam reported that they were unwilling to pay the entire bill because of the inconsistency of service, both seasonally and daily, while most of the non-paying respondents of Cuddalore cited high costs and poor quality as the reasons. The vast majority from both cities agreed that inconsistent delivery and poor water quality were acceptable reasons for not regularly paying their water bills and believed that the way to encourage non-payers to pay was to improve water quality and service consistency. Respondents in Nagapattinam also reported that one reason for not paying was that no one checked whether payments were made, so a customer would not be disconnected for non-payment.

**Survey Findings and Recommendations** Research makes clear the role of expectations in judgments about service quality. There is a quality threshold (not yet quantified) below which residents lose faith in the managers of the local government and therefore are unwilling to invest increased taxes or fees. The citizen survey resulted in the following recommendations:

- Improve the water delivery system, especially in Nagapattinam. Before residents are willing to pay higher fees, they must trust that the system will deliver water of high quality, dependable in volume and frequency.





Overhead tanks are part of the water distribution system.

- Offer a subsidized connection fee that can be paid in installments over time, with a lower installation fee and a temporary reduction in monthly cost for those who pay in full at the time of installation. This will provide an incentive for citizens of all income groups to become customers.
- Increase the installation fee as service delivery improves.
- Establish a credible enforcement system with penalties for non-payment, especially in Nagapattinam.

The survey also highlighted the fact that the high rate of non-payment represented a significant loss of revenue that otherwise could be invested into the system. Non-payers compared to payers were more likely to rely on other sources of water because they were not satisfied with the municipal system and because they could divert their city water fee to private sources, since there was no penalty for non-payment of the city fee.

The survey also suggested that payment of property taxes to support other municipal services should increase after service delivery improves and tax payment enforcement becomes standard.

### Detailed Water Supply System Study

The CityLinks team next studied the water supply systems for the two cities to determine where the water comes from, how it is stored and treated, and how it is distributed to customers. The purpose of the study was to assess the capacity of the system to deliver an adequate volume of palatable water.

**Thirubandhipuram Headworks** At Thirubandhipuram, which is about six kilometers (four miles) from Cuddalore, eight 200-millimeter-diameter bore wells were drilled under the water supply implementation scheme for Cuddalore. One has become defunct, leaving seven in operation. Water is extracted from each of these bore wells at the rate of 1,250 liters (330 gallons) per minute and fed to a reservoir with a capacity of 2 million liters (528,000 gallons). Since the bore well water contains excess iron, two aerators have been installed to remove it. The water is passed through the aerator for iron removal and then collected in the reservoir from which the water is conveyed through a gravity main to five zones. From there, the water is distributed to consumers in the “new town” area through a distribution system consisting of a network of pipes.

**Capper Hills Headworks** There are nineteen bore wells drilled around Capper Hills and Kotangi, also about six kilometers (four miles) from Cuddalore. Water is extracted at 600 liters (158 gallons) per minute from each well and fed to a ground-level reservoir with a capacity of 1.5 million liters (396,000 gallons). Two aerators have been installed to remove iron from the water before it is collected in the reservoir. Six new iron removal plants were also constructed, as the existing aerators did not



### Program Goals

The goals of the water improvement program were to:

- Improve the quality and quantity of water delivered through the existing distribution systems in Cuddalore and Nagapattinam
- Improve access to information for citizens
- Increase transparency in urban governance for better service delivery.

have the required capacity. This water is distributed to four other reservoirs and is ultimately distributed to customers in the “old town” area through a network of pipes.

The water supplied to citizens is at 90 liters (24 gallons) per capita per day, which conforms to the Central Public Health and Environmental Engineering Organization (CPHEEO) recommendations. But consumers experience scarcity of water in several areas due to uneven distribution and inadequate storage. In Kammiampettai, for example, the residents experience acute shortages, and municipal authorities supply additional water delivered by water tankers and trucks. Moreover, the bore wells drilled at the headworks are becoming defunct prematurely due to over-extraction, resulting in the reduction of water supply in the system.

As mentioned earlier, the water extracted from the bore wells at both the headworks is unpalatable because of excess iron, and two aerators have been installed at each of the headworks to remove it. But the capacity of the aerators is inadequate, as the iron content of the bore wells has been progressively increasing due to overextraction of water. At Capper Hills, iron removal plants have now been built to remove the excess iron, but there is no iron removal plant at Thirubandhipuram at present.

### Water Testing

A major finding of the research conducted by NRC and Mothertouch was that people were not paying, owing to poor water quality and inconsistency of water supply. Consequently, the CityLinks team undertook water testing to ascertain the quality of the water supplied by the municipalities. The study was conducted at the end-user level; that is, the collection points were mainly house service connections and public fountains.

In Cuddalore, nineteen samples were taken within the town, including two samples from each of the nine zones and one sample from the tanker truck that delivers water to Kammiampettai, the westernmost part of the town where the pressure is low due to its slightly elevated terrain. In Nagapattinam, twenty samples were collected with the help of the plumbers who work on a contract basis for the municipality. The collected samples were tested at the District Water Testing Laboratory of Tamil Nadu Water Supply and Drainage Board (TWAD) in Cuddalore. Furthermore,





Testing water quality

engineers from Palm Bay, Florida, brought portable water testing kits with them to test the water at several points in the distribution system. The results of both tests (at TWAD and with the portable kits) were the same. The tests showed the following results for turbidity, total dissolved solids, iron content, and bacterial count.

**Turbidity** In both cities, all the samples were within the permissible turbidity limits according to the CPHEEO and the Bureau of Indian Standards (BIS). However, according to World Health Organization (WHO) standards, the turbidity levels of the samples were too close to the maximum permissible limits.

**Total Dissolved Solids** In Cuddalore all samples were within permissible limits for total dissolved solids. In Nagapattinam the samples were all well within the permissible limits, but in Nagore and Pattinacherri, two areas of the city, the levels were higher than in the rest of the samples.

**Iron Content** In Cuddalore a few samples had higher-than-permissible iron content, while all the samples from Nagapattinam were well within the permissible limits.

**Bacteria** The water samples that were tested were satisfactory in terms of the presence of bacteria, but the CityLinks team concluded that bacterial contamination of the water supply could not be ruled out. During site visits, the team had observed that water was disinfected by the addition of bleaching powder at one of the nine sites (Manjakuppam). However, the bleaching powder stock appeared to be very old and badly stored. The bags containing the powder were damaged, exposing the contents to the atmosphere, so they probably had a low chlorine content, and it is likely that disinfection was inadequate.

### Program Implementation

The water improvement program was implemented by:

- Surveying citizens to determine their opinions of the water supply and their willingness to pay connection and monthly fees
- Assessing the capacity of the water extraction and distribution systems
- Testing water quality
- Installing equipment to improve water disinfection and distribution
- Educating citizens about the improvements and encouraging them to connect to the municipal systems.

### Installation of Pressure Gauges

Many respondents to the citizen survey reported problems of insufficient water pressure and hence received insufficient water during the stipulated time. In order to help the city monitor water pressure regularly, the CityLinks team identified locations in the water distribution system where pressure gauges could be installed. The team procured thirteen gauges for Nagapattinam and twelve for Cuddalore and helped each city take a set of readings.

### Installation of Chlorinators

Taken together, the water tests and the citizen survey revealed issues of water volume and quality. In terms of volume, the TWAD Board had already initiated improvements to increase the supply of water for Cuddalore. To avoid duplication, the CityLinks team decided to focus on improving water quality instead.

In terms of quality, disinfection is an important aspect of water supply management. As noted, the team found that the disinfection system needed improvement, based on a site visit to Manjakuppam, where they found that the bleaching powder stock was old and poorly stored.

It was unclear whether disinfection occurred at all in other places, because the team did not have access to test reports on residual chlorine in the distribution system. Though the test reports did not indicate bacterial quality to be unsatisfactory, the contamination of water in the conveyance system as well as in the distribution system could not be ruled out, and hence the consumers thought that there was a health risk. The water could not be considered safe for human consumption.

The CityLinks team believed the conventional method of adding bleaching powder to the water supply suffered from the following deficiencies:

- The bleaching powder available in the market is of unknown quality and may not have adequate chlorine content.
- Stacking the bleaching powder for a long period and exposing it to the atmosphere may result in a reduction in chlorine content.
- The process of manually dumping bleaching powder inside the reservoirs may not be satisfactory, as it depends on the ability of the persons doing the work and the regularity of application. The bleaching powder is handled by unskilled workers, and errors in the calculation of the correct amount cannot be ruled out.
- Direct dumping of bleaching powder inside the reservoir results in sludge deposits and hence reduction of storage capacity.



Chlorinators help improve water quality

To protect consumers from health risks, the CityLinks team sought to implement a satisfactory disinfection system utilizing modern technology. They hoped that addressing citizens' doubts about the safety of the municipal water supply would provide an incentive for them to hook up to the system instead of obtaining water from other sources.

Technical experts advised that gas chlorination is the most efficient and cost-effective drinking water disinfection system in the world, despite its safety requirements. Based on that advice, the CityLinks team provided and installed a chlorinator for each town. The team identified suitable installation sites, prepared detailed proposals to the two cities, and discussed the proposals with stakeholders. The municipalities gave final approvals from their council members for installation.

Implementation of gas-chlorination systems was new to the municipalities, and their installation enhanced local knowledge of advanced disinfection methodology. The municipalities agreed to incur the operational and maintenance costs: manpower to operate the machines; repair and renewal of the equipment; cost of spare parts, chlorine gas, and other consumables; and transportation and hydrostatic testing of the chlorine gas cylinder. This ensures sustainability after the conclusion of the CityLinks program.

### **The Urban Management Centre**

A key partner in the CityLinks team that worked on the Post Tsunami Recovery Program was the Urban Management Centre (UMC), a not-for-profit organization that works in collaboration with ICMA to implement programs that help professionalize urban management in India.

Based in Ahmedabad, UMC is a legacy organization of ICMA and is known as ICMA South Asia. UMC advances good governance by encouraging the creation, sharing, and replication of innovations; by facilitating peer-to-peer exchanges; by conducting hands-on, practical training; and by providing practitioner-based assistance that results in sustainable solutions to local government needs.

Facilitating a network of more than 1,800 cities in India, UMC works extensively in the areas of financial management, sustainable planning solutions, service delivery and environmental management, association development, innovations documentation and transfer, establishment of city-to-city partnerships, capacity building, and urban indicators and performance measurement.

ICMA wishes to acknowledge UMC's contribution to the present case study, which is based on innovative practices documentation completed by UMC for the CityLinks Post Tsunami Recovery Wrap-up Symposium, held in Chennai, India, on September 25, 2007.

### Water Connect Awareness Campaign

Based on survey results, the CityLinks team determined that citizens were willing to hook up to the municipal system but needed to be convinced that the water quality was acceptable and that service would be reliable. They also needed to better understand the fee system. The team therefore sought technical assistance from a local firm to educate citizens and encourage them to connect to the municipal water system and pay for municipal water services on a regular basis. Increasing the number of household connections would not only provide citizens with better, more regular access to water, but would also enable the municipality to generate increased revenue and collect additional fees that could be invested back into improved service delivery.

The local team conducted a rapid survey to get a “feel” for the attitudes and expectations of the public. The following were the main observations:

- A reasonable proportion of the population wanted to have water connections, provided connection was assured within a reasonable time frame and no further (unofficial) charges were insisted on.
- Areas where rampant unauthorized connections existed (most of them made on request of local councilors) did not offer much scope for new and official connections.
- Wherever public fountains are available, it may be more difficult for the team to persuade citizens to apply for individual water connections.
- More than ten resident welfare associations that the team interacted with were very enthusiastic about new water connections provided “extra” charges were not insisted on.
- Most of the people who already had water connections complained about the availability of water supply for less than a half hour per day.

The outreach campaign included:

- An audio campaign through a three-wheeled “auto rickshaw” doing the rounds for six hours every day in selected areas. All areas were covered at least three times during the campaign period.
- Video campaigning with a short, two- to three-minute film featuring appeals by a famous film personality. The film was broadcast about ten times per day for two weeks on the local cable network in Cuddalore (which has a network of about 13,865 cable connections) and also in Nagapattinam.
- Distribution of handouts.

The two municipalities gave full support to the Water Connect program by making relevant information on water connections available.





## **Results and Sustainability**

At the end of the program, almost 20,000 citizens in each city had access to safer drinking water. By the end of September 2007, 670 applications for water connections had been distributed to citizens in Nagapattinam, and approximately 365 applications had been filed. In Cuddalore, approximately 1,200 applications had been distributed, and 980 applications had been filed. The filing of those applications shows a significant change in citizens' perception of the water quality, as well as their interest in supporting the municipal water system. By successfully increasing the number of connections, Cuddalore and Nagapattinam could increase their revenues by at least \$150,000 per year. The program demonstrated that if citizens are given the right information and if processes for accessing municipal services are streamlined, citizens will access those services and pay their bills in a timely manner.

This CityLinks project also built the capacity of the cities to manage and maintain their water systems. The team coordinated closely with municipal staff in both Cuddalore and Nagapattinam, working with them and training them to ensure that the improvements would be sustained after the project ended. The cities showed their commitment by undertaking to regularly measure the pressure of water in the distribution system and to take corrective measures as needed. They also demonstrated commitment by allocating funds for operation and maintenance of the two chlorination plants in the post-project phase. And in both cities, the public awareness campaign motivated citizens to connect to the improved municipal water systems.

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