

Resilient urbanization and infrastructure governance: the case of the Phnom Penh Water Supply Authority, 1993–2007

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Abstract

After years of civil war, Cambodia began to focus on reconstruction and the development of its much-needed infrastructure across the country in the early 1990s. While most government institutions at the capital/provincial levels were crippled, the Phnom Penh Water Supply Authority (PPWSA) was able to provide excellent water service to most of the capital's residents, even the extremely poor. This case represents a traditional utility that was able to creatively experiment with new management practices and solicit community involvement in the administration of its work. It also illustrates the fact that under certain conditions, urban water services can actually generate revenues to subsidize other functions of the government. Specifically, it provides a useful illustration of a resilient governance of infrastructure able to adapt to rapidly changing and challenging circumstances.

Keywords: Cambodia; Community planning; Governance; Resilience; Water supply

This paper examines the relationship between a municipal water supply utility and urban communities in Phnom Penh, Cambodia. In doing so, it contributes to a growing literature on the importance of water infrastructure and services suppliers during rapid urbanization processes, as well as the importance of how good governance of infrastructure development and management can result in planning success, even under the most challenging of circumstances. Importantly, this story also bolsters the view that communities can be effective planners and regulators, and not just passive recipients of development assistance. This latter point is an essential aspect of successful and resilient urbanization.

Today, the Phnom Penh Water Supply Authority (PPWSA) is an autonomous, commercially oriented, and self-sufficient body, which operates under commercial law. Importantly, it is seen as the most efficient and effective customer-oriented public enterprise in Cambodia. Most surprising about its success at serving a city of about 2 million residents is the story of how it rebounded from almost complete destruction to a well-functioning utility during the post-war and post-genocide period. Rather than a

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one-time success, this ability to rebound and weather major challenges was illustrated again when it successfully negotiated a major peace-time increase in urbanization and demand. In this paper, we argue that this rebound – or resilience in more contemporary language – resulted from a distinct relationship between the formal government entity and its community constituents.

In summary, each of the coordinated steps initiated by the PPWSA at the order of its director and supported by development assistance aid was a necessary prerequisite for effective water supply governance. These steps, however, would have been impossible to implement without leadership and engagement at the community level, especially from those areas most in need. An often overlooked component of the PPWSA's success was the fact that leaders in the predominantly poor, periurban communities of Phnom Penh proved to be great facilitators of the success of the PPWSA, once they were effectively engaged.

Literature review: the state, the private sector, communities, and resilience

'Partnerships' in development became important over the 1990s, as development banks and bilateral agencies began to see the potentially important role of the private sector in the provision of basic public goods. Donor fascination with the potential of these partnerships became especially prominent in the provision of water supply, with some key reports advocating and modeling the role of private capital in the provision of public goods (Kessides, 2004). Because urbanization is such a multi-faceted process, partnerships mirroring these many facets are necessary and certainly needed. Such cross-sectoral linkages, in general, fall into three classes of institutions in the provision of clean water in developing cities: the public sector, private firms, and community institutions.

The state/public sector

Nickson (2002) states that it is the role of government to ensure adequate water to all because water is a good with considerable positive externalities, namely a service that brings wider public health benefits to society as a whole. The state can lead the way in water provision in four ways: first, as the provider of water; second, in the role as an enabler; third, as a partner, working with the private sector and/or community; and finally fourth, as a water resource manager. None of these roles are mutually exclusive and often coexist within the same urban settlements.

As a provider, direct provision of a service involves the physical act of constructing, maintaining, and delivering a water network (Allen *et al.*, 2006), and the rationale for state provision is a desire to protect the public interest in supplying essential public services (Kessides, 2004). A natural monopoly exists if total costs are lower when a single enterprise produces the entire output for a given market than when any collection of two or more enterprises divide the production among themselves (Donahue, 1989; Megginson, 2005). This concern of monopolies is mainly due to economies of scale, since much of a municipal water supply system involves engineering scale economies to keep costs relatively low and quality/reliability relatively high, especially regarding water capture and transportation (Kessides, 2004). Due to the total control of the market that a monopoly creates, economists usually suggest that natural monopolies – whether public or private – require some sort of regulation to prevent over-pricing – or in extreme cases gouging – and this has often led to the justification for public ownership and operation (Megginson, 2005).

Private sector partnerships: a critique of state approaches

Starting in the 1980s and through the 1990s, private sector participation in infrastructure was widely seen as a relief from the inefficiencies, corruption and failures in government services provision, including water and sanitation. Privatized services, the theory went, could be managed more effectively, and goods and services rendered more efficiently by private markets than by governments, and at lower costs to the public (Donahue, 1989; Gormley, 1991; Megginson, 2005). At the time, various forms of water and sanitation privatization in developing countries were popular (Budds & McGranahan, 2003).

In addition to efficiency and scope of the state rationales, privatization offers the promise of attracting new resources to the water and other sectors, freeing up public resources for other objectives of public policy (Prasad, 2006). In exchange for such development finance, such partnerships generally transfer either control or ownership of public enterprises or services from the government to the private sector (Gormley, 1991); that is, the government is to steer, not to row (Tendler, 1997), through ‘build-operate-transfer’ (BOT) and sometimes ‘build-operate-own’ (BOO) arrangements.

However, privatization alone is not enough to improve financial performance; other structural reforms, such as regulations, policy and its implementation (Saxena, 2011) play a crucial role (Parker & Kirkpatrick, 2005). Insufficient regulatory frameworks that lack checks and balances have low credibility, allow for widespread corruption, and do not value technical expertise, such as auditing, accounting and a tax system, rate hikes, customers being cut off from service, water quality deterioration, material corrosion, secret contracts, bribery and corruption, and lack of regulations (Lee & Schwab, 2005). Because of this difficulty in matching private finance and management with effective government systems, privatization has not been the panacea envisioned by donor agencies.

From 1995 to 2001, there was \$754 billion in private infrastructure development in developing countries. Although water projects make up only 5% of total investment, the water sector does appear to be the infrastructure sector with the greatest promise – due to steady, long-term cash flows driven by relatively inelastic demand – but it is this sector that has shown the least amount of progress in terms of attracting private investment, with only 5% of the world’s population being served by the formal private sector (Budds & McGranahan, 2003).

Community-based initiatives

While communities working together might not be a new idea, the field of international development has begun to move away from centralized, rational-comprehensive and top-down forms of planning in favor of decentralized, incremental and bottom-up strategies (Tendler, 1997, in Mason & Beard, 2007). Planners and policy-makers acknowledge that development requires a basic transformation in social, economic, and political structures that enable people to help themselves to increase their productivity and income (Grekel, 1995; Spencer, 2008; Spencer & Guzinsky 2010). As Shuber (in Winayanti & Lang, 2004) aptly puts it, ‘urban poor communities are no longer seen as welfare beneficiaries, but partners in a process to improve their communities and as contributors to the overall wellbeing of the city’, and sometimes as an agent of change through collective efforts.

Resilient governance of water infrastructure

The three institutions present in the literature on development described above – government, private sector, and communities – have provided useful frameworks for understanding water governance in peri-urban areas and, in particular, in the provision of basic urban services. Another, perhaps equally appropriate area in the field of governance, particularly as it applies to urban services, is the concept of ‘resilience’.

The term ‘resilience’ originates simultaneously in areas of social science and ecology to describe distinct processes such as psychological development in human responses to traumatic events (e.g. Greene, 2002; Agaibi & Wilson, 2005; Betancourt & Khan, 2008; Tran *et al.*, 2012), as well as in ecological responses to environmental disturbances (e.g. May, 1972; Holling, 1973; Bodin & Wiman, 2004). Other fields such as economics (Farber, 1995), engineering (Hollnagel *et al.*, 2006), and others have applied the term, and interdisciplinary scholars also have explored the intersection of the social and ‘natural’ environments regarding resilience (Adger, 2000; Gunderson & Holling, 2002).

Noticeably absent, however, is an exploration and understanding of the systems of human governance, and the ability to adapt and bounce back. Perhaps closest to this emphasis is the extensive scholarship and gray literature on planning and resilience. This arm of the concept focuses on communities’ vulnerability regarding a range of natural disasters (e.g. Burby *et al.*, 2000; Cutter *et al.*, 2003; Vale & Campanella, 2005), but shies away from a deeper understanding of the process of human governance. This failure of the literature on resilience to directly address the ability of human governance systems to productively adapt to rapid environmental and social change is, perhaps, one of the reasons why the concept remains – after almost 40 years since its introduction into the ecology literature – stubbornly difficult to incorporate into plans of action and implementation.

The lens of resilience upends the characterization described above, in which the state, the private sector, and community groups are distinct actors with clear divisions. Tandler’s (1997) underappreciated concept of blurry public–private boundaries in her discussion of ‘co-production’ is perhaps the best characterization of the structure of governance in periurban areas, and such ‘unorthodox’ approaches to urban services may constitute some of the more important planning institutions in rapidly urbanizing areas (Joshi & Moore, 2004). In this way, the idea of resilience takes on a more powerful approach to community-level participation in development. Our following description of the supply of clean water in Phnom Penh from 1993 to 2007 is an example of resilient urbanization and infrastructure governance.

Data, methods, and historical background

As a descriptive project, we took a qualitative approach towards understanding the evolution of this system and relied on a review of documents, as well as focus group interviews in two communities, and one-on-one interviews with managers of the water system.

The document review component of the research included numerous secondary documents written about the PPWSA, as well as its own internal documents secured through agreements with the PPWSA administration. In particular, we reviewed annual reports, statistics on usage and coverage, as well as strategic plans. Numerous reports and evaluations of the PPWSA have also been conducted by external agencies such as the Asian Development Bank and technical papers published in the water supply literature, and our review included a number of these.

Our document review was complemented by group interviews in three communities: Prey Nokor, Kok Khleang 2, and Ta Ngoun. In each community field visit we were hosted and guided by a local resident, spent several hours walking through each of the communities, sitting with residents and families, drinking tea, and having residents describe and show us their houses and related infrastructure.

Finally, we met with key administrative leaders at the PPWSA after having reviewed the documents and visited the three communities. Our largely qualitative approach to understanding the experience of the PPWSA necessarily has some limitations. Aside from the standard issue of generalizability of case studies, some of our information was gathered through talking with individuals institutionally invested in the success of the program. Knowing this natural bias, we have tried to critically interpret these interviews based on our best judgement, knowing that the source of some of our information risks bias. Nevertheless, without any valid method for externally validating these intentions, and combined with independently organized interviews with local communities, we were able to develop as balanced an understanding of the PPWSA and its history as possible.

Historical development of the PPWSA, 1895–1993

The water supply system for Phnom Penh was initially established in 1895 by a French company called The Indochina Company of Water and Electricity (CEEI). One of its first actions was to build the Chrouy Changva Water Treatment Plant with an average production capacity of 15,000 m³/day with a distribution network of 40 km in the northern part of Daun Penh District. The water supply sector at the time was allowed to earn a profit if it ensured sufficient production and was financially self-sufficient, and CEEI operated effectively on a market basis.

After Cambodia's independence from France, the CEEI became a government-owned company and was renamed the PPWSA in 1960. It was a production and commercial unit of the city government to produce and supply safe drinking water for its population. In 1959, PPWSA renovated and expanded production capacity at the Chrouy Changva Water Treatment Plant to 40,000 m³/day. From 1959 to 1970, the PPWSA increased its production capacity by developing additional new water treatment plants and distribution networks, as well as renovating the old plant, Chamkar Morn Water Treatment Plant with a production capacity of 10,000 m³/day.

In 1966, the Phum Prek Water Treatment Plant was built with a production capacity of 100,000 m³/day, an amount needed to meet the increased water demand of the city's growing population. By the end of 1970, the PPWSA had expanded to reach a total distribution pipeline network of 288 km, significantly increasing the system capacity to supply the city and at the same time generating considerable revenue. Around this time, it gained sufficient economies of scale to become financially self-sufficient, operating without any external assistance, and standing alone as a revenue-positive utility. Intervening political events in subsequent years, however, undermined this significant achievement.

The two decades following the late 1960s were filled with considerable political turmoil and insecurity due to the Viet Nam war and specifically the components where fighting, bombing, and eventually genocide occurred in Cambodia. Importantly, an original plan to make the PPWSA an autonomous enterprise, independent of the municipal government at that time, was postponed as a result of the civil war raging throughout the country. In 1975, the genocidal Khmer Rouge regime (1975–1979) took over the country and made Cambodia a classless society by forcing people to work in agricultural communes, and the water supply of Phnom Penh's overall operations was almost completely halted because the entirety of the urban population was forced to evacuate the city to live in rural areas.

Thus, urban water management and supply during the Khmer Rouge period was only for a small number of its cadres and soldiers living in Phnom Penh, and almost no attention was paid to the three water treatment plants, or the connected production networks, maintenance operations, and supply networks (Biswas & Tortajada, 2010).

With the collapse of the Khmer Rouge regime in 1979, the PPWSA faced tremendous challenges in rehabilitating the water treatment plants and in managing the water supply sector due to dysfunction and a lack of power supply that resulted from the war's widespread destruction. Skilled personnel were simply not available to properly maintain and operate the existing urban water system, and available records of the urban utilities had been destroyed.

Reviving the plans that had been shelved in 1966, the PPWSA became an autonomous body in 1986. Despite this administrative change, it operated under heavy subsidy from the Government of Cambodia until 1993, and even so, the overall capacity remained severely compromised. Water production capacity in Phnom Penh had decreased by about half, from 150,000 m³/day in 1975 to 75,000 m³/day in 1993. The system's total revenue covered only about half of operating cost (PPWSA, 1996, 1999), and there were over 500 staff working for PPWSA with an average monthly salary of 50,000 riels (about US\$ 20.00 at that time). They were unqualified, underpaid, lacked motivation, and inefficient. Moreover, nepotism was widely practiced, and upper management staff was often seen to be working for self-interest rather than for the interest of the PPWSA.

The Paris Peace Agreement of the early 1990s paved the way for sustained economic development and opened Cambodia to the outside world. With the relative political stability resulting from this agreement, a national coalition, and assistance of the United Nations in the country's first national election processes, the Royal Government of Cambodia was able to secure development assistance from a number of international agencies, and the PPWSA was transformed into a Public Enterprise with true financial and administrative autonomy in 1996 under the Sub-decree No. 52 (PPWSA, 1999).

Context of rapid development: periurbanization and water demand

Starting in 1979, the population had started to move back to Phnom Penh because of the Peace Agreement, the change in the country's politics and economic development policy, and a growing set of urban job opportunities. Subsequent disastrous flooding in Cambodia's rural areas in the early 2000s compounded these political and economic forces, resulting in rapid urbanization and exponential growth in Phnom Penh. Because they were self-reliant and used to habits of living in a rural setting, most of these migrants managed to live without a regular supply of water and lack of sanitation as if they were living in rural area (Biswas & Tortajada, 2010). Over time, however, this rural–urban migration placed significant pressures on urban services that could not be addressed by simply importing a rural lifestyle into the city. Figure 1 shows the PPWSA water stations from 1993 onwards.

From 1993 to 2008, Phnom Penh had grown from a population of about 700,000 to about 1.3 million, roughly 10% of the country's population; equally important, the city faced growth rates annualized at about 5% that promised sustained demand for its services, whereas the annual growth rate of the urban population at the national level was lower at about 3.4% (Ministry of Planning, 2000). An urbanization study in 2015 found that the urban population nationwide in 2014 accounted for nearly 30% and will increase to about 44% by 2030, which will put even more pressure on the capacities for service delivery. Thus, the Royal Government of Cambodia has prioritized urban services and especially clean water supplies. The national targets to improve access to safe water in the Cambodian millennium

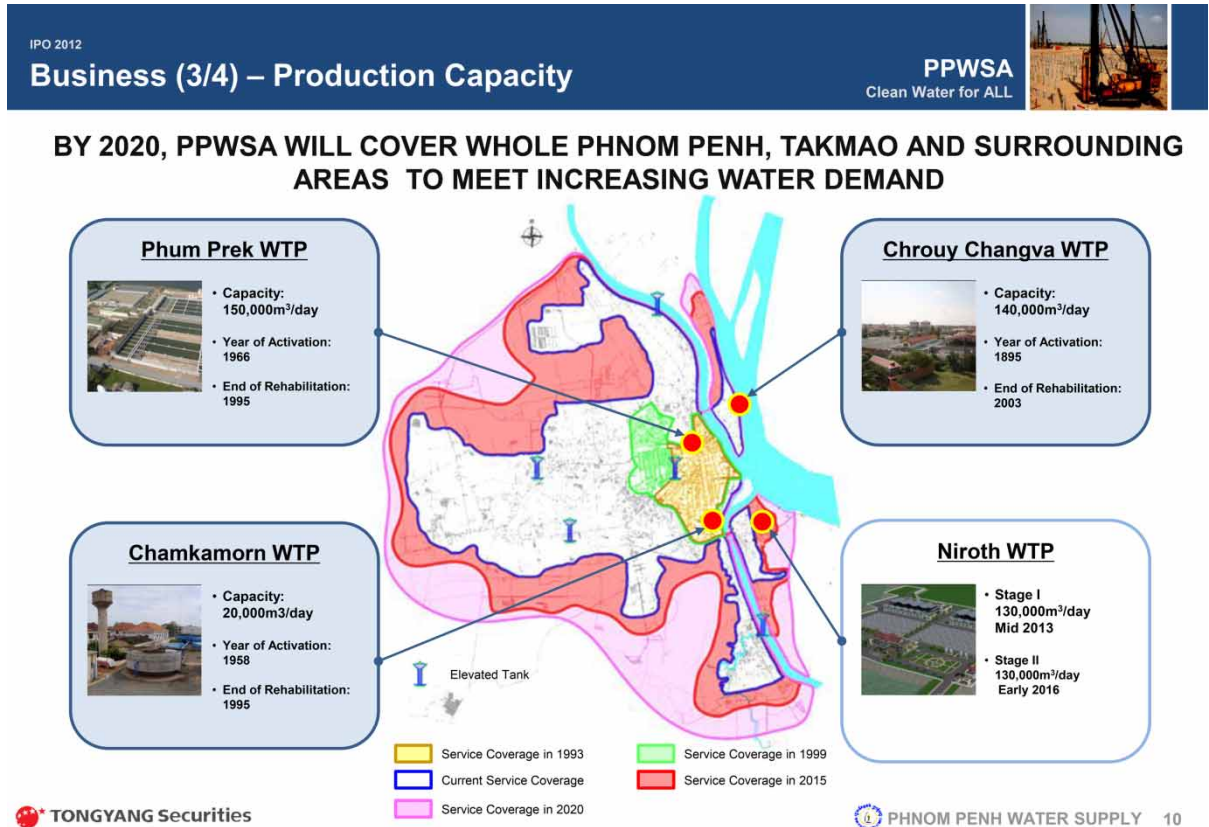


Fig. 1. The existing and planned PPWSA water supply stations and coverage, 1993–2020. Source: PPWSA¹.

development goals (CMDGs) were met early, and in Phnom Penh's central districts², the overall target had been met by 2007.

The PPWSA had rapidly increased the supply capacity and expanded its served population to reach approximately 800,000 people in urban and periurban areas of the city by 2004. Conservatively estimated, water demand was projected to increase from 133,402 m³/day in 2004 to 271,093 m³/day in 2020 on a daily average basis and from 204,027 m³/day in 2004 to 414,612 m³/day in 2020 on a maximum basis (PPWSA, 2006). However, rapid urbanization and economic development in the city with a prominent presence of hotel and commercial development, numerous garment factories in periurban areas, and particularly the recent expansion of municipal boundaries meant that the water demand exceeded projections. By 2007, water demand in the whole city had already reached 236,000 m³/day, which was 1,000 m³/day in excess of the water production capacity at the time (235,000 m³/day), and almost equal to the 2020 projections (interview with H.E. Ek Son Chan, 2007). Despite this

¹ <http://www.ppwsa.com.kh/en/index.php?page=vision-and-mission>.

² Administratively, Phnom Penh consists of 12 districts (*khans* in Khmer). Four khans in the central core are considered urban and other khans are considered rural (or suburban/periurban). Recently, 20 communes of adjacent districts of neighboring provinces were transferred to form districts of the capital.

growth in demand, the PPWSA, by 2007, was still able to manage its supply for 24 hours/day. Some PPWSA officials, however, feared that water demand in the dry season would be too great due to water resource limits. To provide supplemental water, PPWSA also had plans to dig deep wells as an additional source (PPWSA, 2006) as indicated in the master plan and feasibility study of the Phnom Penh water supply system. The plan became a blueprint for the utility's development over subsequent years, and all projects supported by donors had to fit within this framework. It was, however, only one of the several other important factors that have contributed to the remarkable and steady improvements in the performance of the PPWSA (Biswas & Tortajada, 2010).

In summary, from the mid-1990s through the late 2000s, although the PPWSA was faced with a range of major challenges arising from rapid periurbanization and industrialization, it managed to increase the annual water production by over 400% and the distribution network by over 500%. Its approach to meeting these increased demands under strict financial constraints provides an example of resilient urban services in which the state agency becomes a community organizer and blurs the line between public and community roles in service provision.

Institutional resilience in the supply of Phnom Penh's Water: public sector activism and community-level oversight, 1993–2007

The PPWSA has been heralded as an exemplary water-delivery system run by a public body in Asia and Pacific and beyond (Macan-Marker, 2003). Both the utility and its leader have received numerous awards and citations³. In 2004, the PPWSA received the Asian Development Bank's Water Prize for its dramatic overhaul of Phnom Penh's water supply system and for demonstrating leadership and innovation in project financing and governance. In 2006, the Director received the *Ramon Magsaysay Award for Public Service* in recognition of his exemplary rehabilitation of a ruined public utility, bringing safe drinking water to more than a million of people in Phnom Penh. This success, we argue below, is the result of the combination of public sector activism and community level oversight.

Public sector activism

The loss due to unaccounted for water (UFW) was a major problem for the PPWSA in 1993, a year in which it exceeded 70%. Overcoming this problem required a strict systems approach, with several inter-related components (Biswas & Tortajada, 2010). UFW reduction was not possible without a cooperative and motivated staff, which was not in place during the early 1990s. Changing the work culture was the first priority, a difficult task since it required enforcement in a sensitive, fair, and transparent manner by individuals with significant incentives to abuse their positions. A changed working culture started with the senior officials who had to become role models. According to our informants, starting at the top was the key to dramatically improving water service provision. Whereas PPWSA staff used to cause many of the problems, they had to become a part of the solution.

³ This section draws heavily on the article contributed by Ma. Christina Dueñas, Water Knowledge and Communication Coordinator of ADB, who interviewed H.E. Ek Son Chan on Nonrevenue Water. The article can be retrieved from www.adb.org/water/champions/chan.asp (retrieved on 15 June 2007). Included in this section is also data and information we interviewed H.E. EK Son Chan on our visit to Phnom Penh between December 2006 and January 2007.

To counter the negative aspects and inefficiencies plaguing the PPWSA in these early post-war years, a ‘change of culture’ was initiated by the PPWSA General Director, Ek Son Chan, to educate, motivate, and discipline both his staff and the user-public. He began by restructuring the whole organization: higher management was given more responsibility, members of a more dynamic younger generation who possessed better qualifications were promoted to higher positions, staff were given training in the various technical skills needed to run the PPWSA effectively, higher salaries, allowances, and bonuses were introduced for better performance, and penalties were meted out for poor performance.

The second priority was to ensure higher revenue generation in the PPWSA. To achieve this, the PPWSA took a five-step approach (PPWSA, 2005). First, PPWSA began to install water meters for all its connections. In 1996, only 85% of its 32,404 connections were tracked by water meters, with the balance being unmeasured and therefore free to the public. By 2007, all the 152,696 connections had water meters, an almost five-fold increase in absolute numbers as well as a 15% point increase. With the improvement in the water quality, PPWSA even introduced new, more accurate meters.

Secondly, PPWSA set up an inspection team to stop illegal connections. First, the public was advised to eliminate illegal connections, and the PPWSA provided incentives to anyone able to provide information on illegal connections. This new incentive was a radical and difficult change because most of the illegal connections were linked to PPWSA employees. With help from the public who reported these links, PPWSA was able to weed out employees using their positions to benefit family and friends.

Another challenge the PPWSA faced was a high number of illegal water resellers. Records show that 90% of the water resellers in Phnom Penh had stolen PPWSA water. To eliminate this problem, PPWSA implemented a program to control these resellers, involving specific connections, official certification, and a specialized PPWSA team to regulate them. The Director, however, recognized that he could not rely on controlling the supply of resold water alone; rather, he saw it as also a problem of demand for resold water. Thus, a key strategy for eliminating illegal resellers was for PPWSA to reduce the demand for retailed water by extending its distribution network to supply customers directly at an affordable rate.

Third, PPWSA revised and improved its consumer files by administering a consumer survey to identify the actual number of connections. The survey found that in 1993, there were 12,980 documented connections that were not receiving water from PPWSA, while 13,901 others were receiving water but were not documented. The consumer files were corrected and updated, and in 1995, incorporated into an automatic billing system supported by the Government of France. This computerized system was completed in 1996 and enabled the agency, for the first time, to accurately track its customers.

Fourth, PPWSA embarked on a program to educate the public, especially high-ranking families, other government agencies, and even the top management of PPWSA itself on the importance of paying water bills. With a history of relatively unregulated and unenforced controls on water supply, wealthy and powerful individuals and ‘VIP’ families in Phnom Penh had become used to securing their water supply for free, or in exchange for informal gifts. To ensure a fair service with credibility among the broader population, the Director made a commitment to make these customers understand that PPWSA could not continue supplying water if they did not pay their bill, and that the practice up until 1993 of providing water free of charge was over. With strong support from the Prime Minister and relying on the principle of ‘leadership by example’, PPWSA managed to convince those high-ranking officials to pay their bills, such that it matched that of the non-VIPs.

Fifth, and what initially seemed like the most difficult task of all, PPWSA had to increase the water tariff to cover its costs. To avoid having a huge jump in the water tariff, PPWSA proposed to have a

three-step increase in the water tariff over a period of 7 years. With the strong support of international donors and commitment from the Government of Cambodia, particularly the Governor of Phnom Penh City, the Minister of Finance and the Prime Minister, the first step increase was achieved in 1997 and the second step in 2001. However, PPWSA – in the end – did not push for the third step once it realized that its revenue had already fully recovered the cost due to the higher collection ratio and the drop in UFW that had resulted from the four prior steps.

At the same time that these institutional steps were being taken, development agencies provided significant material support. In 1996, with finance provided by the Asian Development Bank, the World Bank, and the Governments of France and Japan, PPWSA started to renew and rehabilitate its distribution network, which was achieved by 2002. Later, with finance from the Asian Development Bank, a new 16 km transmission line was installed across the city of Phnom Penh, thereby covering 100% of the inner city of Phnom Penh and expanding out into suburban areas. This eventually covered approximately 90% of the whole Phnom Penh municipality, and by 2009, it covered about 95%.

By 2006, the total revenue of PPWSA was 78.5 billion riels, a vastly greater sum than the 13.0 billion riels that had been collected in 1997 (PPWSA, 2007a). Several years later, the combined capital and revenue fund of PPWSA was 434 billion riels, and there were 152,696 connections to PPWSA. Despite these tremendous gains in fiscal sustainability, however, the PPWSA had a long way to go in terms of serving the poor.

Community-level oversight: connecting the last 10%

In 1999, government statistics showed that there were 15,000 poor families living legally and illegally in Phnom Penh (PPWSA, 2004). They had an average daily income between USD 0.85 and USD 2.50 per family. These poor communities in Phnom Penh were mostly located at places with difficult access and poor sanitation, drainage, and other hygiene-related infrastructures⁴. Thus, providing access to clean water was essential as an anti-poverty program.

At the time, informal providers to these households provided water service at 8 to 10 times the cost of the municipal rate in Phnom Penh, so reaching the final 10% of the population without service coverage represented a question of social equity as much as one of efficiency. In an attempt to eliminate such water providers, PPWSA developed a two-tiered community planning approach: first, work with local community leaders to develop a creative subsidy program and second, control water theft from the production system by engaging local users proactively.

On the first approach, community residents determined how best to make connections affordable to poor households, defining an innovative mechanism to provide cross-subsidy for water connection to poor households unable to pay the full cost of connection. At the same time that they were recommending these cross subsidies, community leaders asked for, and developed innovative experiments with

⁴ It should be noted that there are two categories of the poor that should be distinguished in this paper. In all PPWSA documents, they used two terms to refer to these two types. First, PPWSA uses ‘inside community’ to mean the urban poor – or ‘squatters’ in a more traditional term. These people are, by law, not entitled to have a permanent title, but in some cases, they may be provided with tenure security. In general, the poor in this category are often formed into community – urban poor communities, for example. In the main, these poor live in informal settlements on which lands belong to the public or private individuals. It is noted that the term ‘community’ is often attached to them and they often have representatives. Second, PPWSA uses ‘outside community’ to mean the poor in general. This type of the poor legally live on their own land but PPWSA defined them as poor families based its criteria.

community education and payment arrangements that made their residents' lives easier, but also would eventually result in increased system coverage and cost recovery for PPWSA. As an added benefit to morale, these recommendations asked PPWSA staff to do more work, for which they eventually would be more highly compensated.

PPWSA efforts to control UFW in poor communities highlight the complementary role of community oversight and regulation in resilient water supply services. The first step the Director took to control UFW was to involve PPWSA staff at the very local community level through incentives or punishments in ways that they became PPWSA's champions.

The second mechanism to control UFW was to include community residents as active partners instead of passive recipients of water services. The PPWSA General Director recognized that they would not have caught as many of the commercial or physical losses in the water system if the public had not been involved in management. Extensive discussions with the Director and his staff revealed that, with the support of PPWSA, communities organized UFW Control Teams to reduce the non-paid-for water being taken out of the pipes illegally. According to staff, the teams were assigned to control 41 distinct distribution zones by investigating and repairing leaks and disconnecting illegal connections. Incentives were given when the teams could reduce UFW in their zones, and fines for those whose zones had increased UFW.

Poor communities also faced problems distinct from UFW that affected the PPWSA's bottom line. Without access to the public water utility, the community knew that they had to pay about USD 0.50 per cubic meter of water, a very expensive rate. Even more present in their minds, however, was the very real cost of taking the time to transport their water from the private vendors to their homes, which often took away large portions of their days – especially for women – that could not be allocated to selling their labor or engaging in small business activities. During community meetings with PPWSA, residents explained that these costs had negative impacts on their family budgets that went well beyond the financial cost of the water itself and their technical access to it.

Recognizing and valuing these concerns, the PPWSA made it official policy to supply clean and safe water directly these poor families, thereby lessening the burden of buying water at a high rate from water resellers. By 2004, PPWSA had made a total of 7,000 connections among the 81 poor communities within Phnom Penh. This figure reflects an almost 100% supply to all poor families living along the coverage area in Phnom Penh (PPWSA, 2005). This remarkable success, however, was not simply done through a formulaic response by PPWSA, but required strong commitment and support from the local community to solve embedded local challenges.

The presence of illegal water resellers in these communities was particularly problematic. As market actors creating small businesses out of a public service, these resellers not only sustained high prices for clean water, but also failed to contribute to the infrastructure through tariffs because most of their water was stolen through illegal connections. Moreover, often these resellers were prominent members of the local community.

In 1998, PPWSA had 53 community representatives getting PPWSA for their communities, who had become water vendors making profits from the poor and from PPWSA. While they might once have been productive advocates and managers to help informal communities access services, these vendors had become small fiefdoms blocking access once the PPWSA adopted its pro-poor policy. Thus, a natural alliance – though latent – existed between the poor communities and PPWSA to end the dominance of the powerful water vendors.

The actualization of this alliance began in that year, when the PPWSA received a loan from the World Bank, in which a small part was for the purpose of supplying water to the poor. Based on this loan,

PPWSA proposed a ‘Clean Water to the Poor’ pilot program that significantly subsidized connections in a small number of communities. To comply with this policy, the poor had to have an official place of residence, and agree to pay both the connection/meter expense amortized over time with interest, as well as monthly usage fees.

The primary challenge with this program was the ability of poor communities to pay a high connection fee of 424,840 riels in total including deposit of 41,400 riels and VAT (value-added tax) of 10%. Understanding that this connection fee, including the water meter, was quite expensive for the poor, PPWSA allowed residents to pay over 10 monthly installments. To increase take-up rates for this plan, PPWSA created two working teams to disseminate this information and explain the PPWSA principles to the poor in their localities so that they could better understand both the financial and health benefits. Moreover, these teams did not just hold one meeting, but counseled households from the information dissemination stage through the moment they got their connections. By implementing this policy and the associated support teams, there were 474 connections by 2000.

Based on the preliminary success of the pilot program, in 2000, PPWSA decided to expand water services to the poor elsewhere in the municipality. This second stage of the strategy, however, allowed, and even required that communities engage actively in system planning and management. Thus, this phase of expansion required that the newly connected households: (1) not change their place of living or move; (2) cooperate in water connection work; (3) report to PPWSA when there is or when they see water leakage; (4) agree to control or report illegal connections; and (5) refrain from re-selling water for profit.

In 2001, to enhance and expand water services to the poor in the four central districts in Phnom Penh, PPWSA did a survey in the newly connected communities to understand people’s opinions and suggestions to improve its services. As a result, it found that there were still many people unconnected to the PPWSA system. Two main reasons for this were either they did not know the benefit from the connection or that – even with the existing subsidy – they could not afford to pay for it. In June 2001, PPWSA adjusted its policy to include three repayment categories instead of just one – 10 months, 15 months, or 20 months – which could be chosen by each poor household, but based on their financial ability. Additionally, the PPWSA discounted 20% of the connection fee for poor households if they were part of an organized community.

In May 2005, the PPWSA further subsidized its connection fees for poor residents, creating four subsidy categories: 30%, 50%, 70%, and 100% of the total connection fee based on their extent of poverty (PPWSA, 2007b). PPWSA assesses the extent of poverty based on the criteria such as household assets and physical housing condition (e.g. if they look rich or not based on what they own; how good their house conditions appeared) as well as household income and needs. To ensure the accuracy of the evaluation, the teams undertook direct observation to each household that applied for the subsidy (personal communication with Mr. Sem Kheng Lin, June 2007).

By the end of 2007, through its ‘Clean Water to the Poor’ program, PPWSA had installed a total of 14,872 water connections for the poor in both central city areas and periurban areas. The following table shows the kind of connections based on various subsidy categories and installment payment plans: 610 families received 100% subsidy, 533 of which lived in the periurban areas of the municipality; 10,434 families are on installment payment for their water connection (Table 1). As of the end of May 2007, the total subsidy amount provided by PPWSA was 936 million riels or USD 228,462.00.

As important as these technical programs were for making clean water connections affordable for the poor, they would not have seen nearly as much success if they had not been combined with two critical adaptations by the PPWSA suggested by community leaders. First, through interviews with local community leaders, the PPWSA found that poor households that had connected earlier often spent more on

Table 1. Connections on subsidy and installment payment.

Kind of connection	Central city areas	Periurban areas	Total
100% subsidy	77	533	610
70% subsidy	188	1,548	1,736
50% subsidy	254	1,210	1,464
30% subsidy	117	511	625
Installment payment	5,138	5,296	10,434
Total	5,774	9,098	14,872

Source: PPWSA (2007b).

the transportation to pay their monthly water bill than the amount of the bill itself. As periurban communities, these households lived – by definition – somewhat distant from the payment center located at the PPWSA central facilities in downtown Phnom Penh. Too poor to afford their own motorized transportation, these households would have to pay for a motorcycle taxi to make a special trip to the payment center. Without many regular reasons to make the trip downtown, these households found that it made more sense to just not pay their bill than to pay the equivalent of twice the cost of service, just to pay the bill. Recognizing this limitation of the system's ability to serve poor and periurban communities, PPWSA opened a number of limited community payment centers and, equally importantly, set up accountability systems such that the engineers making regular visits to these communities were able to collect regular payments from these households when they made their visits to check up on pipes and other parts of the physical infrastructure.

The second innovative practice that PPWSA implemented at the suggestion of community leaders was to educate the periurban communities about the importance of clean urban water. Through the pilot program, the PPWSA found that for years, the residents had felt it an overly burdensome expense to pay for a resource that had formerly been free or open access. Thus, their first and primary problem was getting the communities to understand the true value of what PPWSA was selling. In preliminary meetings with local leaders, PPWSA learned that many of the community members – having come from more rural areas or grown up in place at a time when clean natural sources of water were plentiful – did not place an appropriate value on clean water such that they saw what PPWSA was providing as worth paying much for.

At the recommendation of these communities, PPWSA stimulated demand in these areas by having its engineers provide community workshops in which they explained the health risks of using untreated urban water contaminated by chemicals and heavy metals that might not be apparent through taste or smell. They also demonstrated the high quality of the water by drinking it in front of communities – something that they had even been unable to do with the natural sources they had been used to before – and showing them the process of filtration and treatment. Finally, they would show communities the physical equipment and diagrams of the process for constructing the system so that they might understand better the actual costs of providing the water service.

Without community recommendations to educate the residents on the importance of clean water, the quality of what PPWSA was providing, and the costs inherent to providing it, the system would have been subject to some common challenges of any kind of new infrastructure: a lack of understanding of what the product is (e.g. Spencer, 2007). Of course, some members remained aloof because even this cost was too high, but the community education sessions provided by PPWSA eliminated a community feeling that they were being asked to pay for something that up until then had been free.

Overall, by responding to the recommendations of the local leadership in these poor periurban communities, the PPWSA greatly reduced unforeseen barriers to payment and increased overall demand. In doing so, it generated a much greater understanding among these communities – and potential customers – about the services that they ultimately benefited from in terms of new connections able to pay their bills, as well as countless numbers of users that understood the value of the service and saw their collective interests in protecting the infrastructure and making sure that all users paid their fair share. With these aligned interests in place, these same community residents became the eyes and ears of PPWSA in its efforts to ensure that illegal taps and breakages were immediately reported and addressed.

Concluding thoughts: conceptualizing resilient governance through public sector activism and community-level oversight

Resilient governance is the ability of political and cultural systems to bounce back from severe disruptions. PPWSA's ability to recover in the post-war and post-genocide period to improve on their pre-war system is a unique case study for understanding some key components of resilient governance. The experience of water governance under the public sector in Phnom Penh indicates that water does not have to be free, even under conditions of extreme poverty. Water services in this city and its adjacent regions became quite efficient between 1993 and 2007 in their ability to cover most of the utility's designated service areas. The most important aspect in the provision of safe drinking water was that the poorest of the poor were also able to enjoy access to the PPWSA utility. These successes would not have been possible without changing the culture of PPWSA and, in particular, a change that engaged and encouraged communities in planning and management capacities. These reforms enabled PPWSA to recover its costs of production and transmission, and become financially viable, achieving full cost recovery by 1998 and subsequently able to generate modest profits.

The success of the agency is due, in large part, to strong leadership and commitment of PPWSA leaders and managers, and in particular, their communication and respect for their service area communities. Key decisions such as promoting dynamic and qualified personnel to decision-making positions, creating long-term advisory teams of poor households, and engaging them in 'policing' PPWSA infrastructure were particularly important. However, this was only possible because of supportive political pressures that were identified and applied strategically. As such, PPWSAs becoming autonomous from prominent figures and local fiefdoms contributed greatly to its success. This allowed PPWSA to develop its payment and tariff structure and culture with enthusiastic and motivated staff responsive to consumer demand and operations able to generate revenues for further infrastructure development. At the same time, community education strategies that both built strategic alliances between PPWSA and the urban poor, as well as stimulated demand for this new kind of urban resource to the poor, were essential.

Despite some emerging 'next-generation' challenges to the PPWSA after 2007, the 1993–2007 period of rebuilding and growth was remarkable and more generalizable to other urbanizing contexts if we see it as an example of sustainable and resilient infrastructure governance under conditions of rapid change. In particular, based on the experience of the PPWSA, one might see government bureaucrats as community organizers and advocates for the poor, and community residents as regulators and local water managers as well as vice versa. These reversals of roles and intermeshing of responsibilities suggest that what may be more important than the types of institutions involved in the production of water is the porousness of their institutional boundaries and the pragmatic adaptability of their institutional

cultures. Moreover, these blurred lines suggest an intimate relationship between the expansion of urban infrastructure and the growth of a resilient and adaptable system of urban governance that will progressively become easier to manage over time as the working relationship between community and utility – or the customer and the provider – strengthens through successful collaboration.

On a more theoretical level, the case of the PPWSA suggests that creative leadership of public utility institutions in the area of water supply, in partnership with active community insight, can result in resilient forms of governance. The historical period described in this paper covers two major shocks to the operations of the utility: first, the Cambodian war and genocide, and subsequently, a major unplanned in-migration of rural residents to Phnom Penh. Through each of these shocks, the PPWSA was able to look internally to its own operations as opportunities to change the administration of the utility, as well as externally to the communities of users to assist in basic operations. This creative partnership between the utility and its constituents over a 15-year period, we argue, is the basis for the system's resilience and ability to bounce back and forward during different types of shocks to the water systems. In describing this history of water governance in Phnom Penh, we hope to shift an understanding of resilient urbanization from those focused on engineering and ecological systems to include systems of governance.

Such a shift to governance provides a flexible framework for maintaining basic services to citizens in a context where it is never clear whether the next shock to the system will be environmental, economic, or political. Our focus on an example of how governance can be resilient through community partnership is one that can be applied broadly from transportation to public health and jobs, each of which are essential systems that citizens rely on, yet are also subject to major shocks. The example of the PPWSA should illustrate how a Ministry of Transportation might respond to a shock whereby roads and rails might be flooded, a Ministry of Commerce might respond to the loss of a major trading partner, or a Ministry of Health might respond to the outbreak of Avian Influenza.

While the PPWSA's creative partnership has led to a resilient governance of water supply in Phnom Penh, future research should explore how other cities and systems have managed their services through similar challenges like those described above, with particular attention to how such creative approaches can be implemented at larger scales.

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