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Community resilience and critical urban infrastructure: Where adaptive capacities meet vulnerabilities

In many of Southeast Asia's cities, critical infrastructure development is concentrated in affluent areas; and poor communities, lacking access to basic services, often resort to alternatives that may be unsafe or more expensive. Crucially for policymakers, these options leave communities vulnerable to a range of threats that reduce not just their own long-term resilience, but also that of the city overall. An examination of the water infrastructure in Jakarta, Manila and Ho Chi Minh City amply illustrates this. The cases suggest that to bring about greater community resilience, and thus ensure security and sustainable development, governments must vigorously upgrade critical infrastructure not just to improve efficiency, but also to achieve equity among urban communities.

By Sofiah Jamil and Gianna Gayle Amul

Communities in slum areas such as this one in Ho Chi Minh City often lack access to critical infrastructure, forcing them to rely on alternative solutions that may turn out to be unsafe.
Credit: Axel Drainville / flickr.

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Introduction

Critical infrastructure refers to the structures, facilities, supplies and technological systems needed for development, such as roads, telecommunication networks, piped water and drainage systems, and electricity grids. While the role of critical infrastructure in ensuring development and security is well-recognised by stakeholders, the actual building and provision of such infrastructure, especially in developing countries, has often proceeded in an uneven manner.

- **Consortium of NTS Studies in Asia Website**
- **RSIS Centre for NTS Studies Website**

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In many cities in developing countries, critical infrastructure development is concentrated in affluent areas. Meanwhile, the poor often lack access to basic amenities, and are forced to resort to alternatives that may be unsafe and perhaps more expensive as well. Such solutions have negative repercussions, discussed in greater detail later in this paper, that could affect not just the long-term resilience of urban poor communities, but also that of the city overall. This NTS Insight thus argues that, while governments must vigorously upgrade critical infrastructure, they need go beyond emphasising revenue generation (through privatisation of public utilities and services) and efficiency gains, and also pay attention to achieving equity among urban communities.

This NTS Insight begins by examining the conceptual links between critical infrastructure and community resilience. The connections are then illustrated using the cases of three of Southeast Asia's cities – Jakarta, Manila and Ho Chi Minh City. This paper specifically focuses on these cities' water infrastructure, that is, their facilities for supply of water, wastewater treatment and drainage; and the vulnerabilities that arise from turning to alternative, off-grid sources of water. It then turns to the challenges that governments have faced in providing better water infrastructure; and examines the extent to which existing bottom-up initiatives are able to overcome these challenges.

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Linking critical infrastructure and community resilience

Critical infrastructure is conventionally defined in terms of physical structures and systems. ASEAN, for instance, defines it as 'the primary physical structures, technical facilities and systems which are socially, economically or operationally essential to the functioning of a society or community, both in routine circumstances and in the extreme circumstances of an emergency'.[1]

However, it has become clear that conceptualising critical infrastructure in such terms has its limitations. For instance, in times of disaster, adaptation or resilience strategies that are based on recovery of physical infrastructure (such as water and transportation systems) may miss the mark when it comes to addressing the needs and concerns of vulnerable communities.[2] Poor communities may need the support of social infrastructure such as health services, insurance and compensation for the loss of sources of livelihoods to help them recover. In recent decades, the concept of critical infrastructure has evolved to include soft capital or social infrastructure in the form of human resources and knowledge on community capacity.[3] There are also moves to develop 'smart cities', where physical infrastructure is complemented by intellectual and social capital through information sharing and collaboration.[4]

The robustness of a city's critical infrastructure may influence a community's 'resilience', that is, its ability to bounce back after an emergency or disaster. Within the context of this NTS Insight, resilience is also understood as a community's ability to learn and adapt to adverse conditions brought about by environmental change amid poor access to critical infrastructure. To better understand the connections between critical infrastructure and community resilience, it would be useful to view community resilience as a network of various adaptive capacities across different areas – economic development, social capital, information and communication, and community competence (see table 1). The value of this framework is that it supports a broader conceptualisation of community resilience and critical infrastructure, including the notion that resilience varies in terms of social capital and depends on a 'combination of effective urban governments and well-organised community groups and structures'.[5]

Table 1: Community resilience as a set of adaptive capacities.

Area	Adaptive capacities
Economic development	• Fairness of risk and vulnerability to hazards. • Level and diversity of economic resources. • Equity of resource distribution.
Social capital	• Received (enacted) social support. • Perceived (expected) social support. • Social embeddedness (informal ties). • Organisational linkages and cooperation. • Citizen participation, leadership and roles (formal ties). • Sense of community. • Attachment to place.

Information and communication	• Narratives. • Responsible media. • Skills and infrastructure. • Trusted sources of information.
Community competence	• Community action. • Critical reflection and problem-solving skills. • Flexibility and creativity. • Collective efficacy, empowerment. • Political partnerships.

Adapted from: Fran H. Norris et al., 'Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness', *American Journal of Community Psychology* 41, nos 1–2 (2008): 127–50, http://link.springer.com/article/10.1007%2Fs10464-007-9156-6

Such a framework suggests that the specific ways in which adaptive capacity is manifested in a community could depend on the critical infrastructure made available to that community by the state. This has significant implications. For example, where states or city governments have been unable to provide adequate access to certain critical infrastructure, affected communities have improvised solutions based on whatever resources are available to them. Such solutions are often not the most effective or efficient. Worse, they may have (unintended) adverse impacts not just for those communities but also for the city as a whole. These negative impacts are often greater in cities with a large informal sector[6] that both supplies services to support urban infrastructure and provides livelihood opportunities for the urban poor.[7]

To illustrate these connections between critical infrastructure and community resilience, this NTS Insight looks at one part of a city's critical infrastructure, its water infrastructure. It references the situation in Jakarta, Manila and Ho Chi Minh City, and flags the vulnerabilities that exist due to gaps in provision of critical water infrastructure.

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Critical water infrastructure in Southeast Asia's cities

Box 1: Urban water security and the right to water and sanitation

Water is essential for daily survival, whether for nourishment, sanitation, public health or environmental health. The UN General Assembly recognises the human right to clean drinking water and sanitation facilities. This recognition makes urban water infrastructure, and its protection, management and improvement, a crucial concern for human development, liveable cities and global health.

As a human right, water must be sufficient, safe, acceptable, physically accessible and affordable. However, in many cities, the pressures on water infrastructure (due to urban slums and urban sprawl) increase vulnerability to environmental change. In addition, unsafe drinking water and poor sanitation and hygiene are linked to higher incidence of water-borne diseases, including diarrhoeal diseases, and also vector-borne diseases like dengue. Compounding the situation are the higher temperatures and the urban heat island effect seen in many of Southeast Asia's growing cities.

Sources: *UN General Assembly resolution 64/292*, 3 August 2010, accessed 6 September 2013, http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/64/292; Asian Development Bank (ADB), *Asian water development outlook 2013*: *Measuring water security in Asia and the Pacific* (Manila: ADB), 44, http://www.adb.org/publications/asian-water-development-outlook-2013

Water has been declared a human right by the UN General Assembly, with all entitled to sufficient, safe, acceptable, physically accessible and affordable water (see box 1). Ensuring universal access to water has however proved a challenge for many cities. The cases of Jakarta, Manila and Ho Chi Minh City amply illustrate this.

In Metro Manila and Jakarta, water has been privatised since 1997. Since taking over, the water service providers in the two cities have faced difficulties upgrading and increasing coverage of piped-water supply and sanitation services. Reasons that have been cited include non-payment for services and the large number of people residing in informal settlements.[8] Water service providers also have to deal with loss of significant amounts of water as it is delivered from the source to the consumer, measured as non-revenue water (NRW) (see table 2). The main impediment however is seen as low water rates, and private operators have urged governments to increase rates – something

not easy to do. Proposed increases in the Philippines and Indonesia came under criticism from the public because of the lack of transparency in the companies' negotiations with metropolitan governments.[9]

Ho Chi Minh City has its own water troubles. Although water provision remains government-controlled (table 2), the lack of an integrated water governance body has weakened the city's capacity in groundwater management. The city has relied on groundwater for its water supply since 1920, but the rapid and uncontrolled exploitation of the city's aquifers has affected the quality of the groundwater.

Table 2: The water sectors in Metro Manila, Jakarta and Ho Chi Minh City.

	Water service provider		Population with access to piped water* %	Population with access to sewerage and wastewater treatment %	Non-revenue water (water loss rate) %
Metro Manila	Private	Maynilad Water Services	93	44	53
		Manila Water	72	42	16
Jakarta	Private	PT Aetra Air Jakarta (Aetra)	65	6 (public) 82 (private)	46
		PT PAM Lyonnaise Jaya (PALYJA)	40		38
Ho Chi Minh City	Public	Saigon Water Corporation	75	60	37

*These figures are based on the population under the jurisdiction of the respective water service providers.
Sources: Asian Development Bank (ADB), *Every drop counts: Learning from good practices in eight Asian cities* (Mandaluyong City: ADB, 2010), http://www.adb.org/publications/every-drop-counts-learning-good-practices-eight-asian-cities; World Bank, *Economic impacts of sanitation in Indonesia* (Jakarta: World Bank, Water and Sanitation Program, East Asia and the Pacific, 2008), http://www.wsp.org/sites/wsp.org/files/publications/esi_indonesia.pdf; 'Key figures', *PALYJA*, accessed 18 October 2013, http://en.palyja.co.id/profile/key-figures/; 'Company profile: Overview Aetra', *Aetra*, accessed 18 October 2013, http://www.aetra.co.id/index.php/en_GB/profilPerusahaan/page?id=sekilas; Andreas D. Arditya, 'Better service expected in new water contract', *Jakarta Post*, 6 June 2012, http://www.thejakartapost.com/news/2012/06/06/better-service-expected-new-water-contract.html

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Vulnerabilities from off-grid alternatives

Urban communities without access to piped-water networks have turned to alternatives such as illegal groundwater extraction, bottled water purchases and informal water suppliers. These come with their own set of challenges, which could potentially exacerbate urban vulnerabilities and affect community resilience, as will be evident from the discussion below.

Groundwater

Groundwater is a common source of water in Ho Chi Minh City. In Jakarta and Manila, groundwater extraction from wells is an alternative for those living in communities with inadequate access to water infrastructure. An example is the suburbs along Jakarta's north coast that rely on illegal groundwater extraction because of low water pressure problems.[10]

However, over-extraction of groundwater leads to water tables becoming lower, and this contributes to land subsidence. That in turn increases the likelihood of flooding, which further limits water access. Such risks are most acute for the densely populated informal settlements (slums) that have sprung up in many cities.[11] In Ho Chi Minh City, land subsidence in the southern parts of the city has occurred as a result of illegal groundwater extraction for drinking water.[12] Flooding has become a problem for the city, and in the areas around the city's degraded dyke enclosure, this has resulted in water supply connections being submerged.[13]

Water quality is another concern. Illegally bored wells are shallow and prone to being contaminated, by saltwater (due to flooding), and perhaps more seriously, by urban runoff (due to poor waste management). Studies have highlighted the link between poor water quality and poor wastewater management and sanitation systems; they have found faecal contamination in water from illegal water wells and informal water vendors.[14] In Indonesia, households try to overcome this by boiling but there is still a high rate of *E. coli* contamination, and

diarrhoeal disease is a common cause of death among children.[15]

Inequitable access to sanitation and waste disposal services also contributes to water-borne health risks. This is because temporary residents, usually migrants from nearby provinces, do not have the same access to urban services that permanent legal residents have.[16] In Ho Chi Minh City, 16.6 per cent of poor households use shared latrines and directly drain wastewater and sewage into rivers and canals.[17] These sanitation issues may be further exacerbated by the cost of using public bathhouses. In north Jakarta, residents with no toilet facilities in their homes pay between 500 or 1,000 rupiahs per visit for such facilities.[18] In Metro Manila, the practice of draining private septic tanks into uncovered drainage systems exposes the general population to raw sewage while inadequate sanitation services result in contamination of drinking water. Water-borne diseases account for more than 3.3 billion pesos annually in health costs, with 500,000 affected by such diseases and 4,200 related deaths each year.[19]

The water quality problems in informal settlements could also spill over to other parts of a city. In Ho Chi Minh City, waste from the poor communities in the south and south-west zones, who do not have access to the city's network for wastewater disposal, contributes to the pollution of reservoirs, canals and groundwater aquifers.[20] In Jakarta, in the absence of sufficient public sewers and treatment facilities, many in the city rely on private septic tanks, most of them poorly designed.[21] In 2004, *E. coli* was detected in all 13 rivers in Jakarta monitored by the Jakarta Environmental Management Agency (BPLHD) due to the excessive amounts of sewage produced in the city. In Manila, residential sewage and untreated industrial wastewater have rendered the Marikina and Pasig rivers uninhabitable for aquatic and riparian life.[22] Clearly, human insecurity experienced by the urban poor can ultimately affect the rest of a city's population.

Small-scale water services

Small-scale water services, both formal and informal, is another option utilised in the region's cities. In Jakarta, this solution has come to be a source of insecurity. In the city, the local mafia (*preman*) is exploiting water access deficits by selling water at higher prices than other providers, with the result that Jakarta's poor can pay up to 20 to 40 times more for their water compared to wealthier residents.[23] Such dynamics feed contempt for the unethical suppliers of alternative sources and increases the vulnerability of the poor, and does little to cultivate a shared sense of community resilience among residents.

Formal water service providers usually provide a relatively better degree of security for poorer households. In Ho Chi Minh City, water resellers that source their supply from groundwater are cheaper and legal, but serve only about 100–500 households.[24] Most small-scale water network operators (usually local firms) in Ho Chi Minh City are also legally encouraged to 'socialize investments' to serve 55 per cent of the city's underserviced population.[25] Certain areas in Metro Manila are served by small authorised water network operators. Inpart Engineering, for example, has a bulk supply arrangement with its client communities and Manila Water, and serves 35,000 households.[26] Under such arrangements, connection fees are lower compared to the main water service providers but tariffs are higher because of a daily billing system.[27]

Bottled water

Lack of safe piped-water supply has also made bottled water attractive to many. In the cities examined in this paper, bottled water is popular among the growing middle class, contributing to a boom in the bottled water business. Some members of the urban poor also consume bottled water, either because of increased awareness of the importance of safe drinking water,[28] or because bottled water consumption is associated with wealth/status.[29]

Indonesians consumed 49 litres of bottled water per person in 2011.[30] Based on current consumption rates, that is expected to increase to 86 litres by 2016.[31] In the Philippines, the use of such water is so significant, and the industry so lucrative, that the government is subjecting potable water in bottles and containers to automatic price controls during disasters or crises.[32] In Ho Chi Minh City, 49 per cent of households do not have access to private water taps, and of these, approximately half buy bottled water for drinking and sanitation purposes.[33] Not surprisingly, more than 300 small-scale producers of bottled water have been established since 2007.[34]

The quality of the bottled water sold has however come under scrutiny. In a study conducted by the government of Vietnam in 2012, water from more than 24 per cent of the small-scale bottled water producers that were tested failed to meet required government standards in terms of

water quality.[35] These producers utilised groundwater and tap water contaminated with coliform bacteria.[36] While they charged lower prices, they used coal, gravel and ultraviolet rays for filtration, which are not as effective as the reverse osmosis process used by larger local companies.[37] Aside from the cost of bottled water and, in some cases, poor quality standards, improper disposal of plastic bottles could contribute to flooding.

The bottled water industry in Jakarta serves as a more expensive but relatively safer alternative to the piped-water network.
Credit: nSeika / flickr.

The vulnerabilities associated with groundwater, water from small-scale water services and bottled water could also compound the adverse impacts that climate change will have on these cities. Metro Manila, Ho Chi Minh City and Jakarta are often cited as among the most vulnerable coastal cities in Asia. Metro Manila's population of 11.86 million, Ho Chi Minh City's 7.4 million and Jakarta's 10.19 million are at risk from extreme rainfall, riverine flooding, sea level rise and land subsidence.[38] Continuing urbanisation and population growth will add to the challenges for urban planners.

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Financial limitations and weak governance in the water sector

Why do states often struggle to improve water infrastructure? There are two interlinked reasons: lack of financing and weak governance.[39] These challenges have generated distrust between urban residents and water service providers and have constantly undermined community resilience.

A significant consequence of the overall lack of financial support for the water sector is that water problems faced by the poor have largely remained unaddressed. Public-private partnerships have for the most part targeted middle- and upper-income households, leaving the poor out of the picture. In many Asian cities, poor populations in urban and peri-urban areas continue to grow, yet are left without adequate water services.

This lack of interest in investing in infrastructure for the poorer sections of society is also due to the higher costs involved.[40] In Indonesia, the lack of proper urban planning raises the installation cost of individual water network connections to the numerous households in informal settlements. At the same time, given the poverty levels in such settlements, it would not be feasible to pass the costs on to consumers in the form of higher water bills. With local governments and private concessionaires generally unable to recuperate costs, projects to extend water infrastructure to those areas cannot move forward. Such a situation further drives the critical need for urban plans to prioritise provision of effective water infrastructure to poorer areas.

The lack of financial capacity also contributes to weak governance. Indonesian officials have cited deficits in financial support and human resources as a major impediment to the ability of government agencies to monitor and control commercial buildings that are using groundwater illegally.[41] Exacerbating the situation are unwieldy bureaucratic processes and overlaps in the functions of government agencies within the metropolitan system. In the Philippines, there is no water sector development agency that can provide a comprehensive framework for water governance.[42]

Additionally, one could argue that water privatisation has been both a boon and a bane to the stability of water infrastructure in these cities. On the one hand, privatisation has resulted in wider distribution of water services, with potential negative impacts addressed through government regulations and measures. In Manila, to address the increase in water prices after privatisation, water price monitoring came under the auspices of a corporation owned and controlled by the government known as the Metropolitan Waterworks and Sewerage System.[43] Vietnam introduced in 2012 a Law on Water Resources that obliges project investors to consult communities and related organisations and individuals on the 'exploitation and use of water resources and discharge of wastewater into water sources' that could have an effect on the communities' daily lives.[44]

On the other hand, extensive privatisation of water services has reduced the ability of some states to act on or manage water issues as a collective public good. In Indonesia, historical developments have institutionalised water privatisation. During the New Order regime under President Suharto, sewage issues were considered a private rather than a public concern.[45] This was further concretised by enshrining the privatisation of the water sector into law in 2004. It could thus be difficult to effect change in the governance of the water sector in the country. In Vietnam, the raising of water prices after recent investments in Ho Chi Minh City's water infrastructure could be attributed in part to the monopoly held by the Saigon Water Corporation.[46] Given the existence of structures and market dynamics that emphasise profit over sustainability, efforts to achieve greater equity in water supply (through pro-poor initiatives for example) remain difficult.

To overcome financing gaps, governments have turned to external sources. Multilateral financial institutions are a significant source of funding. As of February 2012, the World Bank has financed eight sewage treatment plants, two septage treatment plants and seven communal septic tanks in Metro Manila.[47] Ho Chi Minh City has similarly turned to sources such as the World Bank, the Asian Development Bank (ADB) and other international organisations to support the city's multibillion-dollar infrastructure development plans.[48] In 2010, the Saigon Water Corporation declared that it will provide clean water to 92 per cent of the city's population by 2015, through enhancing its infrastructure to increase daily capacity and reduce water leakage.[49] This goal is currently being supported by the ADB's 2011–2020

Vietnam Water Investment Program.[50] In Indonesia, several international actors have sought to address poor water quality. The US Agency for International Development (USAID) – through the US Centers for Disease Control and Prevention (CDC) – has worked with Indonesia's Ministry of Health and a private company to provide several water-purifying technologies, such as Air RahMat[51] (a mix of a low concentration of sodium hypochlorite and non-potable water) and Sodis[52] (solar disinfection). Another programme involving Jakarta's public works department together with Mercy Relief and the International Development Research Center of Canada is the Communal Master Meter project, which seeks to improve piped-water access to Jakarta's urban poor.[53]

Although these externally funded projects are important kick-starters for addressing issues relating to critical water infrastructure, there are longer-term challenges of sustaining, monitoring and upscaling these projects to other areas; and greater input from local-level stakeholders is needed to overcome these challenges.

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Sustaining solutions at the local level

The preceding discussion, in highlighting the vulnerabilities engendered by the efforts of the urban poor to adapt to capacity deficiencies, points to the need to consider bottom-up solutions to the various challenges, particularly with respect to the following areas: (1) public-private partnerships; (2) the local system of checks and balances; and (3) community awareness and action.

Improving public-private partnerships

There have been several efforts to make public-private partnerships more pro-poor, such as through water entrepreneurship or cooperative schemes. In Ho Chi Minh City and Manila, residents who are disconnected from the piped-water system or cannot afford water connection fees[54] are able to purchase water from small private water resellers that are allowed to operate by the government in poor districts. Also, cooperatives have been able to reduce transaction costs, which have in turn allowed private concessionaires to supply waterless poor communities at a lower cost.[55]

Manila Water's *Tubig Para sa Barangay* (Water for the Community) introduced less strict land ownership requirements for water service connection applications as well as flexible financing and a socialised tariff scheme for low-income families. This resulted in more than 700 projects, which reportedly supplied water to 1.7 million people from marginalised sectors.[56] Maynilad Water's *Samahang Tubig Maynilad* (STM), which began in 2009, sought to address issues of water access and irresponsible water use through organising communities into cooperatives and through community-based water management training. As of 2012, it serves 2,683 low-income families through 12 STM centres.[57]

In Jakarta, PT PAM Lyonnaise Jaya (PALYJA) and PT Aetra Air Jakarta (Aetra) run water kiosk programmes (where water is delivered using trucks or carts) that aim to improve access to clean water for urban poor communities outside their distribution network.[58] Another example is a Communal Master Meter scheme operated by PALYJA and aimed at poor communities that was piloted and implemented with the support of several international non-governmental organisations (NGOs), including Mercy Corps and USAID.[59]

Enhancing local checks and balances

Civil society organisations (CSOs) have played an active role in providing checks and balances on governmental water policies and initiatives. In the Philippines, CSOs have been a steady presence in Manila's slums, addressing the lack of basic utility services. Damayan ng Maralitang Pilipinong Api (DAMPA), a network of urban poor communities in Metro Manila, conducted community risk and vulnerability mapping and identified water supply and secure housing as priorities for national and local governments.[60] DAMPA also helped establish water cooperatives as a means of negotiating with government and private stakeholders for improved water access. This is done via channelling a community's accumulated savings towards matching local government investment on water infrastructure, thus securing water connections for the community.[61] These cooperatives also act for the community in negotiations with Manila Water to ensure that applications for water connections are fairly processed.[62] In Vietnam, there are also similar community-led savings and credit groups that play a complementary role through contributing part of the cost of building household and public toilets as well as sewers.[63]

To address water pollution in their immediate environment, some communities have also communicated their concerns to the government and the private sector through verbal and written protests, and these are often publicised by the media.[64] More often than not, these community protests have led to government action to regulate pollution or even to the private sector installing waste treatment systems, as seen in the peri-urban areas of Ho Chi Minh City.[65]

In Jakarta, civil society has raised issues related to inequitable water access. CSOs were involved in rallying the participation of affected communities in several protests to demand an end to water privatisation.[66] Recently, CSOs under the Coalition of Jakarta Residents Opposing Water Privatisation (KMMSAJ) criticised Jakarta's metropolitan government when it sold shares of the city's water supply to Manila Water, a company they saw as corrupt.[67]

Cultivating community awareness and action

A main barrier to the sustainability of critical water infrastructure projects has been the lack of awareness at the community level about the features and implications of available alternatives. In Indonesia, the USAID water purifying project and the Communal Master Meter scheme face challenges such as long socialisation processes and trust-building with communities, as well as difficulties in gaining buy-in from preman networks, whose business would be affected by these initiatives. Although there are efforts by community-based organisations to disseminate information on such options,[68] understanding of the new technologies among the general populace remains inadequate. For instance, a survey of households that were introduced to Air RahMat revealed several issues.[69] There were ingrained biases that boiled water was healthier. Air RahMat's chlorine smell also discouraged use. Moreover, there was a misperception that boiling water was more efficient and less costly than Air RahMat. In the long term, however, the rising cost of kerosene would increase the cost of preparing boiled water, and could make Air RahMat more attractive.[70]

Empowering communities to play a part in local water supply management is becoming increasingly cost-effective for the private sector and beneficial to urban poor communities. Manila Water's engagement with communities, particularly with informal street leaders, or *kasanggas*, helped address water loss from illegal water connections and pilferage. The community solutions arrived at through this process contributed to a 50 per cent drop in Manila Water's NRW rate within a decade.[71] Manila Water also allows for metering areas to be formed or reorganised once an area's population reaches a certain density, and as such, serves as a good example of flexible urban water infrastructure that incorporates the community's strengths as well as social realities.[72] In addition, the kasanggas help communicate problems on the ground to Manila Water and also assist in broadcasting the company's local plans and news to communities. In Jakarta, WatSan, a USAID-supported initiative, has a Clean Water Program that helps communities gain improved access to water, educates them about household-based treatment of water for drinking, and trains community leaders to train other members of a community to sustain the above initiatives.[73]

In Ho Chi Minh City, water and environmental protection has become part of the primary education curriculum, with international NGOs such as Water Education for Teachers (WET) supporting this since 2005.[74] The interactive learning and extra-curricular activities related to water conservation help promote awareness among the students' families and communities, and are critical to increasing their personal attachment to their waterways.

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Conclusion

From the discussion, it seems clear that it is important to examine and understand the specific ways in which community resilience manifests in communities with differential access to critical infrastructure. Doing so contributes to the process of developing conceptualisations of community resilience that could form a firm basis for appropriate policies. To that end, this NTS Insight has suggested that it would be useful to think of community resilience as a network of adaptive capacities; with the nature and level of critical infrastructure available to a community being a key factor in how those adaptive capacities are realised within that community.

Viewed through the lens of adaptive capacities, it could be argued that communities themselves, even poor communities, have significant adaptive capacities founded on community competence and social capital. This is borne out by the cases discussed earlier. Urban communities with limited access to public water infrastructure do actually develop their own solutions. However, such adaptive responses, while meeting the community's needs in the short term, remain insufficient for strengthening and maintaining community resilience over the long term – mainly because they tend to address the symptoms rather than the root causes of the problems.

Thus, ensuring community resilience well into the future requires a broad, long-term vision of urban sustainability that can only come about if governments start thinking beyond electoral terms and revenues. Given that trust between communities and governments has been eroded by inequitable provision of resources to areas populated by the poor, efforts to engage communities are also important.

In crafting long-range plans, it must be recognised that provision of critical infrastructure involves a range of issues, and thus other systems; in much the same way that provision of water infrastructure has implications for systems in the urban-development, public-health and private sectors. At the moment, however, multisectoral cooperation continues to be a challenge, especially in urbanising countries with poor governance abilities.

Sustained efforts that are sensitive to needs of the poor and are flexible in adapting to changing socioeconomic and environmental landscapes are also increasingly needed. Of existing initiatives, public-private partnerships and community engagement have to date proven to be the most appropriate mechanisms to meet the challenge of inequitable access to critical infrastructure. Ultimately, ensuring that critical infrastructure meets the basic needs of communities – and thus serves as an effective and dynamic source of security for them – requires that planners view the issues through a pro-poor lens and with an eye to future urban development and climate projections.

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Notes

1. 'Critical infrastructure', *ASEAN DRR Portal,* 2011, accessed 26 April 2013, http://202.46.9.39:8889/KnowledgeBase/DRRTopics/Themes/CriticalInfrastructure.aspx. The definition of 'critical facilities' offered by the UN International Strategy for Disaster Reduction (UNISDR) echoes the ASEAN definition. See: 'Terminology on DRR: Critical facilities'*, UNISDR*, n.d., accessed 2 September 2013, http://www.unisdr.org/we/inform/terminology
2. T.D. O'Rourke, 'Critical infrastructure, interdependencies and resilience', *The Bridge* 37, no. 1 (2007): 25, http://www.nae.edu/File.aspx?id=7405
3. Tracey L. O'Sullivan et al., 'Unraveling the complexities of disaster management: A framework for critical social infrastructure to promote population health and resilience', *Social Science & Medicine* 93 (2013): 239, http://www.sciencedirect.com/science/article/pii/S0277953612005953
4. IBM, 'Smarter cities', *IBM: A smarter planet*, 2013, accessed 2 September 2013, http://www.ibm.com/smarterplanet/us/en/smarter_cities/overview/
5. Stephen Hamnett and Dean Forbes (eds), *Planning Asian cities: Risks and resilience* (London and New York: Routledge, 2011), 16.
6. The informal sector is generally defined as an economic sector consisting of small-scale, self-employed activities (with or without hired workers), typically at a low level of organisation and technology, with the primary objective of generating employment and incomes. Unlike the formal economy, these activities are usually not taxed, not monitored by any governmental agency, nor included in a country's gross national product (GNP). For more information, see: International Labour Organization, 'Resource guide on the informal economy', updated 9 March 2012, accessed 5 November 2013, http://www.ilo.org/public/english/support/lib/resource/subject/informal.htm
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