Chapter 11
Water Demand Management and Improving Access to Water

Corazon L. Abansi, Rosalie Arcala Hall, and Ida M.L. Siason

Abstract The chapter reviews and examines water-related program interventions–social, economic, institutional–that have directly and indirectly influenced water demand management in the Philippines since 2000. Demand focuses on water users and the human dimensions of water use, including degradation of water quality, excessive drawing from aquifers, non-consumptive uses of water, and the organizations that have evolved to represent the various stakeholders. The chapter then examines the feasibility of the emergent emphasis on policies that stress making better use of existing supplies in combination with decentralization and participation of water users, even as new sources are explored. Initiatives by the Department of Interior and Local Government toward expanding water access in areas not served by municipal water districts, participatory management schemes for irrigation associations by the National Irrigation Administration, and intersectoral formation for surface water/river quality management by the Department of Environment and Natural Resources are probed. The chapter describes initiatives such as inter-municipal water transfers, independent community-based collective arrangements for domestic and irrigation provisioning (through cooperatives) and riparian upstream-downstream coalitions for water quality in select locality cases. Such policies and interventions aim to influence demand along principles of efficiency, equity, and sustainability. This chapter explores the application of water-demand programs by select national government agencies to their respective client-groups. The institutional arrangements thus created by these program applications are "grey area" because they are not as yet grounded on water rights or adequately covered in the existing Philippine Water Code. But they portend to better/improved ways by which water can be more equitably accessed.

C.L. Abansi (✉)
Institute of Management, University of the Philippines Baguio, Baguio City, Philippines
e-mail: corazon.abansi@gmail.com

R.A. Hall
Division of Social Sciences, College of Arts and Sciences,
University of the Philippines Visayas, Miagao, Iloilo, Philippines

I.M.L. Siason
University of the Philippines Visayas, Iloilo, Philippines

A.C. Rola et al. (eds.), *Water Policy in the Philippines*, Global Issues in Water Policy 8, https://doi.org/10.1007/978-3-319-70969-7_11

Keywords Water demand management • Water recycling • Water saving-devices • Community participation in water management • Non-price water conservation program

11.1 Understanding Water Demand Management

Rapid population growth, economic development, urbanization, and industrialization have taken their toll on the country's water services and resource base (Araral and Wang 2013, NEDA 2010). The sustainability of the country's water resources is threatened both in terms of quantity and quality. Unless current water usage patterns are changed, future water demand will significantly exceed existing available fresh water resources. There is a need to look at water demand management (WDM) as an alternative management mechanism to address the water problem in the country.

In its simplest, WDM is defined as the management of the total quantity of water abstracted from a source of supply using measures to control waste and undue consumption (Herbertson and Tate 2001). A more elaborate definition states that WDM is the adaptation and implementation of a strategy by a water institution or consumer to influence the water demand and usage of water in order to meet any of the following objectives: economic efficiency, social development, social equity, environmental protection, sustainability of water supply and services, and political acceptability (Jalil and Njiru 2006).

The traditional approach of hydrologists and water resource engineers has been to focus on the supply side and the assessment of available water resources. Forecasts of water demands have often been provided by different institutions with a wide range of uncertainty because of the (i) limited data on historic actual water use; (ii) high levels of uncertainty in establishing efficiency of water use, with significant losses likely in irrigation, urban, and industrial water use; and (iii) uncertainties in the basic economic, social, and demographic assumptions required for water demand forecasts (Herbertson and Tate 2001). As a result, there is a high degree of uncertainty in current forecasts of the supply-demand balance. There are large variations in local availability both in space and time. To ensure long-term sustainability of water resources, the focus of water management needs to shift from a traditional supply side management to demand side management. It is a relatively new branch of water resource science but it offers a promising alternative for sustaining the world's freshwater supplies in the next century and beyond.

In the Philippines, WDM can improve the existing supply-demand balance, especially in water-stressed areas. Though augmentation of supplies would be required to meet the growing demand in urban centers, our future lies in effectively controlling our demand for water resources and efficiently managing and using available resources. The approach calls for the development of a WDM strategy that would aim at reducing losses in the system, improving operational efficiencies, promoting rational use of water resources, ensuring equitable distribution of resources, and exploring alternative sources such as recycling of wastewater for non-potable uses. Implementation of such an approach would require reforms in terms of providing adequate regulatory, institutional, and legal frameworks for delivery of services; tariff reforms that ensure financial sustainability of operations of the utility; and internal reforms within the utility that aim at improving operational efficiencies and reducing losses to acceptable levels (Dziegielewski 2003).

Water demand management therefore requires the implementation of policies and/or measures, which serve to control or influence the amount of water used and thereby lead to improved efficiency in production, transmission, distribution, and use of water. However, a cursory look at existing national policies shows that addressing water tends to be punitive in its provisions rather than incentive-based. Failure of implementation is not new due to the weakness of existing administrative mechanism. Therefore, policies must emphasize on improved management of existing systems rather than augmentation of supply and promoting optimum utilization of available water resources through increased consumer awareness and better operational efficiency at the level of service providers. WDM should be viewed as complementing the supply management efforts and not replacing them, hence, demand-side management is better used in conjunction with conventional approaches (Inman and Jeffrey 2006).

11.2 Goals of Water Demand Policies and Interventions

In practice, WDM comes down to three key goals: efficiency, equity, and sustainability (Turton 1999).

11.2.1 Economic Efficiency

Economic efficiency aims to minimize the amount of water required for a particular purpose. Improving water efficiency can come in the form of reducing losses in the distribution system, reducing the amount or the quality of water needed to perform a task, and changing the timing of water use. Consumers can use water efficiently by reducing water wastage and by choosing more water-efficient products. Reducing the quality of water used is also an alternative since lower quality, less costly water can be safely used for many purposes such as flushing toilets, landscape irrigation, and industrial uses. In terms of timing, using water at off-peak times reduces strain on the water delivery system while irrigating crops at night reduces losses from evaporation. Efficiency also requires that the system is able to cope with water shortages.

11.2.2 Social Equity

WDM strategy must take into account the goal of social equity. Water pricing must not be a barrier to reasonable access to clean water by the poor in both urban and rural areas. The situation of poor women and children requires that policymakers find ways to provide for at least a minimum supply of clean water. Women are frequently the "water managers" in the household, and difficulties in their efforts to ensure the family's water supply can become a barrier to opportunities for education and employment. WDM strategies must also be sensitive to local customs and traditional water rights. Community participation in water management decision making ensures that the benefits of WDM are understood and widely accepted and will greatly increase the likelihood of success.

11.2.3 Environmental Sustainability

There is rapidly growing evidence of the effects of climate change on water availability. The Philippines, which is particularly vulnerable, can expect increased temperatures and reduced rainfall, according to the 2007 Report of the Intergovernmental Panel on Climate Change (IPCC 2007). In the past, water management has generally been based on the assumption that climatic conditions would remain more or less the same. Given the IPCC's predictions, governments need to be prepared to re-evaluate their policies and institutions for the management of water resources. WDM is an effective strategy for adaptation to the current challenge of water scarcity and will become more so as climate change further reduces the availability of water and land. Policies based on WDM strategies contribute to preparedness and social resilience in the face of the challenges that lie ahead for the Philippines.

11.3 Water Demand Management Strategies in the Philippines

This section discusses the different strategies in managing water demand in the Philippines. Broadly, these strategies are categorized as economic, technical, and socio-political.

11.3.1 Economic Strategies/Instruments

Markets and water prices could become highly efficient instruments of appropriate water allocation, if successfully applied. Pricing strategies, such as increasing block tariffs, are commonly applied in water demand management, especially in the urban areas (Araral and Wang 2013). Marginal-cost pricing is viewed as an effective instrument of demand management because consumers will respond to marginal prices by adjusting their consumption (Olmstead et al. 2007). In the Philippines, increasing block tariff is used by water districts. The underlying principles essentially rely on economic valuation while also balancing affordability, conservation, and sustainability.

There are approximately 5400 water service providers in the Philippines (Llanto 2013; NEDA 2010). This figure is not definite because the government does not have accurate information on the water supply sector. There are 879 water districts in the Philippines, 476 of these are registered with the National Water Resources Board (NWRB) and only 511 are operational (World Bank 2005). NWRB is the leading regulatory government agency responsible for ensuring the optimum exploitation, utilization, development, conservation, and protection of the country's water resources. Two private concessionaires, Maynilad Water Services, Inc. and Manila Water Company, are the contracted water providers in Metro Manila. Outside Metro Manila, the major water service providers are the local water districts regulated by the Local Water Utilities Authority (LWUA). A water district is a utility serving a city or municipality but is legally and financially separate from this local government. Local government units (LGUs) and community-based organizations (CBOs) are the biggest domestic water providers serving 55% of those with access to water (NEDA 2010). This is followed by the water districts at 20% and private operators at 5%. The remaining 20% of the population rely on informal sources (self-provisioning, vending) to satisfy their water needs.

11.3.1.1 Economic Strategies of Water Districts

Water districts manage demand by charging for water in proportion to the amount and characteristics of use. Water use is regulated by check valves and meters, signaling the message of wise use of water. Metering of service connections is seen as the economical and equitable procedure for arriving at the appropriate water charges. Metered rates are imposed on the basis of the actual volume of water consumed for a billing period (LWUA 2014a).

The LWUA sets the rules on water tariffs of the WD (LWUA 2014b). The prescribed rate structure consists of two components, the minimum charge (MC) and the commodity charge (CC). MC is also known as the service charge or the demand charge. Minimum charge is fixed, depending on the size and classification of service connection (customer class) and should cover the first 10 m^3 of water consumption. MC covers the fixed cost required to carry on vital water supply functions not directly connected with production and distribution. MC is set using two criteria:

1. MC should be within the ability to pay of the low-income users. It is established that 10 m^3 is enough to supply the domestic water need of low-income users. Hence, the MC for residential water should not exceed 5% of the average monthly family income of the low-income group.
2. MC varies with the size of the meter; the bigger the meter, the higher the MC.

The CC is the amount per cubic meter in excess of MC and covers expenses related to production, distribution, and all costs not covered from MC. This marginal component of the pricing scheme is expected to affect water demand because successively increasing consumption is charged at higher rates so that the basic requirements of consumers are met and more luxurious uses are charged at higher rates (LWUA 2014b).

This tiered pricing scheme is used as a fundamental tool to ensure the sustainability of water systems and the efficiency of water allocation. Massarutto (2007) argues that water pricing aimed at water allocation and cost recovery requires different approaches to pricing as recovery of costs does not necessarily match the cost for allocating scarce water resources. Various authors stressed the economic aspect of determining water rates, stating that, in computing how much water should be charged, it is important to consider generating revenue so that the water provider can include recovering production costs and providing further investment (Hanemann 2005, Glennon 2004, Min 2007).

Recognizing these, the Philippine water districts have slowly adapted market benchmarks for their performance. The water supply industry maintains that the public can be served best by self-sustained enterprises adequately financed with rates based on sound engineering, social, and economic principles. A properly operated and managed water utility should be a self-sufficient enterprise. The challenge for the provider is to identify tariff structures that ensure cost recovery while increasing take-up of basic services among the poor. A modeling of the demand function for the entire market of potential users of the service using survival curve estimation techniques and knowing the costs faced by the provider was done using the Metropolitan Cebu Water District as example (Box 11.1).

Box 11.1: Water Tariff and Demand, the Case of the Metropolitan Cebu Water District

Implementing tariff structures with differential pricing makes it a potentially powerful tool for increasing take-up of important services among the poor, enabling providers of basic services to aid in more sustainable development while still allowing the provision of the service to be viable over the long term. However, altering tariff structures may not work for all types of services where the differences in willingness to pay (WTP) are less determined by level of income. This approach was analyzed using a contingent valuation survey that captured household and business WTP for access to improved water and new sanitation services provided by the Metropolitan Cebu Water District (MCWD) in the Philippines. Results showed that up-front connection charges are a major deterrent to more units opting to connect and access MCWD's water services. Charging a much smaller up-front connection charge and amortizing the remaining costs of the connection charges into the monthly fee results in a substantial rise in demand from 31% of households to 50%. Moreover, this tariff structure results in 30.4% of non-connected households connecting to water services. A tariff structure that price differentiates to equalize demand across different subgroups increases take-up of water services by households to 56.8% based on household income subgroups or 62.2% using geographic subgroups. Moreover, it increases take-up of water services by poor households from 12.2% to 61.9% of the population. This is nearly a 500% increase over the current pricing scenario. Price differentiation, however, is found to be a less effective tool for increasing total household take-up of potential new septage and sewage services. It is shown to only increase overall household demand by 0.8% in the case of monthly septage service fees and 2.4 percentage points in the case of sewage services. However, it is effective in increasing take-up of services by 4.2 percentage

Source: http://www.lwua.gov.ph accessed on April 28, 2016.

11.3.1.2 Economic Strategies of LGU Water Systems and CBOs

A water system operated by the LGU directly provides water through the city or municipal engineering department. This water system delivers domestic water supply to residents in the areas of high population density. The LGU water system is usually established through loans by the LGU or grants from national politicians and international donors. Members of the governance board are selected by the local government officials while the water manager is usually the municipal engineer.

LGU water systems manage demand by collecting fees from users and using the revenue from these fees to cover variable costs and other maintenance costs. In most cases, revenues generated from fees may not be adequate to cover maintenance costs and the LGU subsidizes the rest.

Community-based organizations operate water supply systems through the support of national government or non-government organizations (NGOs) or their own village government. Some are privately organized by a group of families, while others are organized by individual tribal leaders to cater to member-households. These are loose organizations, mostly without legal basis, but guided by customary rules. Some supply both domestic water needs and irrigation. Some of these organizations charge very minimal water fees, but in most instances, water is free.

11.3.1.3 Comparison of Prices of Water Districts, LGU Water Systems and Community-Based Organizations

Results of a survey of managers of water organizations conducted in 2013 (Rola et al. 2016) show that pricing as a strategy to manage demand depends on the pricing policies adopted by the organization. Water prices of the LGU-based water system are based on the cost of repair and maintenance whereas for CBOs, pricing is based on the approval of the members of the cooperative and expenses for maintaining and operating their water system. Water charges are computed based mostly on partial-cost recovery. The complexity of water pricing as shown by these two providers arises from the belief that water is partially a public good so government should be involved in the pricing process (Min 2007). There is also this perception of water as an integral part of the ecosystem, a natural resource, and a social and economic good, hence managers are faced with the issue on how, practically, to achieve the right balance between managing water as an economic and a social good (Gleick et al. 2002, Linton 2010, Feitelson 2012).

Comparing prices across water providers, water districts charge the highest for water use (Table 11.1). Commercial users are charged higher at an average of P293.43 per month for the first 10 m^3 of water. Residential water users, on the other hand, are charged an average of P185.55 for the first 10 m^3 per month. Charges for residential use range from P100.00 to P370.00, while commercial water charges

Table 11.1 Water charges (in pesos/10 m^3 per month), by water organization

Organization		Average	Minimum	Maximum
Water district	Residential	185.55	100.00	370.00
	Commercial	293.43	125.80	614.00
Local government	Residential	51.51	0.00	204.70
	Commercial	117.50	100.00	135.00
Community based	Residential	62.14	0.00	838.00
	Commercial	320.00	65.00	900.00

Source: Rola et al. (2016)

range from P125.80 to P614.00. Community-based organizations have rates averaging P62.14 for residential users. Most (41%) of the CBOs provide the water for free. Hall et al. (2015) argued that water pricing remains heavily subsidized by the state with many politicians refusing to impose water prices at cost recovery.

Water charges for irrigation vary by season, with an average of PhP 944 per hectare during the wet season and PhP 1184 during the dry season.

A common problem encountered by LGU-based organizations and CBOs is the failure to pay the water fee on the part of some users. Where local governments control the water system, communities in general resist investments or abstraction limits that increase fees or impede access (Hall et al. 2015). Agrawal and Goyal (1999) argued that variations and changes in demographic pressures influence the ability of water providers in rural communities to create enforceable rules and resolve conflicts especially for common pool resources. Van Koeppen et al. (2007) agreed that rule setting and enforcement is the Achilles heel of any water policy, and community-based water policies have both strengths and weaknesses in this regard. It is morally more difficult for rural communities to hold other water users, relatives, and neighbors accountable to restricting water use for livelihoods or to use the sanction of cutting water delivery to enforce agreed obligations such as payment of fees on time.

Young (2002) and Herrfahrdt-Pahle (2010) elucidate the importance of ensuring a close fit between social and ecological systems through the existent institutional interface. There is growing recognition that pure market modes are quite rare and that market-based mechanisms require effective regulation to ensure that social and environmental needs are met (Bakker 2003, Freeman and Kolstad 2007). In areas dominated by informal water economies, Abansi et al. (2016) proposed a model that combines and effectively integrates both economic and cultural dimensions to manage water demand and use pattern.

11.3.2 Technical Strategies

Any activity, practice, technological device, law, or policy that can potentially reduce water use may be considered a demand management measure. Hundreds of different measures can be found in the literature (Dziegielewski et al. 1993). Technical interventions aim to meet the existing needs of individual users and uses with less water. These can come in the form of (1) reducing the quantity or quality of water required to accomplish a specific task, (2) adjusting the nature of the task so it can be accomplished with less water or lower quality water, (3) reducing losses in movement from source through use to disposal, (4) shifting time of use to off-peak periods, and (5) increasing the ability of the system to operate during droughts. These five components mostly point to the efficiency by which water is used; improvements can free up significant quantities of water.

11.3.2.1 Introduction of Water-Saving Products and Technologies in Domestic and Industrial Use

Technologies and efficient water use practices can be employed to reduce water use for domestic, commercial, and industrial users. For example, one shower head is considered more efficient than another if it can accomplish the same purpose by using less water or other inputs. For domestic water use, some of the available devices and products are low-flow shower heads, shower flow restrictors, toilet-tank inserts, faucet aerators, low-flush toilets, dual-flush toilets, insulation of hot-water pipes, horizontal axis washing machines, low-pressure supply connections, pressure-reducing valves, water-efficient landscape designs, and irrigation practices. The water efficiency gains from these devices over traditional counterparts can be substantial without diminishing the fulfillment of the original purpose for which water is used. For example, ultra-low flow toilets consume as little as 1/5th to 1/7th of what traditional toilets consume. Toilet dams or other water displacement devices block part of the tank so that less water is required to fill the toilet following each flush. Some problems may occur with the need to double flush, but water savings from these devices are estimated at more than 10%.

In the industrial sector, technological devices include counter-flow washing and rinse systems, reuse of processed water, recirculation of cooling water, ozone treatment for cooling towers, treatment and reuse of blow-down, and water recycling.

The extent of use of these water saving devices and technologies depends largely on the market penetration of these products, the types of industries linked to the system, and the technologies available for the domestic market. As a more aggressive strategy, a municipality can enact standards for water-using appliances, at least for upcoming localities with new construction. A review of the Water Code of the Philippines and Water Crisis Act of 1995 did not show provisions on incentives and rewards for the use of water-saving devices. Only the Clean Air Act of 2004 has a provision (Section 26) for incentive schemes, but these are targeted to technologies and devices for pollution control and clean production. The 2014 Investment Priority Plan of the Bureau of Investment includes incentives for water pollution control and energy-saving technologies but none on water-saving technologies.

11.3.2.2 Introduction of Water-Saving Products and Technologies for Irrigation Water

In agricultural irrigation, the water efficiency gain of drip irrigation over furrow irrigation has been documented by many studies (Tagar et al. 2012, Payero et al. 2005, Yonts 2008). A water-saving technology developed by the International Rice Research Institute called alternate wetting and drying (AWD) can help farmers reduce the amount of water use by eliminating the traditional method of keeping their rice fields continuously flooded (Rosellon 2016). The water level is allowed to drop 1–15 cm below the soil surface before reflooding the field. A perforated water tube, which could be made from PVC pipes or bamboo, is used by farmers to monitor the water level below the soil. According to the Department of Agriculture, AWD reduces irrigation significantly compared with farmers' practice and, in most cases, lessens fuel consumption for pumping water by about 30 L/ha (Fernandez 2015). A field study by the Philippine Rice Research Institute on AWD showed water savings ranging from 16 to35% without decreasing grain yield.

In rice production, a water-saving technology called "aerobic rice culture" requires aerobic rice varieties to be grown in well-drained, non-saturated, and non-puddled soils. Growing rice aerobically saves water by eliminating continuous seepage and percolation, reducing evapotranspiration, and eliminating wetland preparation (Fernandez 2015).

In landscaping and gardening, native species that have high survival under local rain and climate conditions can save large amounts of water. Even though the water consumed for gardening activities in the Philippines may be relatively less, this is also important as the government maintains most of public gardens.

The widespread adoption of AWD, aerobic rice culture, and other alternative technologies depends on incentives for irrigation. Most irrigation systems in the Philippines currently charge farmers a flat rate, based on hectarage, regardless of the actual amount of water they use. A re-visit of the irrigation service fees as well as the type of irrigation system (national irrigation system or communal irrigation system) will have policy implications. Likewise, the manageability of technology can contribute to an enabling environment for farmer adoption. It is often argued that if water is available and easy to apply, then farmers will use more than necessary. Therefore, to promote farmer adoption, technology should be effective, easy to apply, in the desired amount, easy to operate and maintain with local resources, and affordable.

11.3.2.3 Grey Water Reuse

Grey water is wastewater from baths, sinks and washing machines, accounting for about 60% of the outflow from homes. It contains little pathogens and 90% less nitrogen than toilet water, so does not require the same treatment process. Grey water use reduces irrigation water needs, increasing availability of freshwater for other primary uses. The benefits of grey water use especially for agriculture have been demonstrated in many countries such as Africa, Australia, Egypt, Lebanon, Mexico, and Palestine, among others. In the Philippines, wastewater from baths, sinks and washing machines usually go directly to the storm drain, without the benefit of reuse for gardens and farms. Wastewater treatment plants are not available in cities and municipalities, with some exception. Baguio City has a water treatment plant but has been operating by 4000 m^3 more beyond its capacity of 8000 m^3. This urged the local government of Baguio to prepare a site for a decentralized wastewater treatment facility for those who are not serviced by the Baguio Sewage

Treatment Plant. The new facility will prevent wastewater from draining directly into the Balili River System. The Baguio LGU also requires that all high-rise buildings have their own sewage treatment facilities (Refuerzo 2015).

11.3.2.4 Minimizing Non-revenue Water

Minimizing non-revenue water (NRW) is a supply-side water demand management policy. NRW is the difference between system input volume and billed authorized consumption. Accurate information on the quantity of water in and out of the system is paramount to track and control operational efficiencies by helping identify and prioritize actions to reduce losses.

In the Philippines, water districts and concessionaires aimed for metering of water flows at the transmission, distribution, and consumer end to reduce NRW, thus providing information on the amount of water entering the system and consumed. The case of Maynilad's project extending water services to informal settlers to the west zone of Manila significantly contributed to minimizing their NRW. More details about this project are provided in the succeeding sections of this chapter.

Pressure management and leak detection and repair are strategies to reduce NRW. A water supply system is generally designed to operate at pressures, which lead to minimum head loss, while also ensuring adequate pressure to consumers located at the tail end of the network or on levels above the ground floor. High pressure can lead to high system leakage and increased water usage by consumers.

Water supply in many Philippine cities generally faces problems related to supplies at low water pressure. Consumers in many cities such as Baguio, Bulacan, and Iloilo complain of low water pressure and resort to the use of online booster pumps. In a community located near a university in Baguio City, water provided by the Baguio Water District and private water delivery services is not enough for boarding houses and dormitories so owners have drilled wells as deep as 300 feet. These wells are so close together that community leaders fear that empty water tables may already be unsafe for the people living in the area.

11.3.2.5 Peak Season Interventions

Section 18 of the Water Code of the Philippines recognizes the possibility of recurrent water shortage from either peak demand periods and/or times of crises and emergencies. Recurrent water shortage refers to the natural periodic diminution of water in a source of supply to a volume of rate flow insufficient to meet water requirements. Peak water use describes the time of year when residential water use is at its highest. A survey conducted by the NWRB with World Bank in 2014–2015 puts consumption pattern per person per day as varying, largely depending on the water provider. Private sector provides the highest at 120 liters per capita per day (lpcd), followed by water districts at 108 lpcd and the least by LGU at 99 lpcd and CBOs at 86 lpcd. While average per capita consumption is about 96–100 liters of water per day, during peak season (hot and dry summer months), the same household can use about 129–144 liters of water per capita in a day (DILG 2008). Peak-season water demand management interventions take the form of public announcements through websites and news articles urging the public to use water prudently. Practical tips on monitoring daily water use, limiting water usage, and reusing water stretches the precious water supply to provide everyone's water needs during the sweltering months (PCDSPO 2014). Watering of plants is done only when needed, laundry is washed only on full load, and plumbing fixtures are efficiently set up. Peak hours can be avoided when taking showers, cooking, and doing laundry.

Section 8 of the National Water Crisis Act of 1995 provides for anti-pilferage in whatever form, thus presenting a strong policy support to prevent and minimize water loss during peak season.

11.3.3 Social/Political Strategies

The human dimension of water use includes understanding how people use water, their consciousness and knowledge about water, and the behavioral determinants of water conservation. An improved understanding of these elements will help the government develop policies and strategies that can facilitate appropriate behavior change.

Water providers are also implementing non-price conservation measures such as public awareness and information; education, and recycling/reuse with the expectation that these programs will reduce residential water demand (Michelsen et al. 1999). Changing behaviors associated with high water use and encouraging the use of water-saving devices and practices often are seen as effective means to achieve a reduction in water use.

11.3.3.1 Policies and Interventions that Promote Public Awareness and Information

To understand how citizens use water, there is a need to examine the regulatory framework within which water-related behavior takes place, specifically the extent to which individual consumers are engaged. This is basically found in enacted laws pertinent to water. To what extent do these laws directly specify the involvement of water consumers? The Water Code (1976) is explicit in recognizing the need for undertaking public consultation and hearings such as for appropriating water use, adjusting supply during water shortage, and revocation of permits. The National Water Crisis Act (1995) directs nationwide consultations on the water crisis, although the rest of the law is largely devoted to forms of water pilferage and their corresponding penalties.

Only in Letter of Instruction (LOI) 744 (1978) is public education program mandated of water districts on aspects of their operation, including conservation. Likewise, it requires districts to prepare a comprehensive program and system of both formal and informal public consultation when considering increases in water rates. The LOI further mandates the review of the composition of water district boards to ensure that consumers are "properly and fully" represented, although there is no mention of how board members are to relate with the constituency they represent.

The Philippine Clean Water Act of 2004 communicates a greater awareness of the consuming public, initially in its declaration of policy–the pursuit of public health and quality of life; encouragement of "civil society and other sectors in their efforts to organize, educate and motivate the people in addressing pertinent environmental issues and problems at the local and national levels." Two provisions substantiate these policies with the mention of "due public consultation" and the inclusion of individuals and civil society among possible recipients of incentives and rewards for outstanding participation in quality water management initiatives and programs.

Public information and education campaigns continue to be popular means of encouraging users to adopt and maintain long-term water conservation behavior. In general, there has not been a systematic water educational program that has been replicated across the country. There may be occasional campaigns at the local (e.g., city, municipal) levels, which are largely prompted by alarmingly low water supply levels. Such campaigns usually attempt to persuade water users to conserve water, and they also provide users with information on how to do so, such as taking shorter showers, scaling back on lawn watering or car washing, or installing water-saving fixtures. Simple techniques for indoor residential are illustrated which include checking running toilets, dripping faucets, and other household leaks. Most leaks within a home can be easily fixed without investing in new equipment and can be performed with the knowledge and guidance of the local water utility.

During drought, a nationwide public education campaign is conducted, encouraging people to conserve water. In the summer of 2015, Angat Dam, which supplies 97% of Metro Manila's water need, had dangerously low levels. Water officials called for reduction of water use, giving suggestions on how to stop wasteful practices. Newspapers, radio, and television carried stories on the drought, usually accompanied by an exhortation to conserve water.

The above notwithstanding, two water projects, which can be models for increasing public awareness and involvement within communities are described in Box 11.2.

Box 11.2: Model Projects for Public Awareness and Community Involvement

Case 1: Manila Water

Manila Water, the private concessionaire providing water in the east zone of Metro Manila, set up in 1998 the "Tubig Para Sa Barangay" (TPSB, Water For The Community) to serve the water needs of poor marginalized households to easily connect to a piped-in water supply. Of interest here is the community aspect where Manila Water forged a strong partnership with the community and other stakeholders such as local government and non-government organizations. The project divides the service area into smaller territories each handled by a territory manager, whose responsibilities include calling meetings to ensure that all concerns are addressed. Community sense of ownership and responsibility over the project is fostered by involving residents in every stage, holding several public consultations and dialogues, and allowing community members to play crucial roles in the management, billing, collection, maintenance, and monitoring of each water connection. This ongoing program has uplifted the lives of poor people beyond water access, enabling them to pursue livelihood programs to augment limited incomes and raising their quality of life.

Case 2: Maynilad Water Services

The Maynilad Water Services Inc., the second concessionaire providing water to the west zone of Metro Manila, launched its Samahang Tubig Maynilad (STM; Maynilad Water Associations) in 2009. STM extended water services to informal settler families, as these poor households would otherwise not have legal rights and financial resources to apply for water connections from a water district. The approach uses a community-based water management system in which residents are directly involved in the day-to-day operations and administration of the water supply, largely similar to TPSB of Manila Water. Through community organizing, residents are grouped into associations and undergo training for value education and water management to enable them to manage their community water system. Once organized, members of the STM sign a Memorandum of Agreement with Maynilad Inc., committing to their duties and responsibilities as water system administrators. Maynilad installs a bulk water wherein access is either through metered public faucets within the community or piped-in water to a cluster of households, each with sub-meters. This approach has benefitted poor communities.

Sources: Manila Water Company, Inc., 2010. Sustainability Report. http://www.manilawater.com.ph/downloada/2010SustainabilityReport.pdf (Accessed on March 25, 2017).

Maynilad Water Services, Inc., 2011. Sustainability Report. Securing our Resources. http://www.mayniladwater.com.ph/downloads/2011MayniladSustainabilityReport.pdf (Accessed on March 25, 2017)

11.3.3.2 Policies and Interventions That Address Social Behavior and Promote Water Conservation

Citizens' behavior relative to water is shaped not only by his knowledge about water as may be obtained through public education programs but also by other factors. By looking at government legislation, one can identify the behaviors that are explicitly promoted.

The 1976 Water Code recognizes the rights of individuals to know who apply for water permits and to protest any issuance of water permits when these infringe on the right to water of other parties. It further confirms the right to water when it states that individuals are free to draw manually water even from private sources for domestic purposes, as long as it does no injury to the owner. The Water Code also has a whole chapter (VI) on conservation and protection of water resources. Those provisions that apply to individual behavior are duties of individuals controlling wells to ensure water is not wasted or contaminated; preference in granting permits in favor of associations (irrigators) rather than individuals when both apply for the same area; and prohibition of individuals from building works or performing acts that may introduce dangerous substances or pollution into the water supply. The rest of the chapter addresses more macro level interventions.

Section 8 of the Water Crisis Act of 1995 identifies a list of 'pilferage' behaviors considered unlawful: destruction of any property or waterworks of any water utility; malicious acts that injure quantity or quality of water or sewage flow; obstruction with works performed on water mains and distribution network; tapping of water connection without appropriate authorization from water utility; tampering with meters resulting in stolen water; use or receipt of illegally obtained water; and possession of stolen or tampered water meters. The Act further stipulates the penalties for pilferage. It is observed that this law only focuses on behaviors that are prohibited but none on advocated actions.

The Clean Water Act of 2004 provides for incentives and rewards. It mandates "due public consultation" (in coming up with a list of industry categories) and inclusion of individuals and civil society among possible recipients of incentives and rewards for outstanding participation in water management initiatives and programs. However, it does not go any further into strategies for achieving these.

Greenpeace (2007) observed that inefficiency in water usage is aggravated by the absence of regulations, economic incentives, and institutional arrangements needed to promote water conservation and rational use of water. Similarly, Gamboa (2011) recommends that the Water Code be amended to integrate the adoption of integrated water resource management (IWRM) as a guiding strategy.

The aforementioned shows that legislation has little to say about individual behavior. This may be because of lack of knowledge from behavioral research that can guide and lead to more comprehensive water policy. There is growing advocacy for non-structural approaches to water management which encompasses scientific research, education, and persuasion to coordinate how humans use water (FAO 1993).

The social psychological literature has looked into the role of intrinsic factors in influencing people's water conservation behavior. Jorgensen et al.'s study (2009) found that interpersonal and institutional trust is a critical attribute in household water consumption. People will not save water if they feel others are not doing their share of reducing their consumption and if they do not trust the water authority. Another study showed that personal normative beliefs related to water had a positive effect on conservation but antisocial behavior inhibited conservation (Corral-Verdugo and Frias-Armenta 2006). Perceptions of inefficacy of water conservation laws produced no effect on water conservation practices. Jones et al. (2011) explored the link between citizens' social capital and perceptions on restrictions imposed from water consumption policy instruments on one hand and their perceived level of effectiveness on the other hand. Social capital consists of social and institutional trust, participation in social networks, and compliance with social norms. The study found that significant connections exist between elements of social capital and perceptions of citizens toward water consumption policies.

Attitudes are usually considered precursors to behavior although decades of attitude-behavior research has not established an absolute relationship. Behavior is better predicted by intentions. The theory of reasoned action and planned behavior proposes that attitudes, subjective norm or the influence of a person's social environment and control over behavior are the predictors of intentions. A study by Syme et al. (1983) among households in Perth, Australia, had mixed results with water consumption being related in some instances to household size and family income and in other instances to attitudinal factors. Kantola et al.'s (1982) study found that influence on intentions to conserve water was explained by subjective normative feelings (perceived peer pressure) and the exogenous variable age. Expressed attitudes did not contribute significantly to predicting intention to consume water when subjective norms were included in the regression model. The results from attitudinal studies suggest pathways to interventions such as providing appropriate information about the behavior, offering information about consequences, and presenting opportunities to compare oneself with others.

The results of a survey on conservation efforts in Melbourne (Syme et al. 2000) showed that, although most community members were confident that their households could succeed in saving water voluntarily, the general view was that voluntary responses were not effective. Research and industry experience suggest that public acceptability of demand management practices depends on the type of proposed measures and the current water supply situation. Sociological methods include appeals, way of living, or legal action. Appeals, through the media or on accounts, rarely last long before consumers forget the urgency. During periods when drought is severe, individual users may be willing to adopt a wide range of short-term measures, including practices that require changes in their normal economic activities and lifestyles.

In the Philippines, water conservation through reuse and recycling has been promoted even in normal times. Recycled water means water which, as a result of treatment of waste, is suitable for a beneficial use that would not otherwise occur. In the urban sector, recycled water can be used in place of potable water in landscape

Box 11.3: Reuse and Recycling of Water in the Cordillera

Domestic water in the upstream (Baguio City) and midstream (La Trinidad) sites is often inadequate and expensive for water users, hence residents resort to recycling and reusing water. Bath water is used to flush the toilet while laundry or dishwashing water is re-used to clean floors or flush the toilet. When suitable, recycled water is used for gardens. Likewise, use of rainwater is not underestimated. Almost all households have storage drums or tanks for rainwater, which is used for cleaning, laundry, flushing the toilet, and even for bathing.

Commercial water, such as that used in water refilling stations, is also recycled in Baguio City. The filtering process results in a large volume ejected as waste water. Business owners use this water to operate a laundry business. It is common to see these two businesses in areas within Baguio City where there is a concentration of dormitories and boarding houses for students.

Even in the downstream town of Sablan where water is abundant for most of the users, some households live too far from water sources. Therefore, the use of rainwater is a necessity and recycling bath water for watering plants is also done.

Source: Focus group discussions in Baguio City, La Trinidad, and Sablan conducted in May 2013.

irrigation and some industrial uses. Government and water agencies should pursue appropriate opportunities for replacing potable water with recycled water. Likewise, the use of grey water has also received a lot of attention as discussed in the earlier section. Box 11.3 demonstrates the reuse and recycling of water in the Cordillera highlands in northern Luzon, Philippines. The area is characterized by differing stages of economic transformation: from a predominantly subsistence-based downstream community to a mixed subsistence-market midstream community and finally, to a predominantly market-based upstream community.

11.4 Recent Initiatives to Improve Access to Water

Water agencies also have a role in areas where the demand for water is not met due to limited coverage of water supply and sanitation services. Plans for satisfying these "unserved" demand are an important component of demand management as are reductions in water use and losses in areas or sectors with "fully served" demand (Dziegielewski 2003). This section discusses initiatives by the private sector to meet the water demand in unserved areas. Although there are two local government initiatives, the *Sagana at Ligtas sa Tubig sa Lahat or Salintubig* (translated as Abundant and Safe Water for All) and Bottom-Up Budgeting – Water, these are at their initial stages and monitoring is still in progress. Both are aimed at attaining significant progress toward the development of providing universal access to clean and safe water supply by 2025.

11.4.1 Private Sector Participation

Within the sphere of publicly financed networks, water systems piped into premises are limited in coverage, and service delivery is irregular at best. LGUs struggle to expand their utilities, leaving both rich and poor residents underserved. A potential solution to accelerate access to piped water services, especially for the poor is public-private partnerships (PPPs). In this arrangement, private sector capital is mobilized for water system improvements and expansion at a scale far larger than that available from public funds. Water services are more reliable as operators face the incentive to match supply with consumer willingness to pay, enabling a sustainable cash flow, and facilitating service coverage expansion. The private sector also brings technical and financial expertise to manage water utilities in a more efficient and sustainable manner.

11.4.1.1 Initiatives of the Metro Manila Water Concessioners

Before the 1997 privatization, the government-owned and -operated Manila Waterworks and Sewerage Services (MWSS) was the water utility mandated to supply water and provide municipal wastewater treatment facilities in Metro Manila. The National Water Crisis Act of 1995 (RA 8041) provided the legal basis for the privatization of MWSS in 1997, a change that brought about some remarkable improvements in water supply coverage and service performance. The PPP arrangement set targets of reaching 24/7 water service within 6 years and universal coverage for water within 11 years, while ensuring drinking water quality according to national standards at a pressure of 16 psi.

Participation was implemented through a concessionaire contract of 25 years where the concessionaires were assigned the task of operating and managing the facilities, whereas MWSS preserved the ownership of the infrastructure. Following the Paris, France water privatization model wherein the utility split its jurisdiction into two to prevent a monopoly, MWSS granted Manila Water Company the East Zone concession and Maynilad Water Services, Inc. the West Zone concession (Northrop 2012). The concession contracts included targets concerning coverage, service quality, and economic efficiency meant to address issues related to supply distribution, finance, and strengthening the government's anti-pilferage efforts.

The story or the Manila water concessions is a remarkable narrative of turnaround in the provision of water and sanitation services over two decades, first in east Manila, and then in west Manila. Both concessions have achieved world-class performance, doubling the number of water connections since the start of the concession period. In the first 5 years of operation, much improvement was noted in service indicators and there was an initial price drop between 1996 and 1997 (Chia et al. 2007; Montemayor 2003). This was due to the low water tariffs offered by the concessionaires. The partnership between MWSS and Maynilad Water Services, Inc. led to 1,129,497 connections in 2013 (MWS, Inc. 2015).

The Manila concessions both feature pro-poor mechanisms that provide differentiated level of services that are more affordable to base-of-the-pyramid customers and contribute significantly to concessionaire revenues. Details of the pro-poor programs of the two concessionaires are discussed in the succeeding section.

11.4.2 PPP Initiatives in the Provinces

This section examines seven water utility PPPs in the provinces using Castro et al.'s (2015) study and the World Bank's Water and Sanitation Program (WSP) study in the Philippines (World Bank 2015). These PPPs varied in size and contract type. Likewise, catalysts that drove both public and private sectors to come together differed across areas, although they shared a commonality in terms of desperate need (Table 11.2).

A key finding in the implementation of PPPs in both Manila and the provinces shows that different arrangements can lead to affordable, reliable, and clean water services, provided there is sufficient market size and willingness to pay. PPPs can thrive in diverse geographies, as long as service is focused on meeting the demand

Table 11.2 PPPs in provinces across the Philippines

		Partners		Connection	Arrangement
Area	Driver of PPP	Public	Private		
Malasique, Pangasinan	Poor service limited to *poblacion*	Municipal government	Inpart Waterworks and Development Corporation	2419	Concession
Tabuk City, Kalinga	Intermittent water supply	City government	Calapan Waterworks Corporation	3600	Lease
Norzagaray, Bulacan	Drying up of wells	Water district	Phil Hydro/ Maynilad	NA	Build-operate-transfer
Laguna	Water-related health issues	Provincial government	Laguna Water Corporation	61,448	Concession (joint venture)
Quezon, Palawan	Complete lack of water supply	Provincial government	Alfonso XII Water Users' Association		Management operation & maintenance contract
Boracay, Aklan	Inadequate water and wastewater infrastructure	Tourism Infrastructure and Enterprises Zone Authority	Boracay Island Water Company	5531	Concession (joint venture)
Sta Cruz, Davao Sur	Intermittent water supply	Municipal government	Sig Construction	3911	Design-build-lease

Source: Castro et al. 2015

for which consumers are willing to pay. Achievements of PPP arrangements are summarized in the following outcomes:

- 24/7 water service
- Water availability ≥100 liters/capita/day
- Water pressure ≥ 7 psi
- Drinking water quality according to Philippine national standards
- Working ratio > 50%, assuring adequate revenue generation to operator
- Collection efficiency >90%
- Non-revenue water ≤20%
- Number of staff per 1000 connections within international benchmarks of 3 to 54

However, achieving universal coverage of households in the Philippines remains a challenge. Llanto (2013) reported that about 15.73 million Filipinos still do not have access to a safe water supply, leaving more room to work with the private sector on innovative financing schemes to increase investments in water supply and sanitation.

11.4.3 Initiatives of Concessionaires and Water Districts to Provide Access to the Poor

Pro-poor approaches are not yet universal, but successful approaches have been implemented in some areas. The two water companies in Manila have made efforts to reach the poor who can ill-afford a private water connection. The issue of illegal settlers had to be addressed inasmuch as private utilities are not allowed to connect illegal settlers to the network. Consequently, community-based innovative solutions, such as the provision of a water system for clustered low-income communities (Manila Water's *Tubig sa Barangay* [Water for Communities] Program) and the installation of a bulk water system or public faucet with a mother meter (Maynilad), have been found to overcome this problem and ensure sustainable solutions that develop self-reliance in some areas of the city (Gazmen 2012). Manila Water's operational initiative, Tubig sa Barangay not only enabled the company to meet its goal of reducing non-revenue water through self-managed water districts among informal communities, but it also earned the company legitimacy and support from the urban poor against opponents of privatization (Hall et al. 2015). Maynilad offered discounted tariffs for consumers with monthly consumption below the minimum bracket of 10 m^3 while also providing a network of tap stands to poor communities.

Water districts carry out programs to reduce utility charges for poor residential customers. These charges are often described by the single category of lifeline rates. The lifeline concept of rate design is frequently proposed as an aid to economically disadvantaged and elderly residential customers who might not be able to pay their bills. Boracay also provide discounted tariffs for consumers with monthly

Box 11.4: Dagupan City Water District Island Water Project

The successful innovation of the Dagupan City Water District (DCWD) is the network of underwater pipelines that extend potable piped water service from the mainland of Dagupan to four island barangays of Dagupan City. The P30 million project was funded from the DCWD funds, with major contribution from the Countryside Development Fund of a congressman and the city government of Dagupan. The scale and novelty of the project is attributed to the support of three succeeding city administrations. This is a perfect example of new mayors lending support to worthy projects of the previous mayor. It is also uniquely an undertaking by local divers who installed the pipes under water. Unlike other underwater pipeline projects that hire professional scuba divers, this project made use of local folks who were also able to earn a living out of the project. Their vast and long experience in diving in these waters allowed them to predict underwater current and other factors that helped in project planning and implementation. The local divers are also relied on for regular maintenance activities of the pipelines.

Source: LWUA (2016).

consumption below the minimum bracket of 10 m^3. Likewise Manila, Laguna, and Boracay provide installment plans for connection charges.

In addition to lifeline and discounted rates, water districts implement special projects that provide access to water in extremely difficult areas. The case of the Dagupan Water District is shown (Box 11.4) to illustrate this point. Pipes have to be installed under water and the collaboration of the recipient community has to be solicited to prevent the pipes from being destroyed by the current and to maintain the facility.

11.5 Summary/Conclusions/Insights/Prospects

Water demand management has, over the years, emerged as both an alternative and complement to the conventional water supply management. Major policy approaches to support and promote WDM can target water users and provide through demand-side and supply-side interventions, respectively. On the consumption side, water demand reduction by avoiding undue consumption can be encouraged by a combination of market incentives and communication and education programs that heavily influence social behavior. On the provider side, promotion of devices and technologies that facilitate less water use and strategies that minimize losses in the system and improve water distribution and operational efficiency could lead to more efficient management and use of available water resources. Exploring alternative sources such as grey water reuse and recycling of wastewater for non-potable uses could also augment existing water supply.

Implementation of the two-pronged approach would require reforms in existing policies on water. On the provider side, policies must provide appropriate and adequate regulatory, institutional, and legal framework for delivery of services; tariff reforms must ensure financial sustainability of operations of the utility; and internal reforms within the providers must aim at improving the operational efficiencies and reducing losses to acceptable levels. Water districts are included in the list of government owned and controlled corporations (GOCCs) and are therefore covered for review under the GOCC Governance Act of 2011. A big challenge for water utilities in the Philippines is to improve efficiency from fuller advantage of economies of scale. Where applicable, policies must be supportive of integrated systems that achieve optimal returns despite relatively lower tariffs. As part of internal reforms, water districts must subject themselves to benchmarking, a tool used to measure performance of a water utility through a set of technical, financial, and social indicators, with the ultimate goal of improving its quality and performance. If undertaken on a regular basis, benchmarking supports utilities in assessing progress and promotes accountability by making information available to the public, decisionmakers, and regulators.

On the consumer side, more policy challenges are faced in terms of long-term changes in ways of life and consumer behavior to reduce water consumption. A "rebound effect" is often observed following a water crisis when customers return to their former patterns of water use. A certain amount of savings is more lasting, partly due to the spread of water-efficient technologies, but also due to lasting behavioral changes. However, little information exists on the effectiveness of non-price conservation programs in reducing water demand. Michelsen et al. (1999) recommended that utilities maintain more detailed and consistent information regarding the implementation of their non-price programs. Turton (1999) emphasized the importance of adaptive social capacity for countries experiencing water scarcity. He agreed with Ohlsson (1999) who suggests that the adaptive capacity of a society should also be regarded as a resource, and therefore societies facing water scarcity will have different development trajectories, depending on their adaptive social capacity.

Our review of national laws related to water showed an obvious bias toward punitive provisions, which cannot be fully satisfied, given the shortcomings in administrative mechanisms for implementation. There is a more promising venue for policies that provide for incentives and rewards for rational water use such as grey water reuse and recycling, and use of water-saving devices and technologies. However, implementation of these policies will remain inadequate and confusing unless we put in place a robust national water resource body with a clear mandate to address water issues both on the supply and demand sides.

References

Abansi, C. L., Doble, M. C. C., Cariño, J. K., & Rola, A. C. (2016). Beyond prices: The cultural economy of water in the Cordillera Highlands of Northern Luzon, Philippines. *Asia Pacific Viewpoint, 57*, 280–293.

Agrawal, A., & Goyal, S. (1999). *Group size and collective action: Third party monitoring in common-pool resources*, *Leitner Working Paper No. 1999–09*. New Haven: The Leitner Program in International Political Economy, Yale University.

Araral, E., & Wang, Y. (2013). Water demand management: Review of literature and comparison in South-East Asia. *International Journal of Water Resources Development, 29*(3), 434–450.

Bakker, K. (2003). *Good governance in restructuring water supply: A handbook*. Ottawa: Federation of Canadian Municipalities and the Program on Water Issues.

Castro, A., Jagannathan, V., & Navarro, M. (2015). *Beyond one-size-fits-all: Lessons learned from eight water utility public-private partnerships in the Philippines. Water and sanitation program learning note*. Washington, DC: World Bank Group. http://documents.worldbank.org/curated/en/788411468188355625/Beyond-one-size-fits-all-Lessons-learned-from-eight-water-utility-Public-Private-Partnerships-in-the-Philippines. Accessed 3 Jan 2016.

Chia, P. G., Chua, C. K., Kim, F. C., Teo, S., & Toh, K. L. (2007). *Water privatization in Manila, Philippines-should water be privatized? A tale of two water concessionaires in Manila*. Economics and Management in Developing Countries (7 May 2007, pp 21). INSEAD. http://www.circleofblue.org/waternews/wpcontent/uploads/2012/06/Insead_Water_Privatization_Manila_Philippines.pdf. Accessed 15 Mar 2016.

Corral-Verdugo, V., & Frias-Armenta, M. (2006). Personal normative beliefs, anti-social behavior and residential water conservation. *Environment and Behavior, 38*(3), 406–421.

DILG (Department of Interior and Local Government). (2008). *Benchmarking performance of small town water supply*. Quezon City: DILG.

Dziegielewski, B. (2003). Strategies for managing water demand. *Water Resources Update, 126*, 29–39.

Dziegielewski, B., Opitz, E. M., Kiefer, J. C., & Baumann, D. D. (1993). *Evaluating urban water conservation programs: A procedures manual*. Denver: American Water Works Association.

FAO (Food and Agriculture Organization of the United Nations). (1993). *The state of food and agriculture*, *FAO Agricultural series*. Rome: FAO.

Feitelson, E. (2012). What is water? A normative perspective. *Water Policy, 14*, 52–64.

Fernandez, R. A. (2015). DA promotes water-saving technologies. *The Philippine Star*. Retrieved from http://www.philstar.com/agriculture/2015/11/29/1526946/da-promotes-water-saving-technologies. Accessed 12 Dec 2015.

Freeman, J., & Kolstad, C. D. (2007). *Moving to markets in environmental regulation: Lessons from twenty years of experience*. New York: Oxford University Press.

Gamboa, M. (2011). *Policy brief #1. National College of Public Administration and Governance*. Diliman/Quezon City: University of the Philippines.

Gazmen, P. G. (2012). *Tubig para sa Barangay: Providing clean and affordable water to poor communities using a sustainable model and community participatory approach*. Paper presented at the roundtable discussion on Water Rights and Water Wrongs: Toward Good Water Governance for Development. Social Sciences Division- NAST PHL, January 26, 2012, Hyatt Hotel and Casino Manila, Manila, Philippines.

Gleick, P., Wolff, G., Chalecki, R.R. (2002). The new economy of water: The risks and benefits of globalization and privatization of fresh water." Oakland, California: Pacific Institute for Studies in Development, Environment, and Security.

Glennon, R. (2004). The price of water. *Journal of Land, Resources & Environmental Law, 24*(3), 337–342.

Greenpeace. (2007). *The state of water resources in the Philippines*. Quezon City: Greenpeace Southeast Asia. Greenpeace Southeast Asia. http://www.greenpeace.org/seasia/ph/Global/seasia/report/2007/10/the-state-of-water-in-the-phil.pdf. Accessed 28 Oct 2016.

Hall, R., Lizada, J., Dayo, M. H., Abansi, C., David, M. E., & Rola, A. C. (2015). To the last drop: The political economy of Philippine water policy. *Water Policy, 17*, 946–962.

Hanemann, M. (2005). *The value of water*. Berkeley: University of California.

Herbertson, P. & Tate, E. (2001). *Tools for water use and demand management in South Africa*. Technical Reports in Hydrology and Water Resources, No.73. Geneva: World Meteorological Association. http://www.wmo.int/pages/prog/hwrp/documents/TD73.pdf. Accessed 12 Dec 2016.

Herrfahrdt-Pahle, E. (2010). South African water governance between administrative and hydrological boundaries. *Climate Development, 2*, 111–127.

Inman, D., & Jeffrey, P. (2006). A review of residential water conservation tool performance and influences on implementation effectiveness. *Urban Water Journal, 3*, 127–143.

IPCC (Intergovernmental Panel on Climate Change). (2007). *Climate change 2007: Synthesis report*. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. Geneva: IPCC. 104 p.

Jalil, M. A., & Njiru, C. (2006). Water demand management in urban water supplies: Present and future challenges. In M. M. Rahman, M. J. Bin Alam, M. A. Ali, & I. Smout (Eds.), *Environmental sustainability concerns* (pp. 43–57). Dhaka: Environmental Engineering Division (EED), Centre for Environmental and Resource Management (CERM), and International Training Network (ITN) Centre, Bangladesh University of Engineering and Technology.

Jones, N., Evangelinos, K., & Gaganis, P. (2011). Citizens' perceptions on water conservation policies and the role of social capital. *Water Resource Management, 25*, 509–522.

Jorgensen, B., Graymore, M., & O'Toole, K. (2009). Household water use behavior: An integrated model. *Journal of Environmental Management, 91*(1), 227–236.

Kantola, S., Syme, G., & Campbell, N. (1982). Role of individual differences and external variables in a test of sufficiency of Fishbein's model to explain behavioural intentions to conserve water. *Journal of Applied Social Psychology, 12*, 70–83.

Linton, J. (2010). *What is water: The history of a modern abstraction. Vancouver*. Toronto: UBC Press.

Llanto, G. (2013). *Water financing programs: Creating incentives for private sector participation*. Philippine Institute for Development Studies (PIDS) Policy Notes No. 2013–16. Makati City, Philippines: PIDS. http://dirp4.pids.gov.ph/ris/dps/pidsdps1334.pdf. Accessed 14 Mar 2016.

LWUA (Local Water Utilities Administration). (2014a). *A primer on LWUA and the water districts*. http://www.lwua.gov.ph/about_lwua_14/primer.html. Accessed 27 Apr 2016.

LWUA (Local Water Utilities Administration). (2014b). *Manual on water rates: Chapter 3*. http://www.lwua.gov.ph/downloads_10/LWUA_water_rates_manual.pdf. Accessed 29 Apr 2016.

LWUA (Local Water Utilities Administration). (2016). *Water: Water code of the Philippines implementing rules and regulations.* pp. 16–38. http://www.lwua.gov.ph/downloads_14/watercode-phil.pdf. Accessed 27 Apr 2016.

Massarutto, A. (2007). Water pricing and full cost recovery of water services: Economic incentive or instrument of public finance? *Water Policy, 9*(6), 591–613.

Michelsen, J., McGuckin, J. T., & Stumpf, D. (1999). Non-price water conservation programs as a demand management tool. *Journal of American Water Resources Association, 35*, 593–602.

Min, B. (2007). Determinants of water pricing: A regression analysis with cross-country data. *Water Policy, 9*(4), 363–372.

Montemayor, C. (2003). *The Manila Water privatization fiasco and the role of Suez Lyonnaise/Ondeo*. Paper presented at the Summit for Another World, G8 summit in Evian, 2003). http://www.tni.org/sites/www.tni.org/archives/altreg-docs/manila.pdf. Accessed 8 Dec 2015.

MWC (Manila Water Company, Inc.). (2010). *Sustainability report*. http://www.manilawater.com.ph/downloads/2010SustainabilityReport.pdf. Accessed 25 Mar 2017.

MWSI (Maynilad Water Services, Inc.). (2011). *Sustainability report: Securing our resources*. http://www.mayniladwater.com.ph/downloads/2011MayniladSustainabilityReport.pdf. Accessed 25 Mar 2017.

NEDA (National Economic Development Authority). (2010). *Philippine water supply sector roadmap*. Pasig City: NEDA.
Northrop, A. (2012). *Infographic: Water privatization in the Philippines*. Circle of Blue. http://www.circleofblue.org/2012/world/infographic-water-privatization-in-the-philippines/. Accessed 25 Nov 2015.
Ohlsson, L. (1999). *Environment, scarcity and conflict: A study of Malthusian concerns*. Goteborg: Department of Peace and Development Research, Goteborg University.
Olmstead, S., Hanemann, W. M., & Stavins, R. N. (2007). *Water demand under alternative price structures. National Bureau of Economic.* Research working paper series no. 13573. http://www.nber.org/papers/w13573.pdf. Accessed 15 May 2016.
Payero, J. O., Yonts, C. D., Irmak, S., & Tarkalson, D. D. (2005). *Subsurface drip irrigation: Advantages and disadvantages*. Lincoln: University of Nebraska-Lincoln Extension Circular EC776.
PCDSPO (Presidential Communications Development and Strategic Planning Office). (2014). *Infographic: How to conserve water*. Official gazette of the Republic of the Philippines. http://www.gov.ph/2014/05/23/infographic-how-to-conserve-water/. Accessed 7 Nov 2015.
Philippine Water Districts. *Average Production and Consumption Data as of 10/23/2017*. http://122.54.214.222/UnitCons.asp?Date=10/23/2017. Accessed 24 Oct 2017.
Refuerzo, A. (2015). Baguio wastewater treatment facility to ease water pollution. *Northern Philippine Times*. http://northphiltimes.blogspot.com/2015/10/baguio-wastewater-treatment-facility-to.html. Accessed 10 May 2016.
Rola, A. C., Abansi, C. L., Arcala-Hall, R., & Lizada, J. C. (2016). Characterizing local water governance structure in the Philippines: Results of the water managers' 2013 survey. *Water International, 41*(2), 231–250.
Rosellon, E. (2016). *Exploring water-saving technology for the Philippines' national irrigation system*. IRRI. http://news.irri.org/2016/05/philippine-food-security-chief-explores.html. Accessed 26 May 2016.
Syme G. J., Thomas, J. F., & Salerian, S. N. (1983). *Can household attitudes predict water consumption?* Paper presented at the Hydrology and Water Resources Symposium, 8–10 Nov 1983, Hobart, Australia.
Syme, G., Nancarrow, B. E., & Seligman, C. (2000). The evaluation of information campaigns to promote voluntary household water conservation. *Evaluation Review, 24*, 539–578.
Tagar, A., Chandio, F. A., Mari, I. A., & Wagan, B. (2012). *Comparative study of drip and furrow irrigation methods at farmer's field in Umarkot*. http://waset.org/publications/2316/comparative-study-of-drip-and-furrow-irrigation-methods-at-farmer-s-field-in-umarkot. Accessed 26 May 2016.
Turton, A. R. (1999). *Water demand management (WDM): A case study from South Africa*. MEWREW Occasional Paper No. 4. Presented to the Water Issues Study Group, School of Oriental and African Studies.
Van Koeppen, B., Giordano, M., Butterworth, J., & Mapedza, E. (2007). *Community-based water law and water resource management reform in developing countries*. Cambridge, MA: CABI.
World Bank. (2005). *Philippines: Meeting infrastructure challenges*. Washington, DC: The International Bank for Reconstruction and Development.
World Bank. (2015). *Water and Sanitation Program end of year report*. http://www.wsp.org/sites/wsp.org/files/publications/WSP-End-Year-Report-FY15.pdf. Accessed 27 May 2016.
Yonts, C. D. (2008). *Soil physical properties and irrigation basics [CD-ROM]*. Paper presented at the Irrigation and Energy Workshop for Corn Growers, 11 Feb 2008, Clay Center. https://masters.agron.iastate.edu/files/reeschristopher-finalccproj.pdf. Accessed 26 May 2016.
Young, O. (2002). *The institutional dimensions of environmental change*. Cambridge: MIT Press.

Dr. Corazon L. Abansi is Professor of the Institute of Management, University of the Philippines Baguio and holds a Ph.D. in Agricultural Economics major in Resource Economics. She is an ICM practitioner of UNDP-IMO facility "Environmental Management of the Seas of East Asia". She did research and development work on economics of water pollution, resource valuation and community mobilization while serving as Officer and resource economist of UNDP-IMO Program for the Prevention of Marine Pollution in East Asian Seas. Dr. Abansi is actively engaged in research in the Cordilleras focusing on the economics of hydropower generation and ecosystem services and resource management of indigenous communities. As site coordinator and resource economist of the project, "Towards Good Water Governance for Development" she is working towards developing an adaptive-collaborative water governance mechanism for the Cordilleras and has co-authored three papers published in the Water Policy, International Journal of Water Resources Development and Water International.

Dr. Rosalie Arcala Hall is a Full Professor at the University of the Philippines Visayas (UPV). She completed her Master's degree in Political Science and PhD in International and Public Affairs (2002) at Northeastern University, Boston, Massachusetts. She completed research projects with The Asia Foundation, The Nippon Foundation and Toyota Foundation concerning policy frameworks, their localization, resistance and competing narratives behind contestations in the areas of hard and soft security. She has contributed chapters to the books Rosalina Palanca-Tan ed. Nature and Culture: Environmental Issues in Asia (Ateneo de Manila Press, 2014), and Justine Vaz and Narumol Aphineves eds. Living Landscapes Connected Communities: Culture, Environment and Change Across Asia (Areca Books, 2014). She is co-author to two articles in Water Policy and International Journal of Water Resources Development. Currently, she is a member of the Philippine Commission on Higher Education Technical Committee on Political Science and the Philippine Political Science Association Board.

Dr. Ida M.L. Siason is Professor Emeritus of the University of the Philippines, and served as faculty and Chancellor of the UP Visayas. She obtained a Masters in Psychology degree from the Ateneo de Manila University and a PhD Social Psychology from the Pennsylvania State University, USA. She has been involved in the 'Water Governance for Development Project' of the University of the Philippines. Dr. Siason's research and publications have been in social analysis, women's studies, social-psychological characterization of fishing communities, gender issues, enforcement and compliance, and community-based coastal resource management. She has presented papers in national and international conferences in psychology, fisheries, and more recently on water governance. She has spearheaded activities to promote fisheries social science in the Philippines and was the charter president of the National Network on Women in Fisheries in the Philippines.