

Economic Valuation of Groundwater in Metro Manila and Adjacent Areas

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The National Water Resources Board (NWRB) has completed the water resources assessment study of the entire Metro Manila and neighboring provinces in October 2004. The study documented the critical condition of Metro Manila's groundwater aquifers caused by unregulated and excessive extraction of the resource. In response, the NWRB has adopted policies to preserve the groundwater aquifers. It has imposed a moratorium on new applications for groundwater extraction particularly in critical areas. A series of Cease and Desist orders have also been issued against numerous establishments that have been operating without the required water permits. To complement these regulatory measures, market-based instruments, such as full-cost pricing, have been considered to further enhance policies and other interventions for a more efficient and effective management of existing water resources. This study involved the estimation of the economic value of groundwater, supported by the collection of primary and secondary data on wells, updating of the groundwater database, generation of groundwater thematic maps, and groundwater simulation modeling. Recommendations on pricing policies and other related measures were also formulated to mitigate the depletion of groundwater. The study area includes the entire Metro Manila, southern parts of the province of Bulacan, northern parts of Cavite and western parts of Rizal.

Currently, the water demand of Metro Manila and some parts of the provinces of Rizal, Cavite and Bulacan is being supplied by the, i.e., Manila Water Company, Inc. (MWCI) for the east sector and Maynilad Water Services, Inc. (MWSI) for the west sector. The two concessionaires distribute water coming mainly from surface water sources, and only around 3% from groundwater resources. However, according to studies, only around 60% of Metro Manila's population have access to piped water supply or served by the two concessionaires. Unserved sectors have resorted to shallow well and deepwell construction as well as illegal connections to MWSS pipes. The groundwater in Metro Manila is largely used by residential subdivisions and commercial and industrial establishments, which are either not connected to the central distribution system, or need regular water supply for its operations.

While groundwater is constantly recharged by natural process, it can be depleted if it is pumped beyond the safe levels of water withdrawal. This can result in land subsidence and salt water intrusion. The depletion of groundwater in Metro Manila is evidenced by salt water intrusion in identified critical areas as described in NWRB and CEST (2004), MWSS and JICA (1992), JICA (1996) and JICA (1998). Land subsidence – attributed to the over-extraction of groundwater – has also



been observed, particularly along the coastal areas, causing shoreline changes and further aggravating the flooding problem in these areas (PEMSEA and MBEMP TWG-RRA 2004). The quality of groundwater can also be affected by contamination of pollutants due to leachate from dumpsites, leakage from underground tanks of gasoline stations, and from other human activities. Some wells have been found to be contaminated with coliform bacteria.

In this study, the Groundwater Level Map shows cone of depression in the areas of Bocaue, Marilao, Meycauayan and Balagtas in Bulacan province, cities of Valenzuela, Malabon, Caloocan, Quezon, Parañaque, Las Piñas and Muntinlupa in Metro Manila and coastal parts of Cavite province. These cones of depression cause saline water intrusion. Areas near the cone of depression should also be considered critical because it will also be directly affected when groundwater abstractions continue in the area. Also, upconing of brackish groundwater and connate groundwater is taking place in several areas, especially in the province of Bulacan. For policy consideration, the whole of Metro Manila shall be considered critical area, including the adjoining aforementioned areas. Deterioration in the quality of groundwater also significantly limits the quantity of groundwater that can be economically harnessed by prospective end users. Hence, its use in the present to satisfy human needs should not cause undue disadvantage to future generations who have equal rights to this resource. It is therefore imperative that it should be used judiciously and to conserve this resource for all users both in present time and in the future.

Given the common property nature of environmental services from groundwater use and waste disposal services, households and firms are likely to ignore social costs unless reflected in extraction charges, user fees and effluent charges, which they must pay. Efficient pricing requires that true marginal costs be used, including opportunity costs and externalities involved in the use of this resource. Water tariffs are generally based on average cost pricing, rather than on marginal cost pricing, and opportunity costs are not properly accounted. Moreover, most industries and private subdivisions have self-supplied water. Therefore, they are not subjected to water tariffs, but to a limited form of annual charges. The costs of installing and operating a well and pump have been the principal regulators of groundwater use. As a result, excessive quantities of water are used, and excessive wastewater is produced. In turn, these affect water availability for others and for future use. Setting the socially optimum price equal to the marginal opportunity cost (MOC) would highlight the relationship between the depletion of the resource and impacts on the economy over time.

Groundwater is a depletable resource, and its continued over-extraction has both economic and environmental consequences. Thus, pricing at full service cost is not enough. In this study, the framework for pricing follows Warford's (1994) approach to the pricing of water resources, and this involves estimating the full cost price, which consists of the marginal direct or private cost, marginal user cost and the marginal external cost of using this resource. The marginal private cost (MPC) includes the costs of production, such as investment and operating costs which are a function of water consumption. The MPC can be estimated using either the average incremental financial cost (AIFC) or the average incremental economic cost (AIEC) – the latter can be applied using shadow prices to account for distortions in the economy. Studies by Saunders, Warford and Mann (1977), indicate that when the problem of capital indivisibility exists, computing the marginal cost as the average incremental cost becomes more appropriate. Many World Bank-funded water projects use this method for tariff setting (Bahl and Linn 1992). ADB had also recommended that the economic price of water be set equal to AIC – in particular, average incremental economic cost or AIEC (ADB 2008). The marginal user cost (MUC) or the depletion premium involves estimating the present value of the cost of replacing the resource when it becomes depleted at some future period. The marginal external costs (MEC) refer to the costs of environmental damage caused by over-extraction of groundwater (e.g., drying up of wells in the area saltwater intrusion, land subsidence).

It is essential that the relevant and applicable combination of incentives to achieve efficiency in the use of groundwater resources be found. The main policy instrument considered in this study is the increase in the price of water used/purchased to reflect the marginal opportunity cost. Table 1 shows the charges that may be imposed in addition to the existing annual charges being collected by NWRB from groundwater users.

Table 1. Groundwater Charges to Account for the User (Depletion) and Externality Costs (PhP/cu.m.)						
	Area A			Area B		
	Municipal	Industrial	Commercial	Municipal	Industrial	Commercial
Additional Charges:						
1. Install additional wells	9.00	34.42	27.48	4.02	17.21	16.04
2. Install additional wells		36.86	34.01		19.61	19.04
* with interference effect						
3. Conjunctive use of GW and surface water		28.72				

This paper also focused on determining the right mix of pricing, fiscal and regulatory instruments and other measures (e.g., potential technological solutions and public awareness campaign) for the efficient use of groundwater resources. Incentive systems (like pricing instrument) are not costless since they involve regulation, monitoring and enforcement. Conservation or switching to water-saving technologies, likewise, entails investment costs. Strengthening capacity, improving governance, enhancing service quality, updating required information and conducting stakeholder participatory activities must be done simultaneously with adjusting groundwater prices. Reforms in groundwater charges must be accompanied by capacity development and reforms in the regulatory agency. Coordination with government agencies, such as MWSS, LWUA, DENR-EMB, should be further strengthened, particularly for the development of other water sources, sanitation and sewage treatment facilities, including setting of wastewater charges. The other policies which could be looked into are: the expansion of the MWSS distribution system and increased coverage (in terms of area and sectors served); the regulation of pumping rates in areas affected by land subsidence and those already contaminated by salt water and other critical areas; zoning of water-intensive industries to places with relatively abundant water supply; implementation of effluent and wastewater charges; and fiscal incentives.