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Challenges to water resource management: ensuring adequate supply and better water quality for the present and future generations

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Abstract: One of the most important life sustaining natural resources that a country should continually protect, preserve and enhance is water. All forms of life depend on water. Access to clean and potable water immensely contributes to the improvement of the quality of life. The human body needs to continually consume regular amounts of water in order to replace lost body fluids and to function properly. The production of food and raw materials by the agricultural sector as well as the manufacturing, mining and construction activities in the industrial sector all require huge amounts of water as a major input. The cheapest form of electricity comes from hydroelectric power plants which rely on water flowing through man made dams in the country's various major river systems. The provision of uninterrupted water supply improves the living conditions of all households and supports the continued expansion of economic activities whether in agriculture, industry or the services sector. A severe water shortage will lead to a deterioration in the quality of life as well as economic losses for firms heavily dependent on water as a major input for production.

The main objective of the study is to provide insights for policy recommendations that will improve water quality, improve waste water treatment, eliminate water pollution , protect watershed areas and reservoirs as well as promote the use of water harvesting facilities by both households and firms.

Key words: integrated water management framework; water demand and supply; improving water quality; watershed protection, ground water contamination; water harvesting

1. INTRODUCTION

One of the most important life sustaining natural resources that a country should continually protect, preserve and enhance is water. All forms of life depend on water. Access to clean and potable water immensely contributes to the improvement of the quality of life. The human body needs to continually consume regular amounts of water in order to replace lost body fluids and to function properly. The production of food and raw materials by the agricultural sector as well as the manufacturing, mining and construction activities in the industrial sector all require huge amounts of water as a major input. The cheapest form of electricity comes from hydroelectric power plants which rely on water flowing through man made dams in the country's various major river systems. The provision of uninterrupted water supply improves the living conditions of all households and supports the continued expansion of economic activities whether in agriculture, industry or the services sector. A severe water shortage will lead to a deterioration in the quality of life as well as economic losses for firms heavily dependent on water as a major input for production.

Objectives

The main objective of the study is to provide insights for policy recommendations that will improve water quality, improve waste water treatment, eliminate water pollution , protect watershed areas and reservoirs as well as promote the use of water harvesting facilities by both households and firms.

2. METHODOLOGY

The study uses a descriptive approach in order to provide an overview of the current state of water resources in the Philippines, as well as a thorough discussion and analysis of the issues confronting water resource management.

3. RESULTS AND DISCUSSION

3.1 Water Demand

Groundwater demand

Based on the estimates provided by the National Statistical Coordination Board (NSCB) published in the Philippine Water Resources Report for 2003, the industrial demand for groundwater in 1988 was measured at approximately 2.229 billion cubic meters and had increased to 3.769 billion cubic meters by the end of the year 2001. Using these estimates to arrive at an annual average growth rate of 4.123 percent, ground water demand for 2008 would be at 5.0 billion cubic meters and 6.372 billion cubic meters by 2014. Ground water is actually subsurface water found in underground aquifiers which can be extracted through deep well digging operations.

As the population continues to grow, the domestic demand for groundwater also continues to increase from 3.906 billion cubic meters in 1988 to 5.8297 billion cubic meters in 2001. This reflects an annual average growth rate of 3.128 percent over the 1988 to 2001 period (NSCB, 2003). With this rate of increase, groundwater domestic (household) demand is estimated at 7.23 billion cubic meters for the year 2008 and 8.7 billion cubic meters for the year 2014.

Surface water demand

Surface water which is found in lakes, rivers and streams was subject to substantial increases in demand over the 1988 to 2000 period. The use of surface water for domestic/ household consumption increased from 1.02754 billion cubic meters in 1988 to 1.25965 billion cubic meters in the year 2000 (NSCB, 2003). This reflects an average annual increase of 1.71 percent over the 13 year period. Based on this yearly rate of increase the demand for groundwater will be approximately 1.443 billion cubic meters in 2008 and 1.597 billion by the year 2014.

Industrial demand for surface water increased from 175.99 million cubic meters in 1988 to 242.34 million cubic meters by the year 2000. This reflects an average annual growth rate of 2.7 percent (NSCB, 2003). Using this yearly rate of increase, surface water industrial demand will be at approximately 300 million cubic meters by 2008 and 352 billion cubic meters for the year 2014.

Water Demand in the Major Metropolitan Areas

The National Water Resources Board (NWRB) has identified seven critical major metropolitan areas in the Philippines where the projected demand for water is expected to dramatically increase over the next 10 years. By the year 2025, water demand is expected to reach 2.883 billion cubic meters in Metro Manila, 342 million cubic meters in Metro Cebu, 203 million cubic meters in Zamboanga City, 153 million cubic meters in Davao City, 111 million cubic meters in Bacolod City, 98 million cubic meters in Cagayan de Oro City, and 87 million cubic meters in Baguio City. These Metropolitan areas are expected to have one of the most rapid increases in population growth because of rural to urban migration and increased birth rates. They are expected to attract the largest amount of investments in manufacturing, construction, electricity gas and water, as well as in commercial and residential establishments.

However, the amount of exploitable groundwater in these nine major metropolitan areas fall short of the projected demand for 2025. In 1998, exploitable groundwater was 191 million cubic meters for Metro Manila, 60 million cubic meters for Metro Cebu, 54 million cubic meters for Zamboanga City, 84 million cubic meters for Davao City, 103 million cubic meters for Bacolod City, 34 million cubic meters for Cagayan de Oro City and 15 million cubic meters for Baguio City.

The largest gap between projected demand and exploitable groundwater is 2.692 billion cubic meters for Metro Manila, 282 million cubic meters for Metro Cebu, 149 million cubic meters for Zamboanga City, 72 million cubic meters for Baguio City, 69 million cubic meters for Davao City , 64 million cubic meters for Cagayan de Oro City, and 8 million cubic meters for Bacolod City (NWRB, 1998). Aside from the projected demand being larger than the exploitable groundwater in these seven critical major metropolitan areas, it is also important to consider that a large percentage of groundwater is not fit for human consumption. The Environmental Management Bureau under the Department of Environment and Natural Resources reports that 66 percent of the 611 classified inland bodies of water were not fit for human consumption due to the pollution caused by the dumping of wastes from mining and industrial plants. Approximately 57 percent of the deep wells being monitored for groundwater extraction were highly contaminated with fecal colliforms (Philippine Environment Monitor, 2003). This further limits the amount of clean and potable water which could be used in these critical metropolitan areas.

Household consumption of water includes drinking, hygiene, sanitation, food preparation and laundry (Inocencio, 1999). The agricultural sector's use of water is primarily for irrigation or inland fisheries. Industry uses water as an input for production for processed food and beverages , the production of electricity, as well as a cooling agent for equipment and machinery which operate at high temperatures. Then mining sector uses water in the process of extracting certain mineral ores. Based on the World Resources Institute (2003), roughly 88 percent of total water withdrawals is attributed to the agricultural sector, 8 percent is accounted for by domestic household use, while the remaining 4 percent is for industrial and commercial purposes.

3.2 Water Supply

The Philippines' water resources are primarily composed of inland freshwater, coastal, bay and oceanic water. Water for domestic household consumption as well as for commercial and industrial use is taken from inland freshwater sources. Forest cover in mountainous areas serve as watersheds by absorbing rainfall and gradually allowing water to flow from the forest into rivers, lakes or coastal areas. Rainfall contributes to the accumulation of groundwater which can be accessed by the digging of wells. The country has 421 principal rivers, 59 natural lakes, and many

reservoirs with an aggregate area of 50,000 square kilometres (NSCB, 2003, Greenpeace, 2007, NWRB, 2003).

Ground water supply

The stock of groundwater had decreased by 79.182 billion cubic meters from 1988 to 2001, reflecting a reduction at an annual rate of 5.3 percent during the thirteen year period. The decrease in the stock of groundwater is largely attributed to the rising demand from the industrial as well as the household sector (NSCB, 2003).

Surface water supply

The stock of surface water decreased from 220.440 billion cubic meters to 193.091 billion cubic meters from 1988 to 2000 reflecting a yearly rate of reduction at 7.3 percent. Irrigation of agricultural land accounts of the largest share in the use of surface water followed by household consumption and industrial demand (NSCB, 2003).

The Philippine Environment Monitor of 2003 provides a description of the total amount of surface water potential and groundwater potential which can be developed in the country in order to meet the need for agriculture, industry and household use. The total water resource potential for the entire country is estimated at 145.990 billion cubic meters. Roughly 86 percent of the total water resource potential is surface water measured at 125.790 billion cubic meters, while 14 percent or 20.2 billion cubic meters makes up the groundwater potential. The regions with the largest water resource potential are: 1) Northern Mindanao at 31.116 billion cubic meters; 2) Southern Mindanao at 20.548 billion cubic meters; 3) Western Visayas at 15.344 billion cubic meters; 4) Southeastern Mindanao at 13.675 billion cubic meters; 5) Southwestern Mindanao at 13.182 billion cubic meters; 6) Eastern Visayas at 11.907 billion cubic meters and; 7) Cagayan Valley at 11.335 billion cubic meters. The remaining five regions which have water resource potentials below 10.0 billon cubic meters are: 8) Central Luzon at 9.611 billion cubic meters; 9) Southern Tagalog at 7.780 billion cubic meters; 10) Ilocos at 4.498 billion cubic meters; 11) Bicol at 4.145 billion cubic meters and; 12) Central Visayas at 2.939 billion cubic meters. The identification of these 12 water resource regions are based on the hydrological boundaries set by the DENR, EMB and NWRB.

Estimates of water resource potential reveal that Northern, Southern, Southeastern and Southwestern Mindanao possess the largest potential followed by the Western and Eastern Visayas regions. Identifying the water resource regions with the greatest potential provides a possible solution for the large projected growth of water demand in the major metropolitan areas by 2025. Decongesting overcrowded metropolitan areas such as Manila, Cebu and Davao could be undertaken by enhancing infrastructure development and encouraging the entry of both domestic and foreign investment in less crowded cities, provinces and municipalities located in the Mindanao and Visayas regions where water resource potential is greater. However, this will require the implementation of a rational land use policy in order to avoid the problems experienced by these overcrowded cities in the form of severe vehicular traffic, compliance with zonal regulations for commercial, industrial and residential establishments and the protection of agricultural lands, watersheds, forest reserves and national parks to preserve and protect the ecosystem.

Factors affecting water supply

The main source of fresh water is rainfall. Forest reserves and watershed areas facilitate the absorption of rain fall in order to replenish ground water sources. Rainwater flowing through forested mountain slopes ultimately increase water levels in streams, rivers and lakes which increase the supply of surface water that can be used. During the last three decades, the production and supply of clean and potable water has been threatened by the lack of rainfall in the major watershed areas and reservoirs being managed by the government's local water utility agencies. The country is visited by an average of 20 typhoons per year which helps replenish water sources behind dams and reservoirs, but the growing population along with the rapid pace of urbanization, accompanied by the need to generate hydroelectric

power as well as the provision of water for irrigation has increased the rate of water usage faster than the rate at which it can be replenished.

The occurrence of the "El Nino" phenomenon every 4 to 5 years brings drought to several regions in the country which creates more difficulty replenishing depleted surface and ground water sources because of the absence of rain and the longer dry spells during summer.

Deforestation has dramatically reduced the ability of large tracks of land to absorb rainwater and recharge groundwater sources. During the past 50 years roughly 97 percent of the country's forest cover has been lost due to extensive logging activities both legal and illegal, with only 7.2 million hectares left from the original 27 million hectares of forest cover (Forest Management Bureau, 2009). The encroachment by illegal settlers and the activities of illegal loggers in watershed areas have reduced its ability to absorb rainfall and replenish reservoirs and ground water sources.

It will be absolutely necessary to identify protected forest reserves and watershed areas as well as intensify efforts to plant more trees in these protected areas in order to increase the rainfall absorption and replenish groundwater and surface water sources.

Water quality

Inadequate sewerage treatment systems has increased the amount of domestic household waste water, industrial effluence and agricultural run-offs that have contributed largely to the pollution of ground water and surface water sources severely compromising water quality. The Joint Monitoring Program for Water Supply and Sanitation of the World Health Organization and UNICEF (2004), reports that only 7 percent in the urban areas and 2 percent in the rural areas in the Philippines are connected to a sewerage system. A majority of households use flush toilets that drain into a septic tank or into sewers that lead to canals and river systems without being treated, contaminating both surface and groundwater. The rapid rate of urbanization has led to a larger number of households and firms not connected to a sewerage treatment system, disposing of untreated waste and contaminating both groundwater and potential surface water sources. In poverty stricken communities, households do not have toilets and kitchens and no sources of clean water which makes them vulnerable to water born diseases such as typhoid, cholera, gastroenteritis, diarrhoea, dysentery, hepatitis and other bacterial infections. The absence of an extensive sewerage system that will treat waste water severely compromises the quality of groundwater as well as surface water specially if these water sources are located close to residential and industrial areas.

Water distribution

Leaking pipes, illegal connections and faulty or tampered water meters have made water distribution inefficient and increases the amount of non-revenue water (NRW) either being lost or pilfered. Lost revenue does not allow the water utility operator to recover its costs and induces the firm to pass the burden of uncollected revenues to legitimate consumers. Legitimate consumers are penalized with higher water prices, part of which is used to recover the systems losses. Manila Water which operates the water concession for the East Zone had non-water revenue at 55 percent in 1999, which consequently worsened in 2002 at 57 percent. However, with the replacement of old pipes and the installation of new ones alongside the removal of illegal connections and the replacement of old and faulty meters, NRW had declined significantly from 57 percent in 2002 to 47 percent in 2004, 38 percent in 2005, 34 percent in 2006, 25 percent in 2007, 18 percent in 2008 13 percent in 2009 (ADB, 2010). New investments in pipes, pumps and the ability to eliminate illegal connections and faulty meters improve efficiency in water distribution which provides uninterrupted supply and consistent water pressure for legitimate consumers. This also makes it easier for water utility operators to recover costs and investments in infrastructure as the true cost of producing and distributing water is reflected by a reasonable price.

Agency overlaps in water resource management

Water resource management in the Philippines is subject to a relatively complex system of governance because of the regulatory overlaps that exist among the different agencies involved in it. The Philippine Water Supply Sector Roadmap (2010) and Elazeui (2004), provides a description of the system of governance applicable to water resource management. A brief discussion of this is presented as follows:

Protecting forest reserves, watersheds and improving the quality of water

The National Water Resources Board (NWRB) serves as the lead coordinator for water resources programs alongside administering and enforcing the Water Code. It is under the Department of Environment and Natural Resources (DENR) but needs to coordinate policy implementation with two other agencies under the DENR namely the Forest Management Bureau (FMB) and the Environmental Management Bureau (EMB).

The FMB is necessary to ensure that forests and watershed areas are protected, developed and managed to prevent encroaching by informal settlers and denudation and exploitation by both legal and illegal loggers. The FMB can formulate and implement policies and programs in order to meet the above mentioned goals and continue the conservation of forests and watershed areas.

A well protected forest reserve and watershed area will better absorb rain fall replenishing both groundwater and surface water which will be subject to extraction, treatment and distribution by the operators of the various water utilities. The EMB is expected to set and enforce water quality and effluent standards, criteria, as well as guidelines for all aspects of water quality management, to ensure that the water provided by the utility operators will be safe and fit for human consumption.

Water for irrigation and fisheries

Because the agricultural sector uses the largest volume of water for both irrigation and inland fishery, the Department of Agriculture (DA) becomes involved through its line agencies particularly the National Irrigation Administration (NIA), the Bureau of Soil and Water Management (BSWM) and the Bureau of Fisheries and Aquatic Resources (BFAR).

Water collected using dams from river systems are used for irrigation. The NIA undertakes water resource projects for irrigation as well as for flood control, drainage and hydropower development for agriculture.

The BSWM is responsible for formulating and implementing policies and programs for the protection of existing and potential sources of soil and water for agricultural development.

The BFAR establishes plans for the proper protection and management of the country's fisheries and aquatic resources. Coordination with the DENR and the NRWB become necessary if surface water sources such as lakes and rivers are at the same time being used for fishing and irrigation activities.

Safe water, sanitation and avoiding water-borne diseases

The Department of Health (DOH) is the third department that is involved, through its line agency which is the Environmental Health Service (EHS). Water produced and distributed by the utility operators will be subject to regular testing by the EHS. The EHS will be responsible for monitoring the safety of water for consumption and the implementation of sanitation programs and other strategies that will forestall the spread of water-borne diseases.

Hydro-electric power generation

The National Power Corporation (NPC) is part of water management due to its use of the dams to generate hydroelectric power. It must coordinate with the NIA as well as the NWRB in order to establish rules and guidelines in determining when the dams can be actually used for hydroelectric power generation subject to acceptable water level

requirements. During periods of low water levels during the summer, the NPC must temporarily abandon hydroelectric power generation in order to give way for irrigation and household use.

Water utility regulators

The Metropolitan Waterworks and Sewerage System (MWSS) is responsible for producing and distributing water to the end users (both consumers and firms) with MWSS regulating water concessionaires rates and service standards in Metro Manila as well as maintaining existing assets and infrastructure.

The Local Water Utilities Administration (LWUA) promotes, finances and regulates the construction and operation of local water utilities outside Metro Manila.

Final comments

The three departments namely: the DENR, DA and DOH, and their respective line agencies NWRB, FMB, EMB, NIA, BSWM, BFAR and the EHS, alongside three government owned and controlled corporations NPC, MWSS, and LWUAA have well defined goals and functions pertaining to the management of water resources. All of the above mentioned agencies will be subject to the coordination and regulatory functions of the NWRB which will adopt the encompassing policy framework to be recommended by the National Economic Development Authority (NEDA).

However, the overlaps across the line agencies, the departments and water utility regulators creates an environment wherein there are two many laws and a large number of these are neither enforced nor monitored. There are 23 key water related legislations subject to implementation by the various line agencies but many of these laws are not implemented or carried out because of budgetary constraints as well as the lack of enforcement and monitoring.

The need to encourage rainwater harvesting

Local governments should encourage households and firms to engage in water harvesting in order to help conserve water. Collecting rainfall and making use of proper storage facilities (rain water collectors and covered wells) should allow both households and firms to reduce water consumption expenditures. Encouraging this practice at the barangay level to be implemented nationwide will contribute substantially to the conservation of the country's water resources. Republic Act No. 6716 which is known as the Rainwater Act of 1989 was enacted for this purpose. However, the law is currently not being enforced and monitored.

4. CONCLUSIONS

The goals of increasing current water supply, improving water quality and ensuring that future generations will continue to get access to this vital resource will require: 1) an integrated water resources management framework; 2) greater environmental awareness from consumers and stakeholders; 3) effective regulations with clear rules and guidelines to implement the clean water act; 4) the strong enforcement of environmental laws; 5) and more investments into engineering structures that correct water quality and improve waste water treatment infrastructure. In addition, it will be necessary for the price of water to reflect its true cost of production and distribution which should include the protection of watershed areas, and allow for the recovery of cost and an acceptable return on investment for water producers. It will be necessary to encourage more private sector participation not only in water production and distribution, but also in its conservation and the protection of groundwater and surface water sources.

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