The State of Water Resources in the Philippines

Rubio, Christabel Jane P.
Graduate Student, Dept. of Civil and Envir. Engrg., Kongju National University, Cheonan, Korea

Jeong, Sang Man
Professor, Dept. of Civil and Envir. Engrg., Kongju National University, Cheonan, Korea

Lee, Joo Heon
Associate Prof., Dept. of Civil Engrg., Joongbu University, Kumsan, Korea

ABSTRACT: This paper sought to provide information regarding the water resources in the Philippines, focusing on the issues of water quality, status of water use and water scarcity, and other threats to water availability. Although the country has sufficient amount of water resources, it was found out that water availability is still threatened by some major water resources problems: increasing water demand due to drastic growth in population, water resources pollution, droughts and flooding and weak institutional framework to address these problems. Water quality problems include increasing groundwater and surface water pollution. Moreover, drought and flooding have also increased damages in recent years due to deteriorating watersheds and high economic and population growth. In relation to these, the Government enacted national laws to define and deal with water control and quality management. The objective of this research was to present and evaluate current conditions and issues on Philippine water resources.

INTRODUCTION

In spite of the abundance and wide variety of its water resources, the Philippines still confronts serious problems concerning water quality, accessibility, water shortage and temporal distribution.

According to World Fact Book, the Philippines, an archipelago of some 7,107 islands, only 2,000 of which are inhabited, is geographically considered a medium-sized nation with a total area of 300,000 square kilometers: 298,170 sq. km. land area and 1,380 sq. km. water area. There are three major island groups in the country, namely: Luzon, which has seven regions; Visayas, with only three regions; and Mindanao which has six regions. The islands are home to almost 88 million people with a population growth rate of 1.84 percent (Central Intelligence Agency, 2005).

1. WATER RESOURCES

Philippines, as reported by Philippine Environment Monitor, is endowed with rich natural resources, including water, which is essential for the country's economic development. The country is classified into 12 water resources regions, which are defined by hydrological boundaries, physiographic features and climate homogeneity, total of which is 1,830 sq. km., about 0.61% of the total area (World Bank Group, 2003; Department of Environment and Natural Resources, 1999). Water resources of the Philippines include rainfall, inland freshwater (rivers, lakes, and groundwater), and marine (bay, coastal, and oceanic waters).

State of Water Resources in the Philippines reports that as a tropical country, rainfall ranges from 1,000 mm in some sheltered valleys to 5,000 mm in the mountainous parts of the country per year, of which 1,000-2,000 mm are collected as runoff by a natural topography with significant variation from one area to another due to the direction of the moisture-bearing winds and the location of the mountain ranges (Greenpeace, 2007).

There are 421 principal river basins in 119 proclaimed watersheds. Of these, 18 are considered major river basins as illustrated in Figure 1 and shown in Table 1. These are sources of municipal and domestic water supply, irrigation, and power generation. Cagayan River Basin in Cagayan Valley is the largest with a drainage area of 25,649 sq km.

The Bureau of Fisheries and Aquatic Resources reports that there are 79 lakes in the country mostly utilized for fish production. In fact, 10 are considered major host for aquaculture production as presented in Table 2.

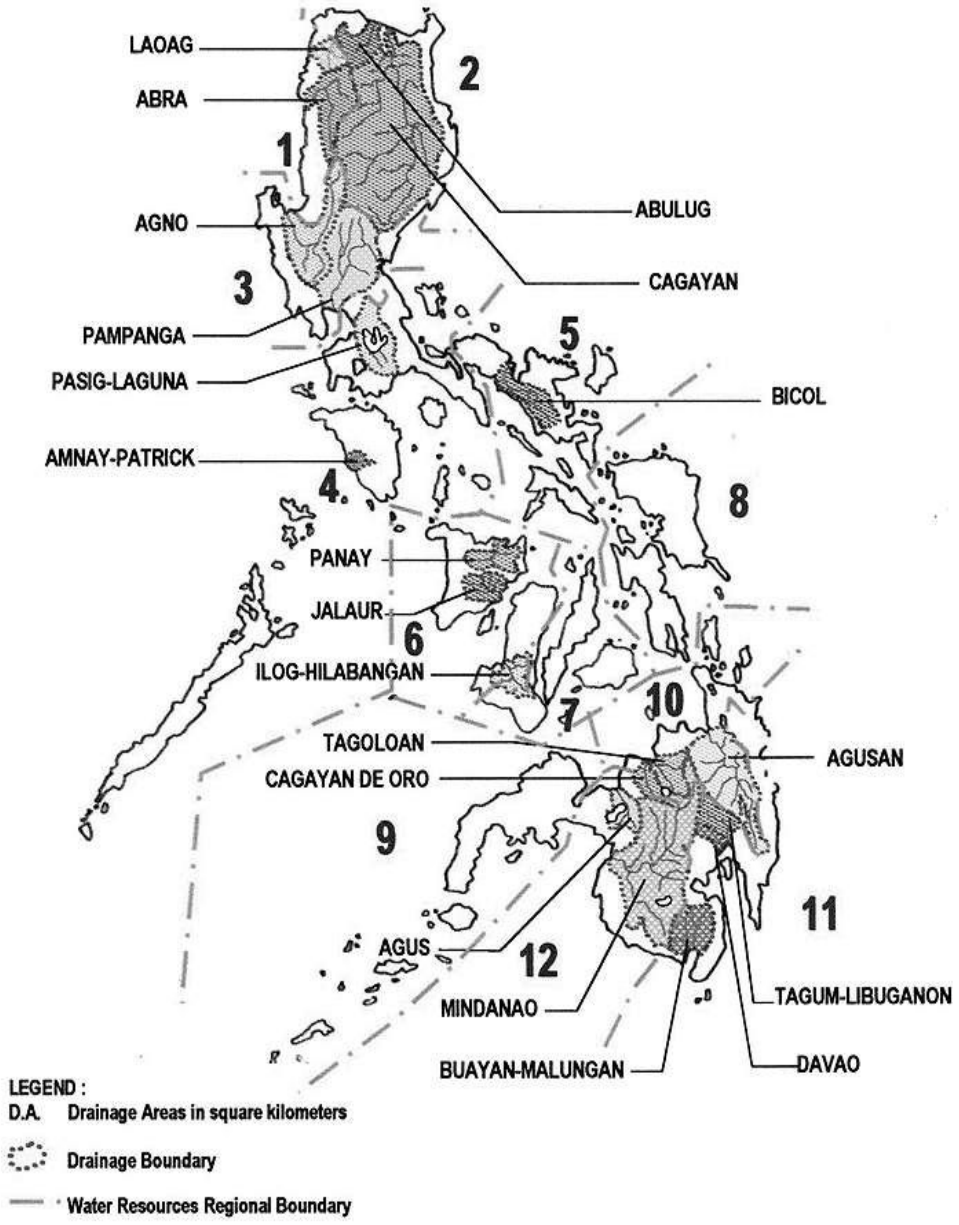

Figure 1. Major River Basins and 12 Water Regions in the Philippines

Laguna Lake is the largest with a total area of 3,813.2 sq km (including watershed area and lake proper) and is also one of the largest lakes in Southeast Asia. Lake Lanao, the largest lake in Mindanao, is one of the 17 ancient lakes on earth and is a major source of hydropower (Environmental Management Bureau, 2001-2005).

As indicated in the Philippine Environment Monitor (PEM) – Water Quality, the country has extensive reservoir in terms of groundwater, with an aggregate area of 50,000 sq km. Groundwater is replenished or recharged by rain and seepage from rivers. It contributes 14 percent of the total water resource potential in the Philippines. As noted in Table 3, the recharge or extraction potential is estimated at 20,200 MCM per year. Based on the water rights granted by the National Water Resources Board (NWRB) since 2002, 49 percent of groundwater is consumed by the domestic sector, and the remaining shared by agriculture (32 percent), industry (15 percent) and other sectors (4 percent). In terms of sectoral demand, agriculture has a high demand of 85 percent, while the industry and domestic have a combined demand of only 15 percent (World Bank Group, 2003).

Table 1. Major River Basins in the Philippines (Environmental Management Bureau, 2001-2005)

RIVER BASIN	REGION	DRAINAGE AREA (sq km)
Cagayan River	Cagayan Valley	25,649
Mindanao River	Southern Mindanao	23,169
Agusan River	Northern Mindanao	10,921
Pampanga River	Central Luzon	9,759
Agno River	Central Luzon	5,952
Abra River	Ilocos	5,125
Pasig – Laguna Lake	Southern Luzon	4,678
Bicol River	Bicol Region	3,771
Abulug River	Cagayan Valley	3,372
Tagum – Libuganon River	Southeastern Mindanao	3,062
Ilog – Hilabangan	Western Visayas	1,945
Panay River	Western Visayas	1,843
Tagoloan River	Northern Mindanao	1,704
Agus River	Southern Mindanao	1,645
Davao River	Southeastern Mindanao	1,623
Cagayan River	Northern Mindanao	1,521
Jalaud River	Western Visayas	1,503
Buayan – Malungun River	Southeastern Mindanao	1,434

Table 2. Ten Major lakes in the Philippines (Environmental Management Bureau, 2001-2005)

Names of Lakes	Location	Area (sq km)
Laguna de Bay	Laguna and Rizal	900.00
Lake Lanao	Lanao del Sur	347.00
Taal Lake	Batangas	233.56
Lake Mainit	Surigao del Norte/Agusan del Norte	17.43
Naujan Lake	Oriental Mindoro	78.99
Lake Buluan	Sultan Kudarat	61.34
Lake Buhi	Camarines Sur	38.00
Lake Labas	Cotabato	21.40
Lake Cataungan	Mindoro	21.11
Lake Bato	Camarines Sur	18.00
TOTAL		**1,903.71**

Philippine maritime territorial waters cover about 2.2 million sq km, wherein 267,000 sq km are coastal waters and 1.934 million sq km are oceanic waters within the exclusive economic zone (EEZ). The country's total discontinuous coastline is approximately 32,400 kilometers with eighty percent of the provinces and 65 percent of the cities and municipalities sharing the coast.

Overall, the Philippines' total available freshwater resource is at 145,990 MCM/year based on the 80 percent probability for surface water, and groundwater recharge or extraction at 20,200 MCM/year.

Table 3. Groundwater Availability (in MCM) (World Bank Group, 2003)

Water Resources Region	Ground water Potential	Surface Water Potential	Total Water Resources Potential	Percent Groundwater to Total Potential
X Northern Mindanao	2,116	29,000	31,116	6.80
VI Western Visayas	1,144	14,200	15,344	7.45
IX Western Mindanao	1,082	12,100	13,182	8.21
XII Southern Mindanao	1,758	18,700	20,458	8.59
XI Southeastern Mindanao	2,375	11,300	13,675	17.37
III Central Luzon	1,721	7,890	9,611	17.91
IV Southern Tagalog	1,410	6,370	7,780	18.12
VIII Eastern Visayas	2,557	9,350	11,907	21.47
II Cagayan Valley	2,825	8,510	11,335	24.92
V Bicol	1,085	3,060	4,145	26.18
I Ilocos	1,148	3,250	4,498	27.75
VII Central Visayas	879	2,060	2,939	29.91
TOTAL	**20,200**	**125,790**	**145,990**	**13.84**

2. QUALITY OF WATER RESOURCES

2.1 Water Quality Classification

Data from the Environmental Management Bureau (EMB) show that as of 2005, it has classified 525 water bodies in terms of best usage and water quality, representing 62.5 percent of the inventoried water bodies in the country. Of these water bodies, 263 are principal rivers, 213 are minor rivers, seven are lakes, and 42 are coastal and marine waters.

Table 4 presents the breakdown of classified inland surface water bodies in the country. Of these 525 water bodies, 133 have distinct classification based on their upstream, midstream, and downstream sections, hence, the total number of classifications made reach 611.

Table 4. Water Classification by Beneficial Use (Environmental Management Bureau, 2001-2005)

Classification	Number
INLAND SURFACE WATER	
Class AA Waters intended as public water supply requiring only approved disinfection to meet the PNSDW[1]	5
Class A Waters suitable as water supply requiring conventional treatment to meet the PNSDW	203
Class B Waters intended for primary contact recreation (e.g., bathing, swimming, skin diving, etc.)	149
Class C Waters for fishery, recreation/boating, and supply for manufacturing processes after treatment	231
Class D Waters intended for agriculture, irrigation, livestock watering, etc.)	23

Note: There are 133 water bodies with two or more classification.

[1] PNSDW Philippine National Standard Drinking Water

2.2 Water Quality Assessment

On its report entitled Water Quality, Philippines Environment Monitor presented an overview of the country's water quality and availability status, water pollution conditions of surface, ground and coastal waters, and the responses being made by the Philippine Government, given by Table 5.

As shown, the country is facing a serious problem regarding the quality of the water resources therefore affecting the availability of drinking water. The report also stated that by the year 2025, water availability deficit would take place in several river basins such as in Pampanga and Agno, in Pasig-Laguna, in Cagayan Valley, all other regions in Luzon, in Jalaur and Ilog-Hilabangan, and in the island of Cebu as a result of climate change impacts(World Bank Group, 2003).

In relation to these, there are national laws that define policy and deal with the abatement, control, and water quality management, some of which are: Philippine Environmental Code (PD 1151); Republic Act No. 9275, Clean water Act (2004); Commonwealth Act 383, Anti-Dumping Law (1938); Presidential Decree 984, Pollution Control Law (1976); Republic Act No. 9003, Ecological Solid Waste Management Act of 2000.The Philippine Clean Water Act of 2004 is the law that provides for a comprehensive water management program to protect the country's water bodies from land based sources of pollution such as industries, mining, agricultural operations, as well as community household activities.

Table 5. Philippine Water at a Glance (World Bank Group, 2003)

Issues/Topics	Status	Priority
Pollutants/Parameters		
Biochemical Oxygen Demand (BOD)	→64% of the river Biochemical Oxygen Demand (BOD) exceeded public water supply criterion. →Critical areas are Metro Manila, Southern Tagalog, and Central Luzon. →BOD levels of Pasig River from 1998 to 2001 show improvement. →Laguna Lake meets BOD for fishery, but half of the rivers that feed the lake have high BOD values.	High
Coliform, Heavy Metals, Pesticides, Toxics, and Others	→Development of database for most parameters needed. →Preliminary groundwater data indicate coliform contamination requiring treatment. →Heavy metals and toxic pollutants from industrial sources contribute to pollution in Metro Manila, Central Luzon, Southern Tagalog, Cebu and mining sources in Cordillera Autonomous Region and CARAGA. →Pesticide pollution in rural areas is from agricultural runoff.	Medium
Salt-Water Intrusion	→60% of the groundwater extraction without permit resulting in indiscriminate withdrawal and salt-water intrusion in coastal areas. →Localized impacts around the coastal areas need countermeasures to limit further intrusion. →Critical areas are Cebu, Iloilo, Dagupan, Cavite, Zamboanga and coastal Metro Manila, and Luzon.	Medium
Water Quantity/Availability	→Ground and surface water resource potential is large and generally sufficient (84,734 MCM). →Basins of Agusan and Mindanao have the highest amount of water while Cebu has the lowest. →Water deficit would be experienced by year 2025 by some of the areas. →Critical areas are Pasig–Laguna, Pampanga and Agno, Bicol, Cagayan, Luzon, Jalaur, Ilog–Hilabangan, and island of Cebu.	Low

(Continued)

Table 5. Philippine Water at a Glance (World Bank Group, 2003)

Issues/Topics	Status	Priority
Sources of BOD Loading and other Pollutants		
Domestic	→Metro Manila: 58 percent; Central Luzon and Southern Tagalog: 51 percent of the total BOD for the region (330,000 metric tons). →Metro Manila, Southern Tagalog, and Central Luzon are critical areas	High
Industrial	→Metro Manila 42 percent of the total BOD for the region. →Mining areas of CAR and CARAGA[1] contribute pollution to the receiving bodies of water. →Toxic pollution and contributions are not monitored routinely.	High
Agricultural	→Southern Tagalog: 35 percent; Ilocos region: 58 percent; and Central Visayas: 46 percent of the total for the region. →Contributions of pesticides and fertilizers residues need to be better quantified and controlled.	Medium
Solid Waste/Garbage	→Contribution to BOD and other pollutants not quantified or well regulated. →Open dumpsites are still operated in Metro Manila and all over the Philippines in spite of the laws. →Metro Manila: BOD contribution is over 150,000 Metric tons per year.	High
Responses		
Monitoring and Analysis	→Strategic and focused monitoring for critical areas is needed. →Monitoring and analysis of data from agencies need improvement. →Public access to information is limited and participation is generally during crisis situations only.	High
Enforcement	→Inadequate allocation of Government resources. →Weak enforcement of water-related legislation and rules. →Constraints in capacity.	High
Policies and Interagency Coordination	→Delineation/clarification of function for many agencies. →Operation of effective regulatory framework for urban sanitation. →Clean Water Act is proposed but not passed.	Medium

[1] CARAGA Region is composed of four provinces: Agusan del Norte, Agusan del Sur, Surigao del Norte, and Surigao del Sur

DISCUSSION

1. STATUS OF WATER USE AND SUPPLY

1.1 Leading Consumers and Users of Water

The country's major water users are the agricultural sector which accounts for 85 percent of the total water supply, the industrial sector which consumes 8 percent and lastly the domestic users which use the remaining 7 percent. Based on the 2003 data, 63 percent of groundwater is consumed by the domestic sector and the remaining is shared by agriculture (17 percent), industry (13 percent), and other sectors (7 percent), as stated by Philippine Environment Monitor (World Bank Agency, 2003).

Estimated water withdrawals according to State of Water Resources in the Philippines as of 2003, based on water-right grantees registered with NWRB is 77,456 MCM/year. About 60 percent of groundwater extraction is without permit, resulting in indiscriminate withdrawal. Over-abstraction from 6,441 registered wells has led to the lowering of aquifers, resulting in saline intrusion and ground subsidence in some areas (Greenpeace, 2007).

1.2 Access to Drinking Water

According to the "2005 Little Green Data Book" of the World Bank, one out of five Filipinos does not get water from formal sources. Only 77 percent of the rural population and 90 percent of those in urban areas have access to an improved water source and only 44 percent have direct house connections. Those without house connections access water from wells, springs, communal faucets, and/or from small scale informal providers.

Metro Manila is being served primarily by the Metropolitan Waterworks and Sewerage System (MWSS) through its two private concessionaries, the Maynilad Water Services, Inc. (MWSI) and the Manila Water Company, and by some private companies serving subdivisions.

In other urban and fringe areas outside of Metro Manila, service is provided by a total of 594 water districts and 250 subdivisions with Certificate of Public Convenience (CPC). As of December 2004, other private suppliers and providers issued with CPC include: a total of 321 out of an estimated potential 1,780 water services providers granted CPC, 500 Rural Water and Sanitation Associations (RWSA), 21 out of 156 water cooperatives, nine economic zones, four private utility operators, and 46 peddlers/hip chandlers. These water districts and private utilities operating in different provinces are monitored and administered by the Local Water Utilities Administration (LWUA) and National Water Regulatory Board (NWRB) (Greenpeace, 2007).

The provincial rural areas are primarily served by the Local Government Units and cooperative water associations, with assistance from the Department of Interior and Local Government (DILG), Department of Public Works and Highways (DPWH), and Local Water Utilities Administration (LWUA).

Water supplied by all sources in the Philippines is considered unsafe for drinking without further treatment. Almost every household incur additional expenditures on water treatment and for bottled water. Such expenditures are substantially higher than what is paid to the water utility. Urban households also spend a substantial amount on bottled water as manifested by the proliferation of "drinking water stations" all over the country. However, "drinking water stations" are in need of improved regulation as the quality of water does not have to meet any standards at present (Madrazo, 2002).

1.3 Water Shortage and Scarcity

The inter-annual variability of the Philippine climate is also highly affected by the El Niño- Southern Oscillation (ENSO) phenomenon. Climatological studies showed that the major drought events in the country are associated with the occurrences of ENSO. An analysis of the indices that mark the ENSO phenomenon indicates that from 1935 to the present, eleven ENSO events have occurred. Observation records show that rainfall deficiencies or events associated with these ENSO episodes vary significantly in duration and magnitude. The drought events during earlier El Niño episodes, area affected and the degree of severity in the Philippines, from the late 1960s to the early 1990s are presented in Table 6 (Department of Environment of Natural Resources, 1999).

Table 6. Drought and Events – Areas Affected and Degree of Severity (1968 – 1998) (Department of Environment and Natural Resources, 1999)

EVENTS	SEVERE	MODERATE
1968 – 1969	Bicol	Rest of the Philippines Except Regions 1&2
1972 – 1973	Central Luzon	Visayas and Mindanao
1976 – 1977		Mindanao
1982 – 1983 a) Oct. '82 – Mar. '83 b) Apr. '83 – Sept. '83	 Central Luzon Southern Tagalog Northern Visayas Western Mindanao Region 2 and parts of Region 1 Region 2 and parts of Region 1	 Region 1, 2, 3 and 5

(Continued)

Table 6. Drought and Events – Areas Affected and Degree of Severity (1968 – 1998) (Department of Environment and natural Resources, 1999)

EVENTS	SEVERE	MODERATE
1989 – 1990 a) Oct. '89 – Mar. '90	Cagayan Valley Panay Island Guimaras Northern Palawan Western Mindanao	
1991 – 1993	Comparable with that of 1982 - 1983	
1994 – 1995	Region 1, 2, 3, NCR, 5 and Palawan	Visayas and Mindanao
1997 – 1998	The whole of Philippines	

The report Crisis or Opportunity: Climate Change Impacts and the Philippines written by the former head of the Philippines Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) Dr. Leoncio Amadore also identifies the Southern Mindanao Drought of 1998 as a case in point. According to this report, the El Nino that occurred in 1997 to 1998 was one of the most severe ENSO events to hit the country. Beginning July 1997, some parts of the Philippines were already experiencing below normal rainfall. By October of the same year, practically the whole country experienced a drastic drop in rainfall, leaving rice and corn production at risk. The peak of the dry spell had ravaged the country until June of the next year (Greenpeace, 2005).

In the summer of 2007, a news article reported that water suppliers in the Visayas are facing supply problems because of the drying up of water sources due to climatic changes. According to Melchor Bibanco, president of the Visayas Association of Water Districts, in an interview, most water districts were experiencing supply problems, especially during the summer season. However, he also observes that this is getting worse each year. He attributed the depletion of water sources to the El Nino weather phenomenon as part of the global climatic changes (Tupas, 2007).

From a little over 190 meters by the end of March 2004, Angat Dam's water level dropped to a critical mark to 70 meters in August due to a prolonged dry spell attributed to climate change. This prompted the government to stop using water reserves for irrigation in some areas (Espada, D., 2004).

2. MAJOR PROBLEMS CONCERNING WATER USE AND SCARCITY

The management of water as a critical resource shall be done in a sustainable manner taking into account the needs of the present and future generations. This is one of the most critical issues confronting the country's water sector, the lack of an appropriate institutional framework to address issues of development and management of water and related resources. Fragmented approach to water management brings about an overlap of work and conflicts among agencies that result in fractional water management plan that does not adequately meet the requirements for sustainability (Barbara, P., 2005).

Another threat to water use is the constantly increasing problem of pollution. Table 7 presents the data from PEM 2003 and those presented in the EMB 2001 – 2005 National Quality Status Report.

Table 7. Pollution from key potential sources (Greenpeace, 2007)

	PEM 2003 (%)	EMB 2001 – 2005 Status Report (%)
Point Sources		
Domestic Wastewater	48	33
Agricultural Wastewater	37	29
Industrial Wastewater	15	27
Non-point Sources	Not Included	11

Although accounts of key sources of pollution for the two reports are both based on BOD load, these reports represent two different sets of references. One is based on the data compiled from 1995 – 2001 (Philippine Environment Monitor, 2003 Report), and the other is based on results of their assessments for 2001 – 2005

(Environmental Management Bureau, National Water Quality Status Report).

In both reports, four regions were found to have an unsatisfactory rating for the water criteria. These include the National Capital Region (NCR) or Metro Manila, Southern Tagalog Region (Region IV), Central Luzon (Region III), and Central Visayas (Region VII).

Apart from increasing industrial and domestic demand, another contributing factor to the water shortage in Metro Manila is the high level of water loss due to leaking pipes and widespread illegal connections. There is tremendous waste of water in distribution lines, irrigation canals, and at homes. Inefficiency in water usage was exacerbated by the absence of regulations, economic incentives, and institutional arrangements needed to promote water conservation and rational use of water (Greenpeace, 2007).

Furthermore, most of the problems encountered in the water sector today arise from an issue of conflicts of use and water allocation. With the increase in population coupled with worsening pollution of water, lack of infrastructure and facilities and dry spell causing shortages regularly in many areas resulting in allocation issues and conflicting rights over the limited water supply (Barbara, P., 2005).

3. OTHER THREATS TO WATER AVAILABILITY

There are other factors, however, that need greater attention now as these affect not only the supply but the availability of water resources itself. One of these is the significant decline and deterioration of watersheds. Excessive logging and shifting cultivation in the watersheds trigger widespread degradation and subsequent erosion and siltation of rivers, lakes, and reservoirs.

Most of the watersheds in the Philippines are in critical condition as manifested from recent and recurring calamities such as flashfloods in Southern Leyte and Northern Mindanao and greater frequency of El Nino in Luzon that reduces the water levels in dams. The chronic shortage of water supply in Metro Manila and the countryside has placed in the forefront the increased recognition of the adverse effects of man's activities in the watersheds which has caused erosion and siltation problems in the country's rivers, lakes and reservoirs. One particular concern is deforestation leading to siltation of dams and waters stored in inland lakes such as the Laguna Lake near Metro Manila and Ambuklao Reservoir in the North (Barbara, P., 2005).

The report Crisis or Opportunity (Greenpeace, 2005) cites data that shows how extreme climate events/variability, such as floods, droughts, forest fires, and tropical cyclones have increased in temperature and tropical Asia in the past few decades. In some regions, such as parts of Asia and Africa, the frequency and intensity of droughts have also increased.

Based on this study, it is anticipated that flood magnitude and frequency are projected to increase, affecting many regions as a consequence of repeated heavy precipitation events, which can increase runoff in most areas as well as groundwater recharge in some floodplains.

In addition, the Philippines has also experienced major water-related incidents that impact on water quality and the water resources itself. The EMB reported that from 2001 – 2005, several water-related incidents occurred, which include oil/chemical spills, mine tailings spill incidents, and illegal dumping of wastes, which resulted in fish kills and water body contamination.

CONCLUSION

Philippines, as a tropical country has sufficient water resources: rainfall, inland surface water and marine. These resources are classified according to beneficial use, most of which are facing serious problems regarding water quality therefore affecting its availability. Water quality problems include increasing groundwater and surface water pollution damaging both fresh water and coastal environment.

Expected occurrences of climatic events such as droughts and floods will have significant negative implications on major water reservoirs in the country. This could ultimately affect runoff to rivers, lakes, and main inland surface water resources. A decrease in runoff because of frequent drought episodes will result to a more serious problem in water availability.

Major problems and other threats concerning water use and scarcity in the Philippines which were presented on this paper clearly endanger the country's abundant water resources. It is evident that more measures and resources are needed to strengthen the existing water quality management group. Due recognition should be given on interrelationships and collaborations among agencies responsible in addressing water quality problem. Without a strong commitment to improve water resources and environmental management, the damage to the Philippine's natural resources could be irreversible resulting in negative impacts on the quality of life of the people and on the economy in the future.

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