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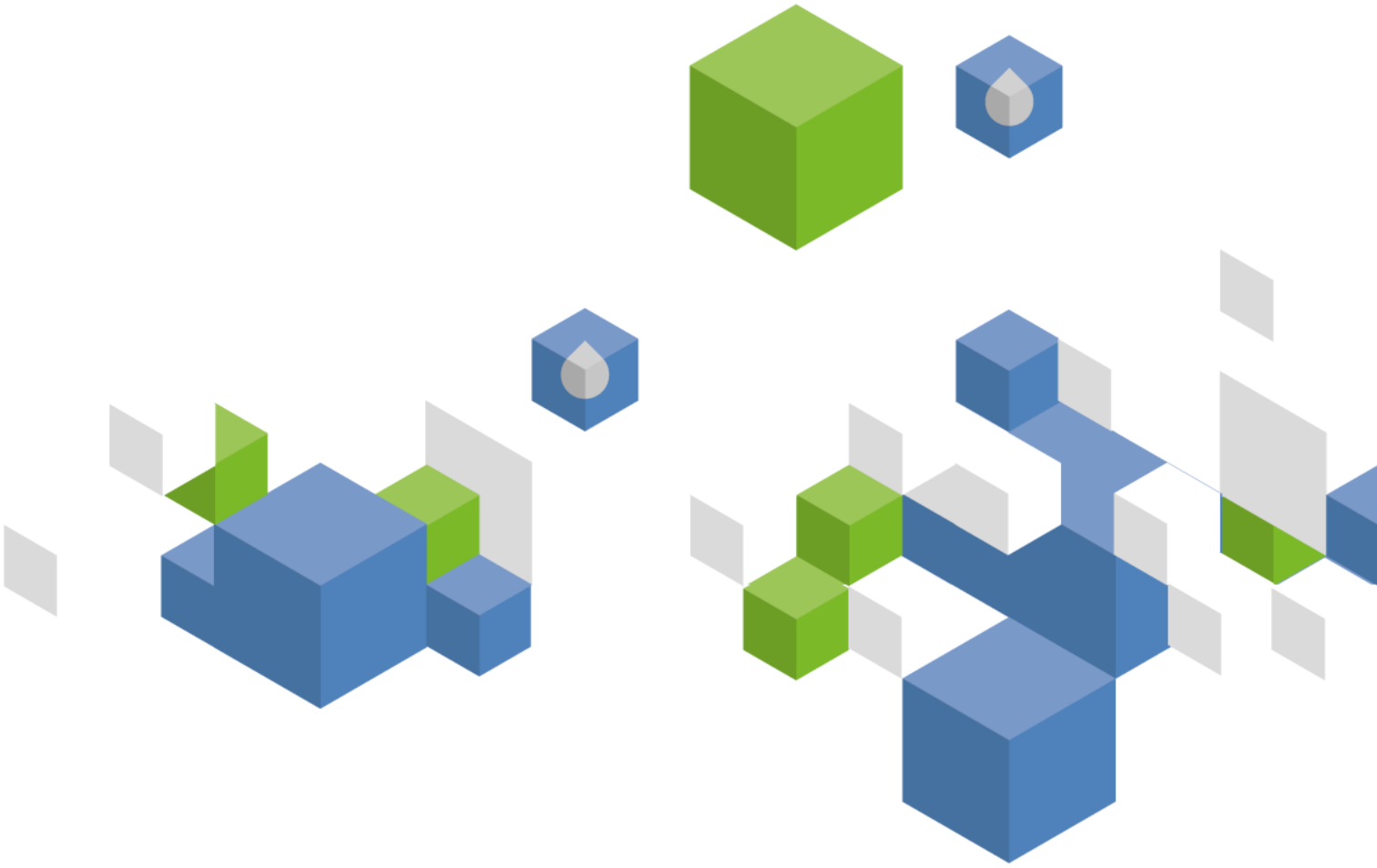

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Philippines

GEOGRAPHY, CLIMATE AND POPULATION

Geography

The Philippines is an island nation located in Southeast Asia. It is composed of 7 107 islands called the Philippine Archipelago, with an area of approximately 300 000 km^2 (Table 1). The archipelago is bounded by the Bashi Channel in the north, the Philippine Sea (Pacific Ocean) in the east, the Sulu and Celebes Seas in the south and the South China Sea in the west. Its northernmost islands are approximately 240 km south of the island of Taiwan, and the southernmost islands lie 24 km off the coast of Borneo (Malaysia).

TABLE 1
Basic statistics and population

Physical areas:			
Area of the country	2009	30 000 000	ha
Cultivated area (arable land and area under permanent crops)	2009	10 450 000	ha
• as % of the total area of the country	2009	35	%
• arable land (annual crops + temp fallow + temp. meadows)	2009	5 400 000	ha
• area under permanent crops	2009	5 050 000	ha
Population:			
Total population	2009	91 703 000	inhabitants
• of which rural	2009	51	%
Population density	2009	306	inhabitants/km^2
Economically active population	2009	38 908 000	inhabitants
• as % of total population	2009	42	%
• female	2009	39	%
• male	2009	61	%
Population economically active in agriculture	2009	13 336 000	inhabitants
• as % of total economically active population	2009	34	%
• female	2009	24	%
• male	2009	76	%
Economy and development:			
Gross Domestic Product (GDP) (current US$)	2009	161 196	million US$/yr
• value added in agriculture (% of GDP)	2009	15	%
• GDP per capita	2009	1 758	US$/yr
Human Development Index (highest = 1)	2010	0.638	
Access to improved drinking water sources:			
Total population	2008	91	%
Urban population	2008	93	%
Rural population	2008	87	%

FIGURE 1
Map of Philippines

PHILIPPINES

FAO - AQUASTAT, 2011

The islands are commonly divided into three island groups, which are further divided into regions, provinces, cities and municipalities and barangays. The islands and their respective administrative regions are:

- Luzon, 142 000 km^2, composed of eight administrative regions: Ilocos (Region I), Cagayan Valley (Region II), Central Luzon (Region III), Calabarzon (Region IV-A), Mimaropa (Region IV-B), Bicol Region (Region V), National Capital Region and Cordillera Administrative Region);

- Visayas, 56 000 km^2, composed of three administrative regions: Western Visayas (Region VI), Central Visayas (Region VII) and Eastern Visayas (Region VIII));

- Mindanao, 102 000 km^2, composed of six administrative regions: Zamboanga Peninsula (Region IX), Northern Mindanao (Region X), Davao Region (Region XI), Soccsksargen (Region XII), Caraga (Region XIII) and Autonomous Region in Muslim Mindanao).

The Philippines has a varied topography with highlands and numerous valleys. Its four major lowland plains are the central plain and the Cagayan valley in Luzon, and the Agusan and Cotabato valleys in Mindanao. These lowlands contrast sharply with the adjacent high mountain areas of the central and east Cordilleras and the Zambales mountains. The highest peaks are almost 3 000 m above sea level at less than 30 km from the sea. There are many active volcanos such as Mayon, Mount Pinatubo, and Taal. Lying on the northwestern fringes of the Pacific Ring of Fire, the Philippines experience frequent seismic and volcanic activities.

In 2009, the total cultivated area was approximately 10.5 million ha, of which 52 percent (5.4 million ha) were for annual crops and 48 percent (5.1 million ha) for permanent crops (Table 1). In 1995, the total cultivated area was around 9.9 million ha, of which 56 percent was for annual crops.

Climate

The climate is tropical and monsoonal with uniform temperature, on average 27°C throughout the year. Humidity is relatively high, above 70 percent everywhere all year except in southern Tagalog, where it falls to 65 percent in March/April. There is low solar radiation, diversity of rainfall and high frequency of tropical cyclones. The main air streams affecting the Philippines are the northeast monsoon, known locally as the amihan, from late October to March, the southwest monsoon, known locally as the habagat, from May to October and the North Pacific trade winds, are dominant during April and early May. Many of the larger islands of the Philippines have high mountain ranges, most of which lie along a generally north-south axis across the paths of movement of the important air streams. Thus, apart from variations in temperature caused by elevation, the orographic effects of mountains significantly influences regional rainfall patterns by causing increased precipitation on windward slopes and rain shadows in their lee during the monsoon periods.

The average annual rainfall is about 2 348 mm/year, but it varies from around 960 mm in General Santos City in southeast Mindanao to more than 4 050 mm in Infanta in central Luzon. The most extreme annual rainfall events ever recorded are 94 mm at Vigan in Ilocos Sur (northern Luzon) in 1948 and 9 006 mm in Baguio City (northern Luzon) in 1910.

The rainfall pattern and annual amount are influenced mainly by altitude and wind. The northwest of the country has a dry season from November to April and a wet season during the rest of the year, called the southwest monsoon. The southeast receives rainfall all year round, but with a pronounced maximum from November to January during the northeast monsoon. In the areas not directly exposed to the winds, rainfall is evenly distributed throughout the year, or there are two seasons but not very pronounced. From November to April the weather is relatively dry while it is relatively wet the rest of the year. The lowest rainfall occurs in the provinces of Cebu, Bohol and Cotabato in the centre of the country.

The archipelago lies in the typhoon belt, and many islands are liable to extensive flooding and damage during the typhoon season from June to December. The frequency of typhoons is greater in the northern portion of the archipelago than in the south. Usually, two or three typhoons reach the country each year.

Population

In 2009, the total population was about 91.7 million, of which around 51 percent lived in rural areas (Table 1). The average annual demographic growth is an estimated 1.9 percent for 1999-2009. In 2009, the population density was 306 inhabitants/km^2 against 236 inhabitants/km^2, in 1996, ranging from 47 inhabitants/km^2 in Agusan del Sur in Region X in Mindanao to 348 inhabitants/km^2 in southern Tagalog in Region IV in Luzon, and more than 13 000 inhabitants/km2 in the Capital Manila.

In 2008, 93 percent of the urban and 87 percent of the rural population had access to improved drinking water respectively.

ECONOMY, AGRICULTURE AND FOOD SECURITY

In 2009, gross domestic product (GDP) was US$ 161 196 million and agriculture accounted for 15 percent of GDP. In 2009, the total population economically active in agriculture was about 13.3 million inhabitants or almost 34 percent of the economically active population, of which 24 percent were women.

Agriculture is the prime mover of the country's economy, being the least import-dependent activity. In 2006, all subsectors posted output gains except poultry, which contracted by 0.4 percent. The crops, livestock and fisheries subsectors performed well and expanded their outputs by 4.4, 2.6 and 6.3 percent respectively. The government's rice programme is moving the country towards self-sufficiency giving a 5 percent increase in production. Even maize, which had negative growth the year before, posted a remarkable increase of 15.8 percent in production in 2006.

The total food supply available for consumption in 2001 was more than adequate to meet the recommended nutrient allowance for the population. Despite a slight decrease of 0.2 percent compared to 2000, the country's per capita food supply exceeded the recommended dietary allowance. The food from animal origin increased by 5.6 percent, whereas food obtained from vegetables grew by 2.4 percent.

Since the early 1980s the Philippines has been a net importer of food and feed grains. Records available at the National Food Authority show that during practically all years from 1980 to 2006 rice was imported to augment the country's rice supply. This trend shows an increase from 0.19 million tonnes in 1980 to 2.14 million tonnes in 1998. In that year the country suffered through one of the worse droughts caused by El Niño. On the other hand, maize imports have generally declined from 1980 to 2006. They were highest in 1990 with 273 650 tonnes and lowest in 2004 with 9 144 tonnes. No maize was imported in 1991-1994, 1999, 2003 and 2006. The drop in net imports did not affect the food supply in terms of nutrient content because of sustained domestic food production.

WATER RESOURCES

There are 421 rivers, not counting small mountain streams that sometimes swell to three times their size during rainy months. The rivers are an important means of transportation and a valuable source of irrigation water for fields and farms through which they pass. There are also 59 natural lakes and more than 100 000 ha of freshwater swamps.

The five principal river basins, cover more than 5 000 km^2, are:

- Cagayan river basin in north Luzon (25 469 km^2);
- Mindanao river basin on Mindanao island (23 169 km^2);
- Agusan river basin on Mindanao island (10 921 km^2);
- Pampanga river basin near Manila on Luzon island (9 759 km^2);
- Agno river basin on Luzon island (5 952 km^2).

Only 18 river basins have an area greater than 1 000 km^2: eight are on the island of Mindanao, seven on Luzon, two on Panay and one on Negros Island. The smallest river basins are frequently under 50 km^2.

In order to have manageable units for comprehensive planning of water resources, the National Water Resources Board divided the country into 12 water resources regions. Major considerations taken into account in this regionalization were the hydrological boundaries defined by physiographic features and homogeneity in climate of the different parts of the country. In fact, these water resources regions generally correspond to the existing political regions. Minor deviations dictated by hydrography affected only northern Luzon and northern Mindanao.

The average annual precipitation is about 2 348 mm (Table 2). The long-term average annual renewable surface water resources are an estimated 444 km^3. In nine years out of ten, the annual runoff exceeds 257 km^3. Groundwater resources are distributed in four major areas covering around 33 500 km^2: 10 000 km^2 in Cagayan, 9 000 km^2 in Central Luzon, 8 500 km^2 in Agusan, and 6 000 km^2 in Cotobato. Combined with smaller reservoirs already identified, this aggregates to about 50 000 km^2. The groundwater resources are an estimated 180 km^3/year, of which 80 percent (145 km^3/year) constitute the base flow of the river systems. Total internal water resources are therefore 444+180-145=479 km^3/year.

TABLE 2
Water resources

Renewable freshwater resources:			
Precipitation (long-term average)	-	2 348	mm/yr
	-	704 340	million m^3/yr
Internal renewable water resources (long-term average)	-	479 000	million m^3/yr
Total actual renewable water resources	-	479 000	million m^3/yr
Dependency ratio	-	0	%
Total actual renewable water resources per inhabitant	2009	5 223	m^3/yr
Total dam capacity	2006	6 274.5	million m^3

Total exploitable water resources are about 146 km^3, of which 126 km^3 is exploitable renewable surface water and 20 km^3 is exploitable renewable groundwater.

There are 59 natural lakes and more than 100 000 ha freshwater swamps. The National Wetland Action Plan, in response to the country's commitments to the Ramsar Convention, nominated and designated the four major wetlands, with a total surface area of 68 404 ha, as sites for Wetlands of International Importance. These include the Olango Island (Cebu), Naujan Lake National Park (Oriental Mindoro), Agusan Marsh Wildlife Sanctuary (Agusan del Sur), and the Tubbataha Reefs National Marine Park in the middle of Central Sulu Sea. The Agusan Marsh Wildlife Sanctuary, 14 836 ha, is of particular importance because it includes a vast complex of freshwater marshes and watercourses with numerous shallow lakes and ponds in the upper basin of the Agusan river and its tributaries rising in the hills of eastern Mindanao.

A survey of surface water storage potential has identified sites for 438 major dams and 423 smaller dams (NWRB, 1978). Total dam capacity in 2006 was 6 274.5 million m^3. The National Irrigation Administration (NIA) has constructed seven large dams and small reservoirs for irrigation projects with a total capacity of 6 180 million m^3. In the Philippines, a dam is considered large when the storage

capacity exceeds 50 million m^3 and the structural height is more than 30 m. The last large dam, constructed in 2002, is the San Roque dam with a total capacity of 850 million m^3. Two of the large dams, with a total capacity of 3 560 million m^3, are managed by the NIA: Magat for the Magat River Integrated Irrigation System (MRIIS) and Pantabangan for the Upper Pampanga River Integrated Irrigation System (UPRIIS). Three of the large dams, with a total capacity of 1 679 million m^3, are managed by the National Power Corporation (NPC): Angat, Ambuklao and Palangui IV. The NPC operates and manages three other dams in Mindanao, with a capacity of approximately 27.7 million m^3: Agus II, IV and V.

The Metropolitan Waterworks and Sewerage System (MWSS) manages two dams for municipal water supply and sanitation in the Metro-Manila areas: the La Mesa dam and Ipo dam with storage capacity of 51 and 36 million m3 respectively. All other small dams have been created with various objectives within the framework of the small water impounding management (SWIM) projects and are jointly managed by the Bureau of Soils and Water Management (BSWM), the NIA and lately the Department of Agrarian Reform, which receive assistance through various international funding agencies. SWIM projects are represented by 350 units of 270 000 m^3 on average, accounting for 94.5 million m^3.

WATER USE

In 2009 total water withdrawal was an estimated 81 555 million m^3, of which 82 percent was for agricultural purposes (including 754 million m^3 of aquaculture), 8 percent for municipalities and 10 percent for industry (Table 3 and Figure 2). Other non-consumptive use of water includes hydropower (110 079 million m^3) and recreation (244 million m^3). In 1995, total water withdrawal was an estimated 55 422 million m^3, of which 88 percent for agriculture, 8 percent for municipal purposes and 4 percent for industry. In 2009, freshwater was the only source of water withdrawal, with 96 percent being surface water and 4 percent groundwater (Figure 3).

TABLE 3
Water use

Water withdrawal:			
Total water withdrawal	2009	81 554.93	million m^3/yr
- irrigation + livestock	2009	67 065.65	million m^3/yr
- municipalities	2009	6 234.94	million m^3/yr
- industry	2009	8 254.34	million m^3/yr
• per inhabitant	2009	889	m^3/yr
Surface water and groundwater withdrawal	2009	81 554.93	million m^3/yr
• as % of total actual renewable water resources	2009	17.0	%
Non-conventional sources of water:			
Produced wastewater	1993	74	million m^3/yr
Treated wastewater	1993	10	million m^3/yr
Reused treated wastewater		-	million m^3/yr
Desalinated water produced		-	million m^3/yr
Reused agricultural drainage water		-	million m^3/yr

FIGURE 2
Water withdrawal by sector
Total 81.555 km^3 in 2009

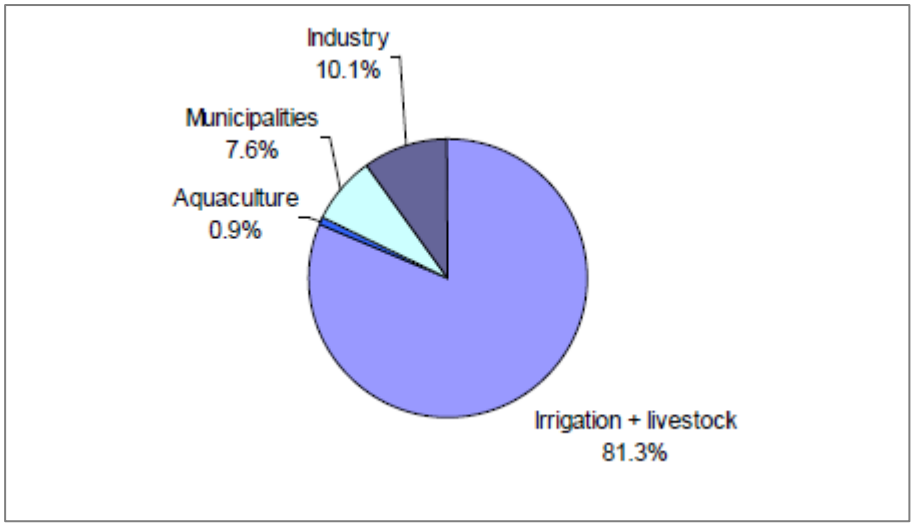
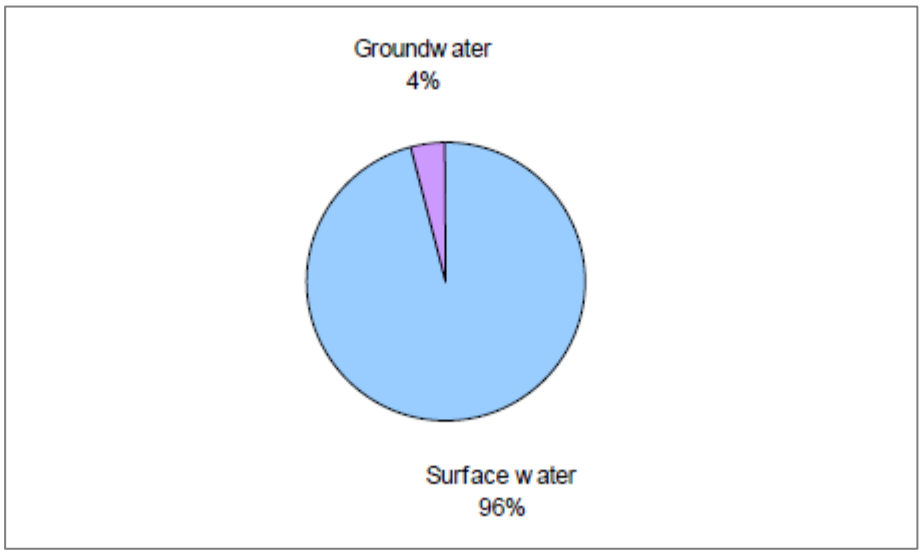


FIGURE 3
Water withdrawal by source
Total 81.555 km^3 in 2009



Private wells are extensively used in rural areas for domestic purposes. Municipal waterworks wells are drilled by the Local Water Utilities Administration for domestic purposes and deep wells have been drilled by the NIA for irrigation.

IRRIGATION AND DRAINAGE

Evolution of irrigation development

Irrigation development has been undertaken by rural communities (Banawe terraces, cooperative irrigation societies (zanjera) and lowland schemes near Manila). Earlier, the major irrigation investment periods have been during the 1920s, the post-war period and the 1970s and early 1980s when public involvement in the irrigation subsector was at its maximum. In this respect, the creation of the National Irrigation Administration (NIA) in 1964 has been decisive.

Irrigation development is highest in Luzon, containing approximately 51.1 percent of the total irrigated land, followed by Mindanao with 38.7 percent and Visayas with 10.2 percent. Luzon, the major investment area for irrigation development, is considered a 'hot spot' for global warming and climate change, because the irrigation systems are located in high temperature areas and are annually subjected to destructive typhoons and flooding.

The irrigation potential in 2005 was an estimated 3.1 million ha, defined by the NIA local irrigation office as the land on slopes of less than 3 percent, which are considered to be the areas with minimum cost of development (Table 4). Aside from this simplified criteria, the Asian Development Bank (ADB) proposed considering additional criteria that allow the use of terraced rainfed lands covering a contiguous area of at least 100 ha, where water could easily be delivered. On the other hand, the World Bank proposed reassessing the irrigation potential to consider new settlements on agricultural land, water resources availability, development cost, need for flood control and drainage facilities.

In 2006, the area equipped for full control irrigation was an estimated 1 879 084 ha of which NIA's national irrigation systems (NIS) represent 38 percent, NIA's communal irrigation systems (CIS) account for 29 percent, small-scale irrigation systems (SSIP) represent 9 percent, private irrigation systems account for 9 percent and private irrigation systems irrigating crops other than rice account for 15 percent. In 1991, non-equipped cultivated wetlands and inland valley bottoms accounted for 39 478 ha, and in 2004 the non-equipped flood recession cropping area accounted for 63 814 ha, thus total water managed in 2006 was around1 982 376 ha. In 1992, the area equipped for full control irrigation was an estimated 1 532 751 ha, of which 42 percent were NIS, 48 percent CIS and 10 percent private schemes.

NIS schemes have been constructed, operated and maintained by the NIA. The construction cost is borne entirely by the NIA, while farmers pay for operation and maintenance (O&M). In 1992, there were about 150 NIS schemes throughout the country. There are three main subtypes depending on water origin:

- Three large schemes: Magat with 80 977 ha; Upper Pampanga with 94 300 ha; and Angat Maasim with 31 485 ha are backed by multipurpose reservoirs. Although classified as single entities, they are actually conglomerates served by multiple diversion structures, which also utilize supplies from uncontrolled rivers crossing the irrigated area. Parts of the service area may be too high to be commanded by the reservoir and are commanded by pump schemes. In 1989, the cropping intensity on these schemes was about 89 percent during the wet season and 78 percent during the dry season.
- Run-of-the-river diversion schemes: Most are relatively small. These diversion schemes can be fairly complicated, with several intakes and reuse systems that are often developed over time in response to observed drainage flows. The largest schemes are located in the alluvial plains. In 1989, the cropping intensity on these schemes was about 72 percent during the wet season and 54 percent during the dry season.
- Pump schemes: In 1992, there were around seven schemes irrigated only by pumps, and five large NIS schemes served mainly by gravity flow but which use pumps for a part of their equipped area.

CIS schemes have been created either by the farmers themselves over the centuries, or more recently by the NIA and then turned over to the irrigation associations for O&M. Almost half of the communal schemes are in the province of Ilocos (northwest Luzon), which reflects a long history of irrigation based on private initiative in this area. These schemes are predominantly diversion schemes; although a few are served by small reservoirs built within the framework of the SWIM projects. The average size of the communal schemes is about 115 ha, but range from 40 to 4 000 ha. The smallest schemes are found in north Luzon, while in Mindanao Island these schemes are generally large, many of them being implemented by the government settlement programmes and then transferred to farmer groups. The association bears 10 percent of the direct cost of construction, and pays back the balance within 50 years at no interest.

Private schemes are generally supplied by pumps. They originated in publicly assisted river lift and groundwater development projects.

TABLE 4
Irrigation and drainage

Irrigation potential		-	3 126 000	ha
Irrigation:				
1. Full control irrigation: equipped area		2006	1 879 084	ha
- surface irrigation		2006	1 863 664	ha
- sprinkler irrigation		2006	4 500	ha
- localized irrigation		2006	10 920	ha
• % of area irrigated from surface water		2006	78.6	%
• % of area irrigated from groundwater		2006	5.7	%
• % of area irrigated from mixed surface water and groundwater		2006	15.7	%
• % of area irrigated from non-conventional sources of water			-	%
• area equipped for full control irrigation actually irrigated			-	ha
- as % of full control area equipped			-	%
2. Equipped lowlands (wetland, ivb, flood plains, mangroves)			-	ha
3. Spate irrigation			-	ha
Total area equipped for irrigation (1+2+3)		**2006**	**1 879 084**	**ha**
• as % of cultivated area		2006	19	%
• % of total area equipped for irrigation actually irrigated			-	%
• average increase per year over the last 13 years		1993 - 2006	1.49	%
• power irrigated area as % of total area equipped		2006	14.1	%
4. Non-equipped cultivated wetlands and inland valley bottoms		1991	39 478	ha
5. Non-equipped flood recession cropping area		2004	63 814	ha
Total water-managed area (1+2+3+4+5)		**2006**	**1 982 376**	**ha**
• as % of cultivated area		2006	20	%
Full control irrigation schemes:	**Criteria**:			
Small-scale schemes	< 100 ha	2006	625 360	ha
Medium-scale schemes	>100 ha and < 1 000 ha	2006	548 978	ha
large-scale schemes	> 1 000 ha	2006	704 746	ha
Total number of households in irrigation			-	
Irrigated crops in full control irrigation schemes:				
Total irrigated grain production (wheat and barley)			-	metric tons
• as % of total grain production			-	%
Harvested crops:				
Total harvested irrigated cropped area		2006	2 695 825	ha
• Annual crops: total		2006	2 657 645	ha
- Rice (first season)		2006	1 117 800	ha
- Rice (second season)		2006	1 304 100	ha
- Maize		2006	96 600	ha
- Sugarcane		2006	65 000	ha
- Vegetables		2006	37 861	ha
- Tobacco		2006	23 884	ha
- Groundnuts		2006	12 400	ha
• Permanent crops: total		2006	38 180	ha
- Bananas		2006	14 210	ha
- Citrus		2006	1 970	ha
- Other permanent crops		2006	22 000	ha
Irrigated cropping intensity (on full control area equipped)		2006	143.5	%
Drainage - Environment:				
Total drained area		1993	1 470 691	ha
- part of the area equipped for irrigation drained		1993	1 470 691	ha
- other drained area (non-irrigated)			-	ha
• drained area as % of cultivated area		1993	15	%
Flood-protected areas			-	ha
Area salinized by irrigation		1999	300 000	ha
Population affected by water-related diseases		2000	866 411	inhabitants

Table 5 reflects the rice-based areas with existing irrigation facilities. The Bureau of Agricultural Statistics (BAS) estimate was larger than the NIA estimate because BAS took into account privately-owned small-scale irrigation system such as shallow tubewells.

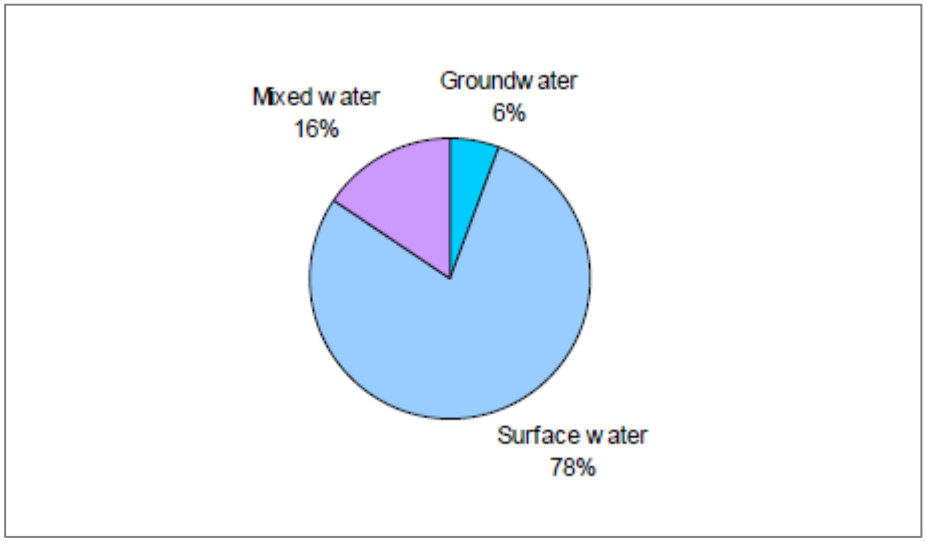
TABLE 5
Irrigation development by different system of the rice-based areas, in hectares, estimated by two institutions (2006)

System:	National Irrigation Administration (NIA)	Bureau of Agricultural Statistics (BAS)
National Irrigation Systems (NIS)	706 237	704 746
Communal Irrigation Systems (CIS)	481 669	548 978
Private Irrigation System	217 832	174 200
TOTAL	1 405 738	1 427 924

In 2008, of a total 748 593 ha of NIS schemes equipped, the actually irrigated area was around 61.5 percent during the wet season and 71.2 percent during the dry season. In 2005, the NIA developed 10 539 ha of new areas and rehabilitated 110 865 ha of existing systems. In 2007, the agency targeted development of 17 585 ha of new area and rehabilitation of 112 534 ha of existing areas. From 1974-2007, the BSWM completed and made operational a total of 177 190 ha and rehabilitated 3 538 ha of irrigated areas.

Surface water development for irrigation is in the form of dams or reservoirs while groundwater development is through pumping from deep and shallow aquifers. Groundwater irrigation development, particularly from deep aquifers, is relatively expensive including O&M. This is one of the reasons why less groundwater is used for irrigation, aside from the fact that groundwater withdrawal is being reserved for municipal/drinking purposes owing to its inherent good quality. In 2007, surface water was used to irrigate 78.6 percent of the area equipped for irrigation, 5.7 percent by groundwater and 15.7 percent by mixed surface water and groundwater (Figure 4).

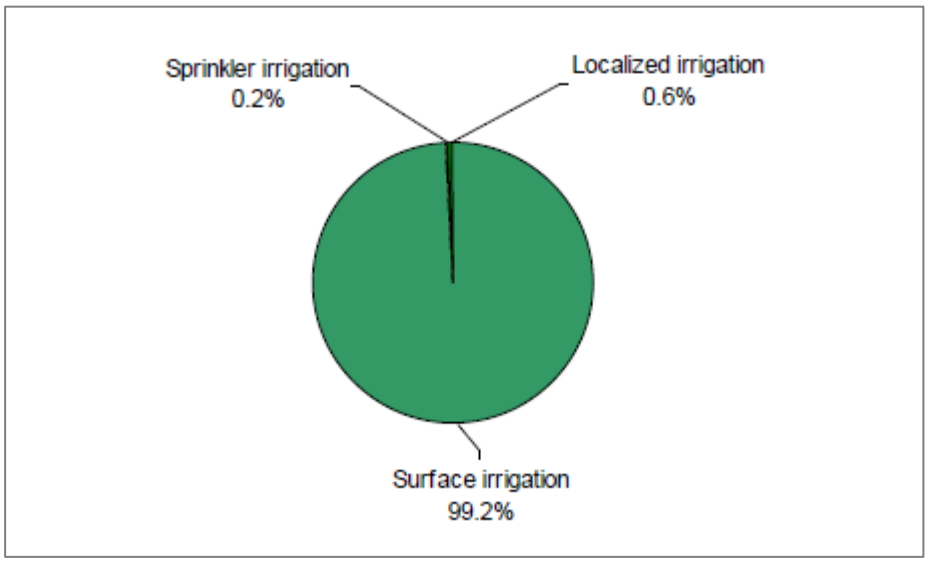
FIGURE 4
Source of irrigation water on area equipped for full control irrigation
Total 1 879 084 ha in 2006



Surface irrigation is the major technique practiced in the Philippines owing to rice, which accounts for 1 863 664 ha or over 99 percent (Figure 5). Lowland paddy fields are flooded to prevent weeds and ensure yields. Sprinkler and localized irrigation systems, 4 500 ha and 10 920 ha respectively, are used on privately-owned large plantation areas such as for banana, pineapple and sugarcane. Their use is constrained by their relatively high investment cost and the skills required to operate and maintain them.

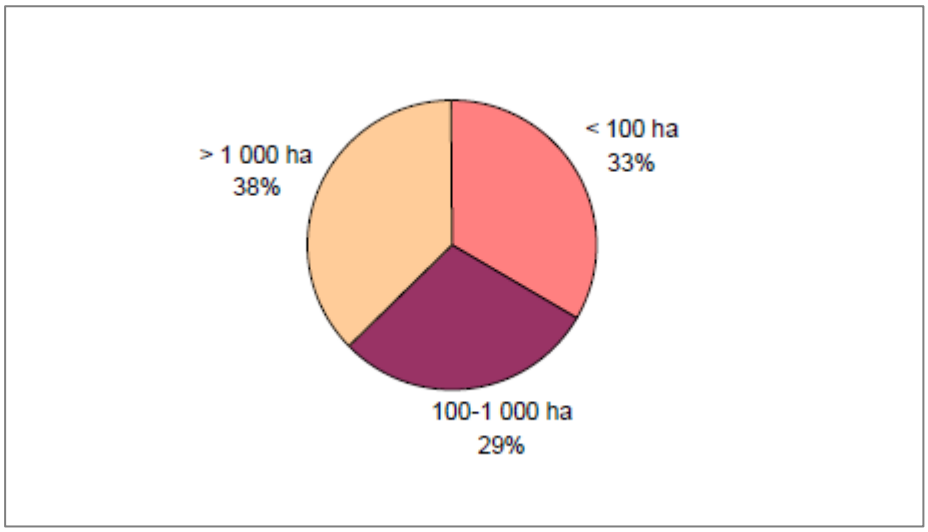
Currently, the use of sprinkler and drip is being promoted, even for small-scale production systems, particularly in water-scarce areas. These include greenhouses producing high-value commercial crops, such as vegetables, where investment costs could be recovered over a shorter period.

FIGURE 5
Irrigation techniques on area equipped for full control irrigation
Total 1 879 084 ha in 2006



Irrigation schemes can be differentiated according to size of the service area (SA). In 2006, small irrigation systems (< 100 ha SA) accounted for 625 360 ha, medium irrigation systems (100-1 000 ha SA) for 548 978 ha, and large irrigation systems (> 1 000 ha SA) for 704 746 ha (Figure 6). In 1999, the average farm size was 2.2 ha.

FIGURE 6
Type of full control irrigation schemes
Total 1 879 084 ha in 2006



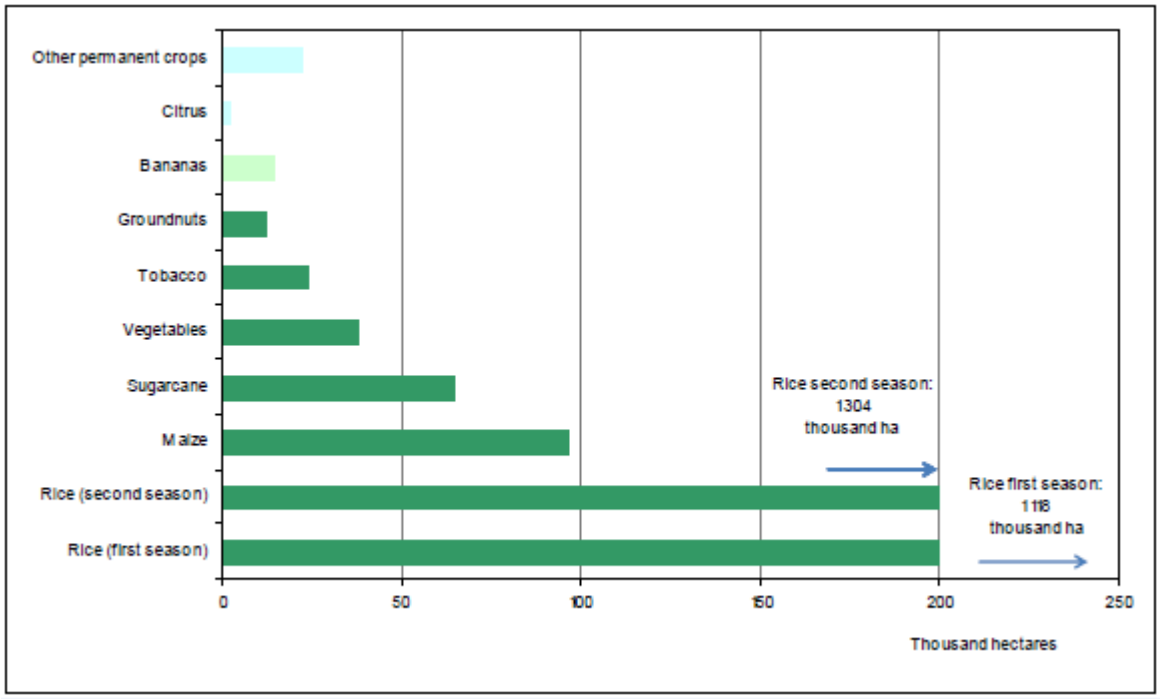
Irrigation water from NIA dams, SWIP and diversion dams is distributed by gravity system, conveying the water through open lined main canals to lateral ditches into the farm paddy fields. Farm lands, at elevations higher than the canal, use pumps to siphon water into the paddy fields. Pumps are also used for extracting shallow groundwater.

Role of irrigation in agricultural production, the economy and society

There are two cropping seasons in the Philippines. All schemes, equipped area and canal capacity, have been designed to provide supplementary irrigation to the entire irrigable area during the wet season. The area actually irrigated during the season should be 100 percent. In practice, this level is never reached owing to many reasons, such as over-optimistic design of service areas, flooding and waterlogging in the wet season, complexity of the irrigation system, pump performance, and conflicts between water supply, power and irrigation. The actually irrigated area varies significantly from one season to another, but it is always much lower than the area equipped for full control irrigation.

In 2006, the harvested irrigated crop area covered around 2 695 825 ha, of which 89.8 percent was for rice, 3.6 percent for maize, 2.4 for sugarcane and 1.4 percent for vegetables (Table 4 and Figure 7).

FIGURE 7
Irrigated crops on area equipped for full control irrigation
Total harvested area 2 695 825 ha in 2006 (cropping intensity on equipped area 143.5 %)



Paddy is cultivated throughout the country during the wet season and in some areas during the dry season when other crops with higher added value are also grown. The yields are much lower (30-40 percent) in the communal schemes than in the national schemes, because the water supplies are uncertain in the small catchment areas where communal schemes are located. On average, the 1992 yield for irrigated paddy was an estimated 3.34 tonnes/ha per season, which was 2.9 times the average yield of irrigated paddy in 1961. For rainfed paddy, the 1992 average yield was an estimated 2.07 tonnes/ha, which is twice the 1961 average yield. Irrigated rice paddy has a 65 percent higher gross return compared to non-irrigated. The sustained increase of water supply for rice production helps significantly satisfy the ever increasing food demand as well as improve food security.

Meanwhile, because of lack of finances to develop new land for irrigation, to help close the food gap, the focus has been on the development and improvement of technology and support services to improve rice production on rainfed land. The actual harvested rice area covered by irrigation facilities increased by almost twice from 1.43 million in 1970 to 2.42 million ha in 2006. The package of production technology, besides water provision, has made the country close to self-sufficient for rice, which is now placed at 97 percent, based on the average annual rice requirement of 118 kg per capita.

Under the BSWM and the NIS schemes, the average cost of irrigation development is about US$ 3 277/ha for new schemes, while the cost of rehabilitating existing schemes is US$ 1 608/ha, and the annual cost of O&M is US$ 98/ha. The average cost of irrigation development in private schemes is around US$ 556/ha; and the cost for rehabilitation of existing schemes is US$ 156/ha. The average cost of sprinkler irrigation and localized irrigation for on-farm installation is US$ 1 556/ha and US$ 2 222/ha respectively.

Status and evolution of drainage systems

In most schemes, drainage water from one field goes into another field downstream either through the irrigation canal or directly. It is, therefore, it is difficult to estimate the drained areas. In 1993, total drained area was an estimated 1 470 691 ha (Table 4).

WATER MANAGEMENT, POLICIES AND LEGISLATION RELATED TO WATER USE IN AGRICULTURE

Institutions

The National Water Resources Board (NWRB) is the overall government agency responsible for all the water resources in the Philippines. It coordinates, integrates and regulates all water-related activities that impact on the physical environment and the economy. The Board regulates water use with a water permit system and resolution of water use conflicts. It is also the lead agency for the adoption and localization of Integrated Water Resources Management (IWRM). The National Economic and Development Authority (NEDA) also plays important roles in the overall coordination in the planning and regulation of water resources.

The Department of Environment and Natural Resources (DENR) through the Environmental Management Bureau (EMB), is responsible for maintaining desirable water quality and implementing water quality management programmes such as classification of water bodies, water quality guidelines and effluent standards, discharge fee system and ambient effluent/monitoring, etc. The DENR has a new office, the River Basin Control Office, which will primarily oversee issues and concerns related to the implementation of integrated water resources management and development.

In 2005, the President created the Water and Sanitation Coordination Office (WASCO) at the Anti-Poverty Commission with the purpose of implementing the Presidents Priority Programme on Water for waterless municipalities. The Department of Health (DOH) monitors the quality of drinking water and regulates premises with sanitation installations.

The Department of Interior and Local Government (DILG) provides technical assistance and capability building to Local Government Units (LGUs) to help them manage water supply, sewerage and sanitation services.

The Department of Public Works and Highways (DPWH) is responsible for flood control and drainage infrastructures. The National Power Corporation (NPC) is responsible for the development of power sources including hydropower.

The Department of Agriculture, through the National Irrigation Administration (NIA) is responsible for irrigation development. In addition, through the Bureau of Soils and Water Management (BSWM), research and technologies for soil and water conservation and harnessing rainwater for agricultural use are developed for use of field extension staff of the local government units. The Agricultural Training Institute (ATI), on the other hand, assists in translating the packages of technologies into information and knowledge materials for the proper conservation and management of irrigation and water for improve agricultural production.

The Metropolitan Waterworks and Sewerage System (MWSS) is a Government owned and Controlled corporation established in 1971 and responsible for the provision of water, sewerage and sanitation services in Metro Manila and parts of the provinces of Cavite and the entire province of Rizal. In 1997, MWSS entered into a concession agreement on operation and maintenance with two concessionaires: the East Zone was awarded to Ayala corporation, which was named the Manila Water Company Inc. and the West Zone to Benpres Holding corporation named Maynilad Water Services Inc. The concession agreement will last for 25 years unless terminated sooner or extended.

The Local Water Utilities Administration (LWUA) governs local water districts in municipalities and cities, and review rates or charges established by local water utilities.

The Laguna Lake Development Authority was established in 1966 as a quasi-government agency that leads, promotes, and accelerates sustainable development in the Laguna de Bay Region. Regulatory and law-enforcement functions are carried out with provisions on environmental management, particularly on water quality monitoring, conservation of natural resources, and community-based natural resource management. This body is supposed to catalyse integrated water resources management (IWRM) in the Laguna de Bay Region, showcasing the symbiosis of humans and nature for sustainability, with a focus on preserving ecological integrity and promoting economic growth with equitable access to resources. From the viewpoint of governance this is a unique case. It is a self-sufficient IWRM authority with a high degree of autonomy for management and financing, and has been delegated the responsibilities of regulating water allocation and tax revenues.

Water management

Water quantity is becoming a limiting constraint for livelihoods and production. Water is not perceived yet as a critical and sensitive issue neither a real priority. There is no real concern about how water resources are used. However, there is a growing awareness and concern about the negative impacts of climate change and problems with pollution, poor water quality and hygiene issues, accompanying rapidly increasing population density.

With high population growth rates, water demand is increasing fast, yet there has been no adequate response. The discharge of domestic and industrial wastewater and agricultural runoff causes extensive pollution of the receiving water-bodies. This effluent is in the form of raw sewage, detergents, fertilizer, heavy metals, chemical products, oils and solid waste. As a consequence, conflicts between different water users have increased.

Institutional arrangements, policy implementation and conflict resolution for water supply and water resources are multi-level and the implementation mechanisms are relatively complex and fragmented. A number of private organizations and coalitions are playing advocacy roles.

The NIA organized a total of 140 Irrigators' Associations (IA) in both NIS and CIS nationwide with 15 951 farmer-members tilling 18 924 ha. Currently the total organized IA organized cover 1 109 684 ha, benefiting 735 879 member farmers. The NIA continues to provide assistance to the IAs in various aspects of their farming activities and community livelihood programmes.

In 1997, the Department of Agriculture (DA) launched, a comprehensive, nationwide irrigation research and development programme to support implementation of the Agriculture and Fisheries Modernization Act (AFMA). AFMA recognizes that sustained agricultural growth provides an enduring solution to the twin problems of poverty and food security. To ensure sustained agricultural growth and global competitiveness, crop agriculture must focus on irrigated areas and 30 percent of the AFMA budget is earmarked for irrigation. Further, AFMA was expanded by strengthening support services and infrastructure for fisheries and livestock.

Finances

In general, the national government sets aside funds annually for the rehabilitation and improvement of irrigation for almost 3 percent, or about 27 000 ha that are lost to poor maintenance and the inability of local communities to maintain irrigation canals and meet rehabilitation requirements as a result of the almost yearly damage caused by typhoons.

Policies and legislation

The Philippine Constitution (1987) provides for the national enabling environment and overarching policy on sustainable water use and water resources management. Right and access to water is well enshrined in the constitution.

The Water Code of the Philippines (1976) consolidated the laws governing the ownership, appropriation, utilization, exploitation, development, conservation and protection of water resources. It reiterates that the water belongs to the State and cannot be the subject of acquisitive prescription. The State may allow the use or the development of water resources by administrative concession, while the preference in the use and development of water shall consider current usage and be responsive to the changing needs of the country. It also reiterates that the measure and limit of appropriation of water shall be beneficial use, which is defined as the utilization of water in the right amount during the period that the water is needed for producing the benefits for which the water is appropriated. The administration and enforcement of the provisions of the Water Code is vested in the National Water Resources Council now National Water Resources Board. The Water Code is now being reviewed to tailor it to changing times and to meet current and future challenges in the water sector.

Presidential Decree No. 424 (1974) created the National Water Resources Council (NWRC), which was renamed the National Water Resources Board (NWRB) in 1987 by Executive Order 124-A. It has the power to coordinate and integrate water resources development and management activities.

The Environmental Code (1997) prescribes, among other things, the management guidelines aimed to protect and improve the quality of water resources through: classification of surface water and establishment of water quality.

The Local Government Code (1991) provides for the empowerment of local executives in the delivery of basic services, which includes water supply and sanitation services.

Republic Act No. 9275 (2004), otherwise known as the Clean Water Act, applies to water quality management in all water bodies in the abatement and control of pollution from land-based sources. The water quality standards and regulations shall be enforced irrespective of sources of pollution. The act also provides that the DENR, in coordination with the NWRB, shall designate certain areas as water quality management areas using appropriate physiographic units such as watersheds, river basins or water resources regions.

The Philippine Water Supply Sector Roadmap is a joint effort of the National Economic Development Agency (NEDA) and NWRB, together with various sector stakeholders, such as national government agencies, water service providers and non-governmental organizations. It seeks to address the gaps and challenges previously identified by various sector studies conducted by international development agencies and research institutions, statistical data from the National Statistics Office (NSO) as well as monitoring data from various government agencies such as the Department of Interior and Local Government (DILG), Local Water Utilities Administration (LWUA) and the National Water Resources Board (NWRB). It is designed to help the country meet the sector's challenges and intended objectives by 2010 in line with the targets defined by the 2004-2010 MTPDP. In the longer term, it also aims to help the country meet the sector's challenge in achieving the MDG goals.

ENVIRONMENT AND HEALTH

The government, through the National Poverty Commission, has placed high premium on the issue of water and sanitation issues. The President's Priority Programme for water for waterless municipalities is classified into three main types of facilities: Level I, or point source system without distribution facilities, Level II, or communal faucet system, and Level III, or individual household connection system. Individual piped supplies (Level III) are provided by water districts, private operators, LGUs, and community-based organizations (CBOs). Shared water supplies are provided by LGUs and CBOs through barangay waterworks and sanitation associations (BWSAs) for point sources (Level I), and rural waterworks and sanitation associations (RWSAs) for communal faucet systems (Level II).

Non-poor urban households mostly rely on septic tanks, which have been found to be poorly constructed and maintained without provisions for dislodging, hence affecting their efficiency for primary treatment of water. Sewerage coverage is very low. Less than 8 percent of the households in Metro Manila have access to sewerage systems, while the over-all urban sewerage coverage is a measly 4 percent. Currently, the few sewerage systems that exist cater to commercial establishments and affluent communities. To ensure increasing and sustainable access to water supply and sanitation services, investment in the sector has to increase rapidly. Current investment is inadequate to achieve the targets consistent with achieving the MDGs. National government and donor financing must be matched by funds from local governments and appropriate participation of the private sector encouraged.

In 1995, water demand in Metro Manila alone exceeded the available groundwater resources. In the 2025 projection, all the major cities will face water problems if water supply depends on groundwater alone. The need to develop other water sources will be critical for sustaining the development of these areas.

The population affected by water-related diseases in 2000 was 866 411.

About 73.3 percent of the cultivated area is limited to only three low-value and low-yielding crops: rice, maize and coconut. Collectively, 42 percent of these croplands are degraded and are considered vulnerable to the impacts of extreme climate events and global warming and climate change phenomena. The BSWM reported about 23 million ha are suffering from various soil problems which is dominated by soil infertility and steep slopes, accounting for more than 70 percent of the total area of the country. In addition, a total of approximately 13.7 million ha are suffering from moderate to severe soil erosion, which is one major driver of the loss of soil fertility in sloping lands.

The main flood-affected areas are in the central region of Luzon, namely the Pampanga, Zambales and Tarlac provinces. About one million ha have been identified as flood-prone areas.

The Philippines has experienced temperature spikes, which could be the result of climate change. Since 1980, high temperatures have become more frequent along with extreme weather events. These include deadly and damaging typhoons, floods, landslides, severe El Niño and La Niña events, drought, and forest fires. Adversely affected sectors include agriculture, freshwater, coastal and marine resources and health.

PROSPECTS FOR AGRICULTURAL WATER MANAGEMENT

Agricultural water is currently under threat by both climatic and non-climatic drivers. Changes in rainfall pattern will significantly disrupt cropping systems, particularly in rainfed areas. It will become more difficult and risky for farmers, in the face of climate change, to rely on rainfall for their planting calendar. Extreme climate events will likely impinge the hydrological system in most of the river basins and will mean water becoming either 'too much' or 'too little'. When water becomes too much, the potential effects include flooding from overflowing rivers and excessive runoff from sloping lands, which damage water infrastructure, such as dams, and irrigation and drainage systems. At the other end, higher

temperatures and decreased precipitation mean too little water, resulting in a decreased water supply and an increased water demand, which might cause deterioration in the quality of freshwater bodies. There will be possible alterations in the distribution of surface water and groundwater owing to changes in recharging (gaining) and discharging (losing) patterns. Stream flows will be significantly reduced and groundwater levels will decline, particularly shallow aquifers may dry up if water extraction is not properly regulated. Non-climatic drivers owing to human activities will continuously provide more pressure on water resources resulting in growing competition among water users.

In view of the above scenario, agricultural water management should incorporate the judicious use of water resources and engineering measures. To be able to deal with 'too little water', focus needs to be placed on both the demand and supply side of water management through water sources rehabilitation, water conservation, and augmentation of water supply, such as the optimum utilization of wastewater as an alternative to water sources for irrigation. To be able to deal with ' too much water', drainage facilities that are used to immediately remove excess flood waters will need to be improved. The design of irrigation systems needs to be reviewed to include the effect of climate change and to incorporate properly designed drainage facilities to protect standing crops. The construction of rainwater harvesting structures (e.g. small water impounding project) to collect and store rainwater in the uplands could contribute to the mitigation of floods downstream and ensure available water during the dry season.

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