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National Water Supply and Sanitation Databook and Regional Roadmaps

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Philippine Water Supply and Sanitation Master Plan

Volume II: Water Supply and Sanitation Databook and Regional Roadmaps

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Acronyms

AIP	Annual Investment Program
AM	Assistance to Municipalities
APIS	Annual Poverty Incidence Survey
ARMM	Autonomous Region of Muslim Mindanao
BOD	Biological Oxygen Demand
BRS	Bureau of Research and Standards
BUB	Bottom-up Budgeting
BWSA	Barangay Water and Sanitation Association
CAR	Cordillera Administrative Region
CDA	Cooperative Development Authority
CALABARZON	Calamba, Laguna, Batangas, Rizal and Quezon
CLTS	Community Led Total Sanitation
CPH	Census of Population and Housing
CSO	Civil Society Organizations
CWA	Clean Water Act
DA	Department of Agriculture
DALY	Disability-adjusted Life Year
DENR	Department of Environment and Natural Resources
DILG	Department of the Interior and Local Government
DJF	December, January, and February
DOH	Department of Health
DPWH	Department of Public Works and Highways
DTI	Department of Trade and Industry
EMB	Environmental Management Bureau
ENSO	El Niño - Southern Oscillation
ESC	Environmental Sanitation Clearance
FAO	Food and Agriculture Organization
FDC	Flow Duration Curve
FHSIS	Field Health Services Information System
FIES	Family Income and Expenditure Survey
HH	Household
HLURB	Housing and Land Use Regulatory Board
HUC	Highly Urbanized City
IA	Implementing Agency
JICA	Japan International Cooperation Agency
JJA	June, July and August
JMP	Joint Monitoring Programme
JV	Joint Venture
KPI	Key Performance Indicator
LDP	Local Development Plan
LGC	Local Government Code
LGU	Local Government Unit
LSSP	Local Sustainable Sanitation Plan
LWUA	Local Water Utilities Administration
M&E	Monitoring and Evaluation
MAM	March, April and May
MDG	Millennium Development Goals
MGB	Mines and Geosciences Bureau
MIMAROPA	Occidental Mindoro, Oriental Mindoro, Marinduque, Romblon, Palawan
MWSS	Metropolitan Waterworks and Sewerage System
NAMRIA	National Mapping and Resource Information Authority
NAPC	National Anti-Poverty Commission
NCR	National Capital Region
NDHS	National Demographic and Health Survey
NEDA	National Economic and Development Authority
NGO	Non-Government Organization
NRW	Non-Revenue Water
NSSMP	National Sewerage and Septage Master Plan

NWRB	National Water Resources Board
NWRC	National Water Resources Council
OBA	Output-based aid
O&M	Operation and Management
ODF	Open Defecation Free
PAGASA	Philippine Atmospheric, Geophysical and Astronomical Services Administration
PAR	Philippine Area of Responsibility
PAWD	Philippine Association of Water Districts
PDP	Philippine Development Plan
PDRS	Project Development and Other Related Studies
PhATS	Phased Approach to Total Sanitation
PIP	Priority Investment Program
PNSDW	Philippine National Standards for Drinking Water
PSA	Philippine Statistics Authority
PWSSMP	Philippine Water Supply and Sanitation Master Plan
RB	River Basin
RBCO	River Basin Control Office
RWSA	Rural Water Supply Association
Salintubig	Sagana at Ligtas na Tubig sa Lahat
SDG	Sustainable Development Goals
SEC	Securities and Exchange Commission
SMP	Septage Management Program
SON	September, October, November
STP	Septage Treatment Plant
TSS	Total Suspended Solids
UN Water	United Nations Water
UNICEF	United Nations Children's Fund
VIP	Ventilated Improved Pit
WASH	Water, Sanitation and Hygiene
WD	Water District
WDM	Water Demand Management
WHO	World Health Organization
WQMA	Water Quality Management Area
WRI	World Resources Institute
WRR	Water Resources Region
WSP	Water Service Provider
WSS	Water Supply and Sanitation
ZOD	Zero Open Defecation

Units

%	percent
°C	degree Celsius
CY	Calendar Year
km^2	square kilometer
km	kilometer
kph	kilometers per hour
lpcd	liters per capita per day
lps	liters per second
m^3	cubic meter
MCM	million cubic meter
mm	millimeter
mg/L	milligrams per liter
PhP	Philippine Peso

About the Water Supply and Sanitation Databook and Regional Roadmaps

The Philippine Water Supply and Sanitation Databook 2018 supplements the Philippine Water Supply and Sanitation Master Plan (PWSSMP) (2018-2040) with maps, data sets, and charts related to the water supply and sanitation (WSS) sector of the Philippines.

While it is apparent that the WSS sector, to date, struggles with the availability and consistency of data, this Databook presents currently available data from various sources as the basis for the PWSSMP 2018-2040. Sources of data are indicated accordingly.

The Regional Water Supply and Sanitation Roadmaps present the framework, vision, goals, and strategies formulated to achieve the Plan targets. They are formulated based on the analysis of the region's existing water supply and sanitation situation through a consultative study and assessment participated in by various stakeholders composed of representatives from regional line agencies, local government units, water and sanitation service providers, and non-governmental organizations and civil society organizations.

PWSSMP 2018-2040

Objectives and Guiding Principles

The Philippine Water Supply and Sanitation Master Plan (2018-2040) sets the direction towards achieving the WSS-related targets in the (i) Philippine Development Plan (PDP) 2017-2022, (ii) Sustainable Development Goals (SDG) 2030, and (iii) Clean Water Act of 2004 (CWA).

Towards achieving the WSS targets, the following are the Guiding Principles used in preparing the master plan:

- The water supply covered in the PWSSMP pertains to the water supply for drinking and domestic use only. This is consistent with the key performance indicator targets on water supply.
- Three (3) potential water sources are considered: (i) surface water, (ii) groundwater, and (iii) rainwater. Excessive use of groundwater (i.e. over-extraction), however, is discouraged to avoid groundwater-related subsidence.
- Even with the country's abundant resources, the country is experiencing water stress with overall water availability per capita per year[1] of 1,446 cubic meters[2] (m^3). The country's topology also makes water resources unevenly distributed and, in some cases, not easily accessible. Rainwater can be optimized in such areas.
- Service level of water supply is classified based on how water supply is accessed by households (i.e., from source, from communal faucets, or from private faucets). It does not, however, define or guarantee the accessibility, quality, quantity, and reliability of water supply.
- Open defecation and unimproved sanitation facilities remain a challenge in the country and continue to contaminate surface waters and groundwater. While data on the extent of contamination remain unavailable, the incidence of waterborne diseases is significantly high in areas where open defecation and unimproved sanitation facilities are prevalent.
- To safely manage excreta and wastewater (i.e., blackwater, graywater), septage and sewage treatment facilities especially in highly urbanized cities (HUC), are preferred. Basic sanitation (i.e., toilets with septic tanks), however, will suffice for rural areas of dense population and where drain fields are adequate.
- Climate change and natural hazards (i.e., erosion) remain a challenge in ensuring continuous supply of clean and safe water.
- The fragmented WSS sector of the country begs for a better institutional setup.
- The PWSSMP shall be prepared by maximizing available data while recommending measures towards improving availability and management of quality and timely WSS sector data.
- WSS infrastructure investments are to be established with the local government units during the regional consultation workshops. Where gaps remain, cost estimates will be done using infrastructure unit cost per household. These investments include new or expansion of infrastructure to address the gaps as well as improvement of existing infrastructure to ensure continuous WSS service to beneficiaries.

PWSSMP Framework

The PWSSMP is envisioned to address the WSS gaps and achieve the national targets by:

- bridging infrastructure gaps and delivering sustainable services,
- anticipating increase in population,
- ensuring climate- and disaster-resilient structures,
- optimizing research and development,
- investing on WSS data and data management, and
- addressing the fragmented sector with a viable institutional setup and financing schemes.

Databook and Regional WSS Roadmap Presentation

This Databook attempts to provide a snapshot of the water supply and sanitation sector as well as the basis and data reference of the PWSSMP (2018-2040). As such, the Databook is divided into 18 sections. (Two of these sections deal with nationwide and regional data.)

Each section is divided into seven chapters:

- Chapter 1: WSS Status (2015): What is the state of water supply and sanitation in the Philippines in terms of household access?
- Chapter 2: Water Supply: Where are water sources found across the regions?
- Chapter 3: Demand: What is the current and future water supply demand?
- Chapter 4: Excreta, Wastewater, and Water Contamination: What is the current and future demand for sanitation facilities?
- Chapter 5: Existing WSS Infrastructure: Current infrastructure and Service Providers
- Chapter 6: WSS Gaps
- Chapter 7: Addressing the Gaps: Proposed Projects and Investments

The regional subsections serve as the regional WSS roadmaps. They shall present the vision, goals, strategies, and programs in regard to providing safe and adequate WSS services to each region's growing population.

[1] United Nations Water says an area is experiencing water stress when annual water supply drops below 1,700 m^3 per person. The values for the water availability per capita per year cover domestic water supply and water uses for other sectors (e.g., agricultural, industrial, commercial, power).

[2] Computed based on groundwater estimates plus surface water estimates at 80% dependability

1 Introduction

Philippines

The Philippines is an archipelago comprising 7,107 islands. It is bounded by the Bashi Channel in the north, the Philippine Sea (Pacific Ocean) in the east, the Sulu Sea and Celebes Sea in the south and the South China Sea in the west. With a total area of approximately 300,000 square kilometers (km²), the country is divided into three major island groups and 17 administrative regions namely:

- **Luzon** (with an area of 142,000 km²) is composed of eight administrative regions: Ilocos (Region I), Cagayan Valley (Region II), Central Luzon (Region III), Calabarzon (Region IV-A), MIMAROPA Region, Bicol Region (Region V), National Capital Region (NCR) and Cordillera Administrative Region (CAR);
- **Visayas** (with an area of 56,000 km²) is composed of three administrative regions: Western Visayas (Region VI), Central Visayas (Region VII) and Eastern Visayas (Region VIII); and
- **Mindanao** (with an area of 102,000 km²) is composed of six administrative regions: Zamboanga Peninsula (Region IX), Northern Mindanao (Region X), Davao Region (Region XI), SOCCSKSARGEN (Region XII), Caraga Region (Region XIII) and Autonomous Region in Muslim Mindanao (ARMM).

About 94% of the total land area of the Philippines is contained within the 11 principal islands, namely Luzon, Mindanao, Samar, Negros, Palawan, Panay, Mindoro, Leyte, Cebu, Bohol and Masbate in order of their sizes.

Due to its archipelagic nature, the country is characterized by a variety of topographical features – from the low marsh, a foot or so above high water at the head of Manila Bay, to the high mountain masses, the highest peak being Mt. Apo in Mindanao with an elevation of approximately 2,954 meters (m) above mean sea level.

The largest mountainous areas and the most extensive plains are found in the island of Luzon. Large inland lakes are few in the Philippines, but semi-enclosed bays are too many to mention. There are four large marshes – two in Mindanao, one in Central Luzon and one in Mindoro.

Lying on the northwestern fringes of the Pacific Ring of Fire, the Philippines also experiences frequent seismic and volcanic activities. The country has many active volcanoes such as Mayon, Mount Pinatubo, and Taal.

A great variety of rocks exists in the Philippines – igneous, sedimentary, and metamorphic. Rock outcrop is rare, and old rocks are thickly covered with sedimentary and volcanic ejecta. Basement complex is below most of the recognized sedimentary rocks and is generally made up of gabbro, andesite's, agglomerates, serpentine, greisses, schist, volcanic breccia's, volcanic stuff, quartsize and basalt flows. Igneous rock is generally basic to semi- basic, that is low to intermediate in silica content.

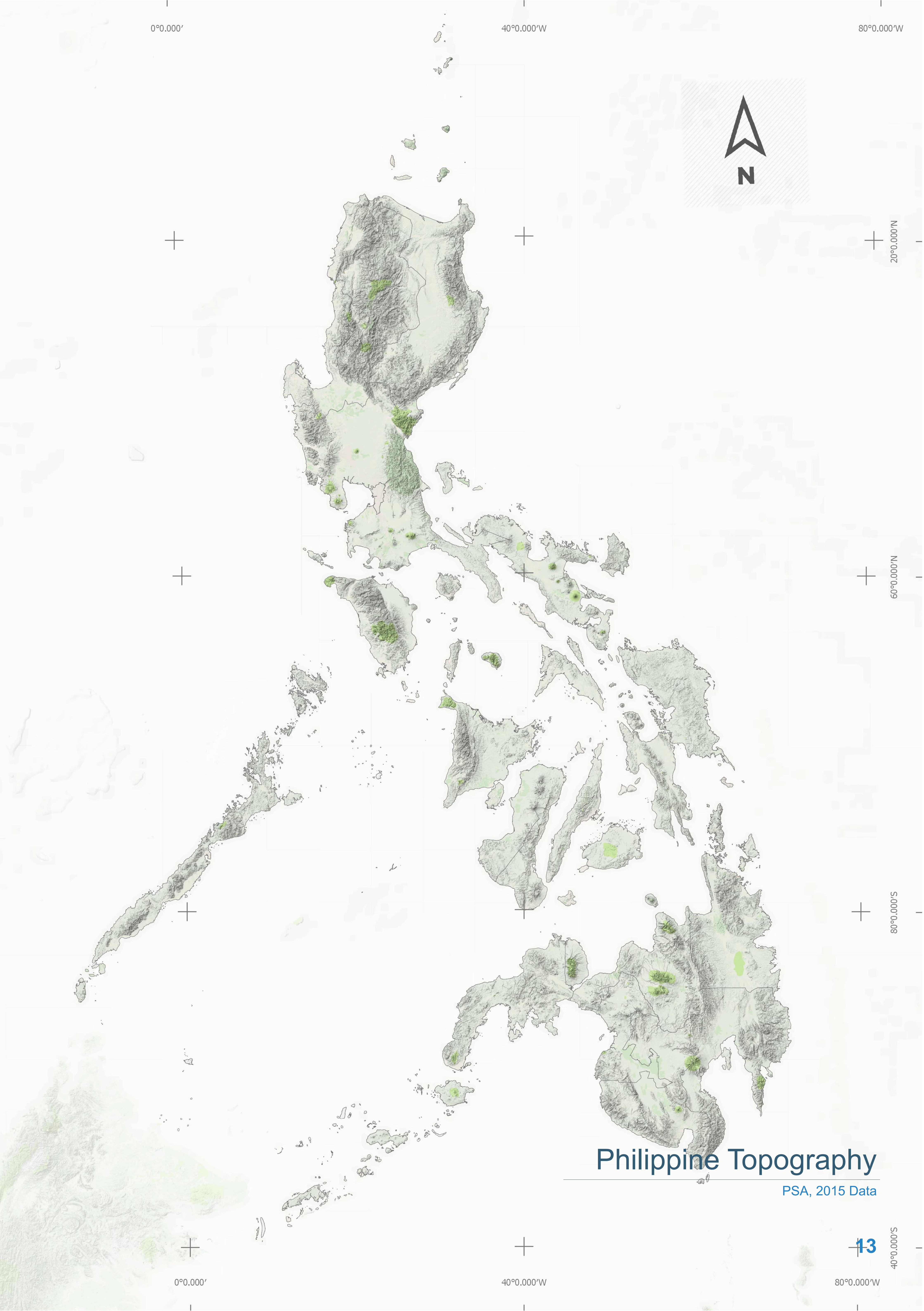
Philippine soils have considerable depth even on relatively steep slopes due to the rapid chemical weathering and the slow physical weathering of rocks. Due to rapid chemical decomposition, however, organic matter in the Philippines is very small and there is very little humus in tropical soil – even when plant material in the tropical forest is about two to three times more than that in the temperate forest.

Carbon dioxide and organic acids provided by this plant material through decomposition attack the rocks and account for the rapid chemical weathering of same.

Subsurface – wise, the Philippine Archipelago could be, as the basic conception, considered as wedges caught between sets of two oppositely dipping subduction zones, where the ocean submarine floor under thrusts beneath the continental or island massif. This situation can be observed in the north and central Luzon (wedged between the Manila Trench and the east Luzon Trench), in the Visayan Shelf (between the Sulu-Negros Trench and the Philippine Trench), and in the Mindanao island (between the Cotabato Trench and the Philippine Trench).

The alignment of these trenches, especially of the two major trenches, the Philippine Trench and the East Luzon Trench trending toward north-northwest to north, characterizes the Philippine Archipelago as a zonal structure with several wide belts connecting island to island arch wise in the same trend with trenches.

The archipelago consists essentially of two separable and distinct structural units – a mobile belt and a stable region. The mobile belt covers almost all the archipelago and is characterized by the concentration of earthquake epicenters, numerous active and inactive volcanoes and deeply sheared zone forming narrow canyons, intermontane basins and straits. The stable region, the southwestern part of the archipelago which embraces mainly Palawan and Sulu Sea, is essentially aseismic and shows the virtual absence of Tertiary igneous activity.



Philippine Topography

PSA, 2015 Data

WSS Sector

Access to water supply and sanitation (WSS) facilities is not only a basic human need but is a human right.

Access to Safe Water

Safe Water Source

Safe water supply refers to water accessed by the population from (i) a community water system that is piped into dwellings and/or yards/plots through a public tap and (ii) protected wells. This is based on the definition used by the Philippine Statistics Authority (PSA) in the following surveys and reports:

- Annual Poverty Incidence Survey (APIS), and
- Family Income and Expenditure Survey (FIES).

About 87.68% of the population in 2015 was reported to be getting water from sources that can be classified as safe sources.[3]

The main sources of water of 12.32% of the Philippine population, however, cannot be classified as safe because these include dug wells, unprotected spring, rivers, streams and lakes, rain, peddled water, and others.

With respect to the 17 regions, the main source of water of more than half of ARMM's population is classified as unsafe. Likewise, the main source of water of more than a million of the population in five regions is categorized as unsafe. These regions are Western Visayas, ARMM, Bicol Region, CALABARZON, and Central Visayas.

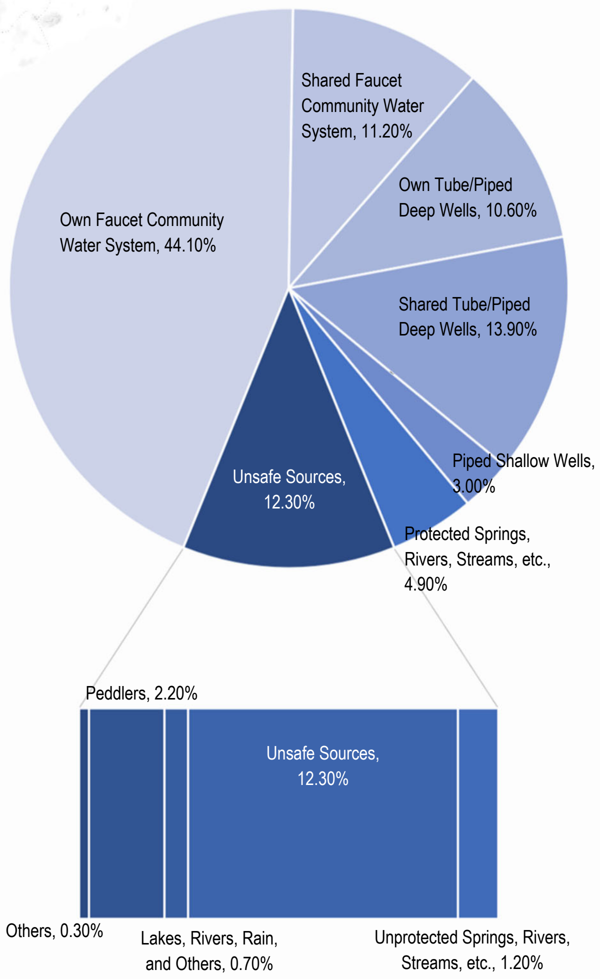


Figure 1: Main Sources of Water Supply of the Population (2015 FIES, PSA)

[3] *2015 Family Income and Expenditure Survey, PSA*

Trend

Data from APIS and FIES for 2004 and 2015 show an improvement in access to safe water supply – from 80.1% in 2004 to 87.7% in 2015.

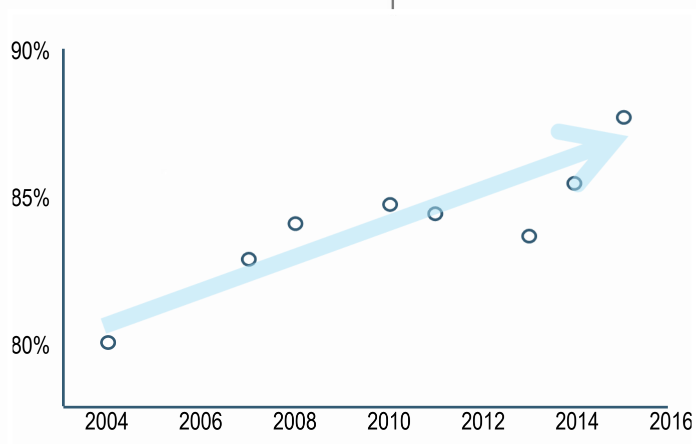


Figure 2: Trend of Access to State Water Supply Data (PSA)

Service Level

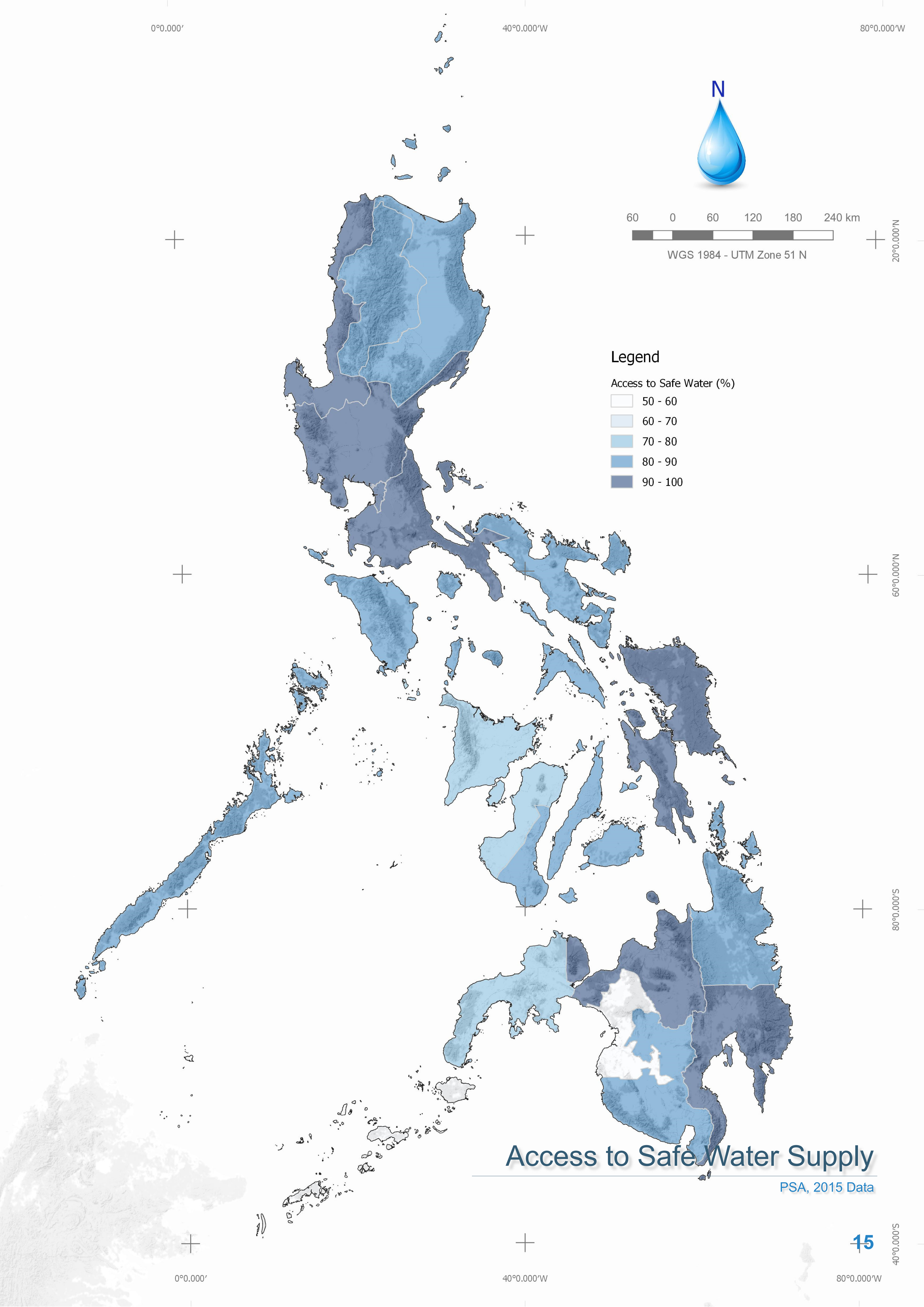
Water supply is usually provided by water service providers. There are households, however, whose main source of water is private – that is, it is not shared with other households or the community, such as private deep wells, and rainwater collectors. The National Economic and Development Authority (NEDA) defines the service levels of water supply in the Philippines as follows:

- **Level I (point source)** - a protected well or a developed spring with an outlet but without a distribution system as it is generally adaptable in rural areas where houses are thinly scattered serving an average of 15 households. (Residents have to fetch water from a source about 250 meters away from where they live.)
- **Level II (communal faucet system or stand post)** - a piped system with communal or public faucets usually serving 4-6 households within a distance of 25 meters.
- **Level III (waterworks system)** - a fully reticulated system with individual house connections based on a daily water demand of more than 100 liters per person.

In comparison with PSA's safe water source classification, community-level piped water systems are categorized as either Level II or Level III. Those with individual house connections are classified as Level III, while those with communal faucets are Level II water systems. Point sources without water distribution piping are categorized as Level I. Level I also includes small-scale water sources within a yard with piping or plumbing installations. A matrix of the service level against the classification of sources of water as per PSA's definition is provided below.

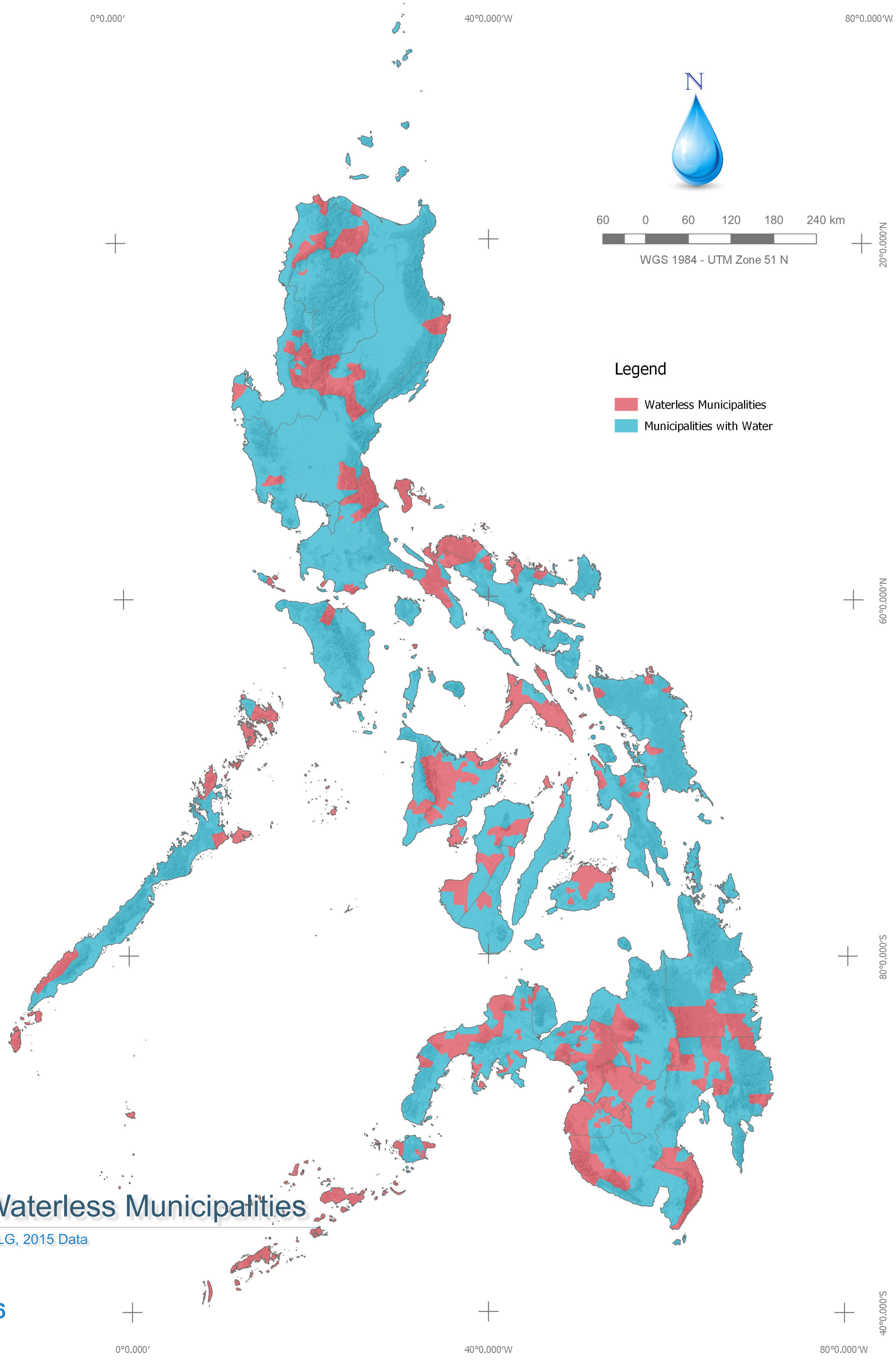
Table 1: PSA Safe Water Source Classification

Service Level	Source of Water	Classification (Safe/Unsafe)
Level III	Own Faucet Community Water System	Safe Source
	Own Tube/Piped Deep Well	
Level II	Shared Faucet Community Water	
	Shared Tube/Piped Deep Well	
	Piped Shallow Well	
Level I	Protected Spring, River, Stream, etc.	
	Unprotected Spring, River, Stream, etc.	Unsafe Source
	Dug Well	
	Lake, River, Rain, and Others	
	Peddler	
	Others	



Access to Safe Water Supply

PSA, 2015 Data



Waterless Municipalities

DILG, 2015 Data

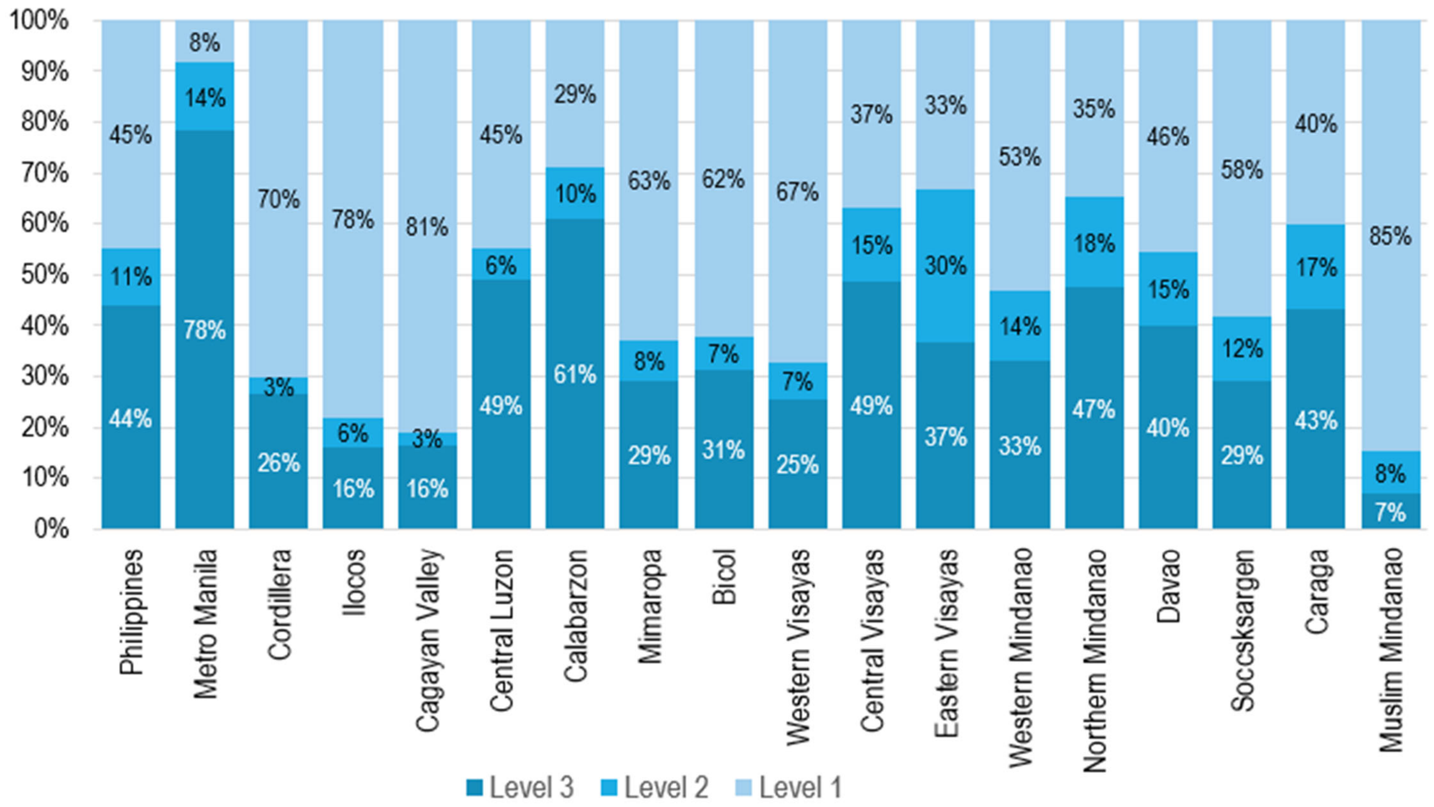


Figure 3: Regional Access to Water Supply

About 43.6% of the Philippine population has access to water from Level III systems, approximately 11.2% from Level II, and the remaining 45.2% from Level I (point source).

Figure 3 shows the regional access to water supply per service level.

Waterless Municipalities

As of 2017, there were a total of 332 waterless municipalities (from the previous 455) across the country as shown on the map on the left. (Municipalities where less than half of the population has access to clean and safe water are considered "waterless".)

Identified by the National Anti-Poverty Commission (NAPC) in 2011, these 332 waterless municipalities were covered by water supply projects funded by the Sagana at Ligtas na Tubig sa Lahat (Salintubig) Program. The program started in 2012.

Drinking Water

Safe and Affordable Drinking Water

Safe and affordable drinking water" is an indicator for Sustainable Development Goals (SDG). SDG 6.1 provides the following normative interpretation of the term:

- Safe – free from pathogens and elevated levels of toxic chemicals at all times.
- Affordable – not presenting a barrier to access or prevent people from meeting other basic human needs.
- Drinking water – water used for drinking, cooking, food preparation and personal hygiene.

In the course of the PWSSMP study, the latest national data available were reported after the PSA conducted the National Demographic and Health Survey (NDHS). In the survey, the respondents were asked about their sources of drinking water and the water treatment done prior to drinking. While the Department of Health (DOH), Local Water Utilities Administration (LWUA), and the National Water Resources Board (NWRB) monitor water quality in accordance with the Philippine National Standards for Drinking Water (PNSDW), the parameters involved in the standards are not consistent with those in the NDHS.

The 2013 NDHS groups the sources of drinking water as "improved source" and "non-improved source". It was noted, however, that even water from improved sources might be contaminated from the handling, transport and storage thereof. The survey report also indicated that a certain percentage of samples underwent appropriate treatment methods (i.e., boiling, bleaching, filtering, and solar disinfecting). While there are no national data on the affordability of drinking water, the NDHS includes time spent to obtain water.

A proxy value may be derived using the following assumptions (see Figure 4):

- Bottled water is considered safe (as defined above) and does not need any treatment.
- Respondents who drink bottled water need not worry about water treatment.
- An appropriate treatment method is sufficient to make water safe for drinking (as defined above).
- The percentage of respondents resorting to appropriate treatment methods represent the number of respondents who do not drink bottled water.
- Water for drinking or household use obtained within the premises or within less than 30 minutes to is considered affordable.

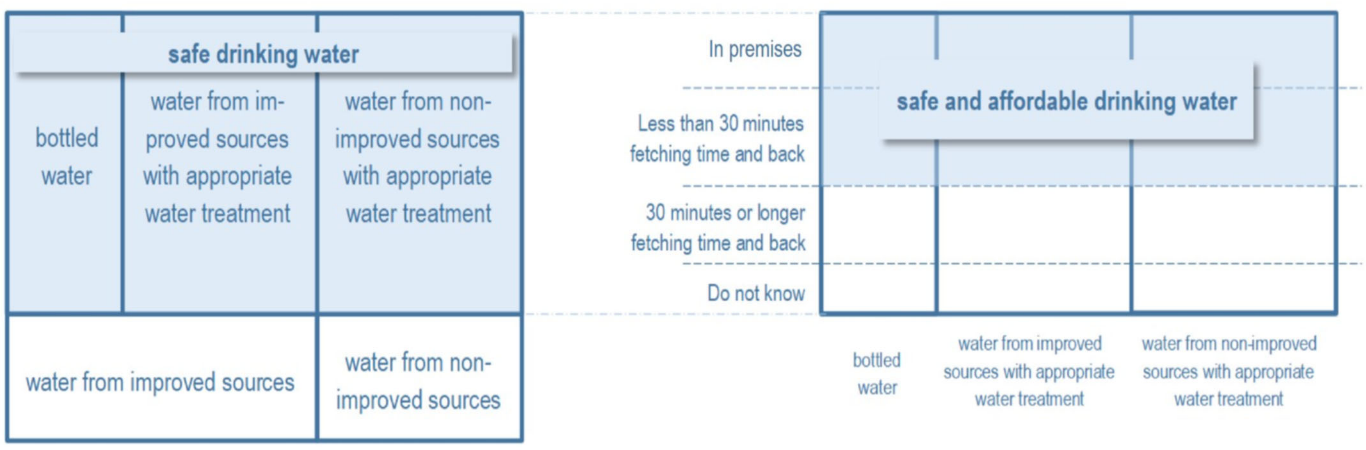


Figure 4: Standards for Safe and Affordable Drinking Water

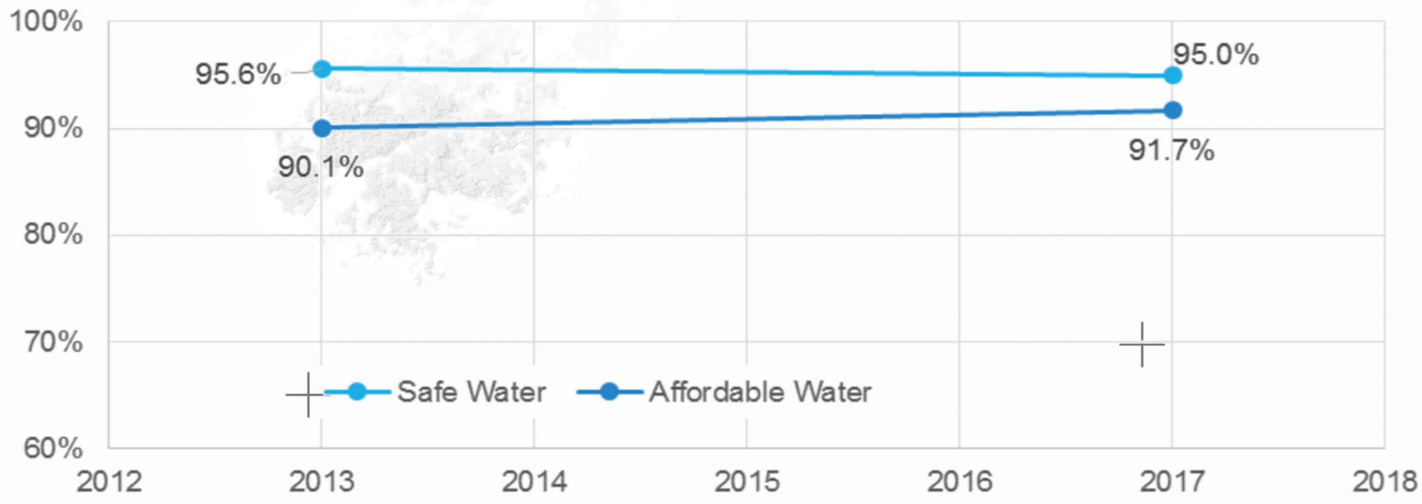


Figure 5: Access to Safe and Affordable Drinking Water, NDHS

Figure 5 plots the 'safe and affordable drinking water' data accordingly.

National Data

The national data on drinking water can be found in the NDHS which is done every five years. The two latest surveys were conducted in 2013 and 2017. The field survey in regard to the 2017 NDHS was conducted during the second half of 2017 and covered a national sample of over 31,000 households.

The 2017 NDHS reports that 95% of households use an improved source of drinking water.

Almost all urban households (HH's) (97.6%) report using an improved source of drinking water compared with 93% of rural households. The percentage of households using an improved drinking water source is unchanged relative to the NDHS 2013 findings at 95.6%.

The most common source of drinking water is bottled water or water from a refilling station (44%) followed by water piped water into the dwelling, yard or plot (24%), and by water from a tube well or borehole (12%).

Overall, eight in every ten Filipino households have water on the premises. 16% of households travel less than 30 minutes or longer to fetch water and 3% travel 30 minutes or longer. Most households (79%) report that they do not treat their water prior to drinking.

JMP Data

The WHO/UNICEF Joint Monitoring Programme (JMP) also monitors global progress of drinking water, sanitation, and hygiene (WASH). JMP uses the respective country's dataset (i.e., censuses, household surveys, administrative data) as well as other datasets that may be available such as compilations by international or regional initiatives, studies conducted by research institutes, or technical advice received during country consultations. Where there are missing data or if data is not available for specific years, estimates are being done accordingly.

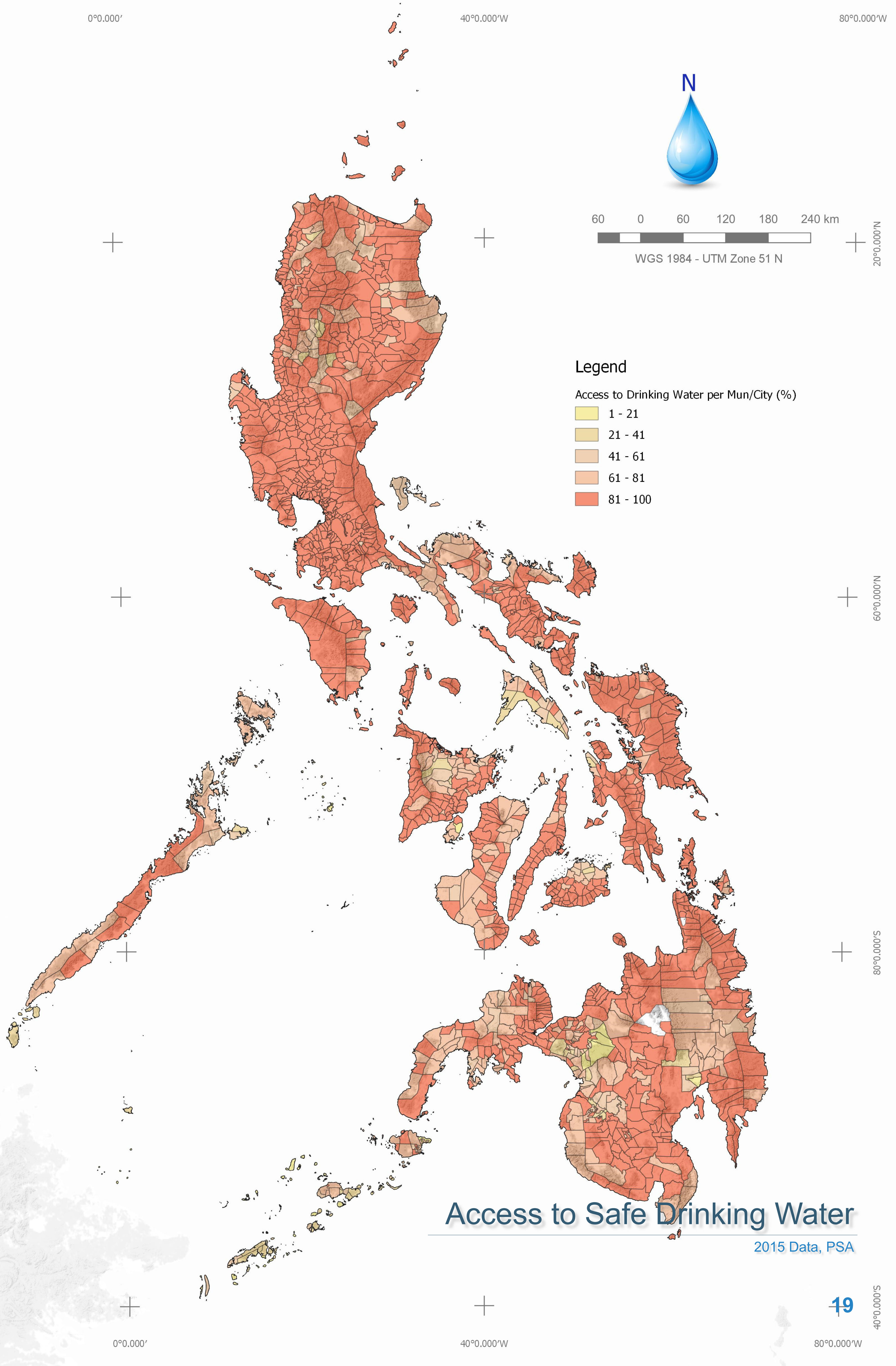
Based on the JMP database, the Philippines' access to safe drinking water is at 90.50% as of 2015 (rural HH's at 85.82%, urban HH's at 96.37%). The figures are derived from the regression analysis conducted using Philippine water data found in various sources including the Philippine census, APIS, NDHS, FIES.

PSA 2015 Census Data

While the population data up to the barangay level based on the 2015 Census are readily available in the PSA website, data on the sources of drinking water (at the city and municipal levels) have only been made available recently. Said data are based on the agency's most recent census.

The classification of sources for drinking water is the same as that of the sources of safe water used in the PSA FIES 2015 (see Figure 1), with the addition of bottled water sources.

As of 2015, 91% of Filipinos had access to safe drinking water sources. The map on the right shows the percentage of access to safe drinking water per municipality as of 2015.



Access to Safe Drinking Water

2015 Data, PSA

Sanitation is essential providing a healthy living environment in households and across communities.

Access to Sanitation

Sanitation service has three (3) data attributes – facility, usage, and management.

- Facility refers to the structure or infrastructure that facilitates the delivery of sanitation service.
- Usage refers to the availability of the facility for use among households.
- Management refers to the proper disposal of excreta (i.e., in situ or transported and treated off-site).

Service levels are based on SDG definitions. These are as follows:

- **Safely Managed** - using of improved facilities which are not shared with other households and where excreta are safely disposed of in situ or transported and treated off-site.
- **Basic** - using of improved facilities which are not shared with other households.
- **Limited** - using of improved facilities shared between two or more households.
- **Unimproved** - using of pit latrines without a slab or platform, hanging latrines or bucket latrines.
- **Open Defecation** - disposal of human feces in fields, forests, bushes, open bodies of water, beaches and other open spaces or with solid waste.
- **Improved facilities** include: flush/pour flush to piped sewer system, septic tanks or pit latrines; ventilated improved pit latrines, composting toilets or pit latrines with slabs.

Table 2 tabulates the service ladder of sanitation against its three (3) data attributes.

Basic Sanitation

Basic sanitation refers to the level of service where the sanitation facility is private (not shared with other households) and where the excreta is separated from human contact (i.e., using toilet fixtures) but where the excreta is either safely managed or not (i.e., with or without a septic tank). The PSA has provided data on basic sanitation specifically in the following surveys and reports:

- Annual Poverty Incidence Survey (APIS) – Part of the survey determines the type of toilet facility a family is using (i.e., own toilet, shared toilet, closed pit, open pit, etc.).
- Family Income and Expenditure Survey (FIES) – The 2015 FIES includes the number of families with access to electricity, amain source of water supply, and toilet facilities by income decile.
- National Demographic and Health Survey (NDHS)
- Philippine Census

Data on access to basic sanitation from 2004 to 2015 from available sources show an improvement in access to basic sanitation — from 68.9% in 2004 to 73.8% in 2015 (see Figure 6).

Adequate and Sustainable Sanitation

The SDG provides a normative interpretation of sanitation as a provision of facilities and services for safe management and disposal of human urine and feces. This is equivalent to the Safely Managed Sanitation service level (as defined earlier). Other SDG 6.2 targets include:

- Access;
- Adequate sanitation;
- Equitable sanitation;
- Hygiene;
- End of open defecation;
- Attention to the needs of women and girls; and
- In vulnerable situation.

All these, however, will be achieved once 100% of the population has obtained access to safely managed sanitation.

The table below provides a matrix of the types of sanitation facilities (as gathered in the NDHS) against sanitation service levels.

Table 2: Sanitation Service Ladder

		Service Ladder				
		No Service	Unimproved Sanitation	Shared Sanitation	Basic Sanitation	Safely Managed Sanitation
Description		Open Defecation	Unimproved facility does not protect against contamination	Improved facility that is shared by multiple households	Private improved facility which separates excreta from human contact	Private improved facility where excreta is safely disposed of on site or transported and treated off-site.
Attributes	With toilet/ latrine facility	No	Yes	Yes	Yes	Yes
	Usage (private/ shared)	N/A	Maybe private or shared	Shared	Private (not shared)	Private (not shared)
	Management (Excreta is safely disposed of in situ or is transported and treated off-site)	N/A	No	Maybe	Maybe	Yes

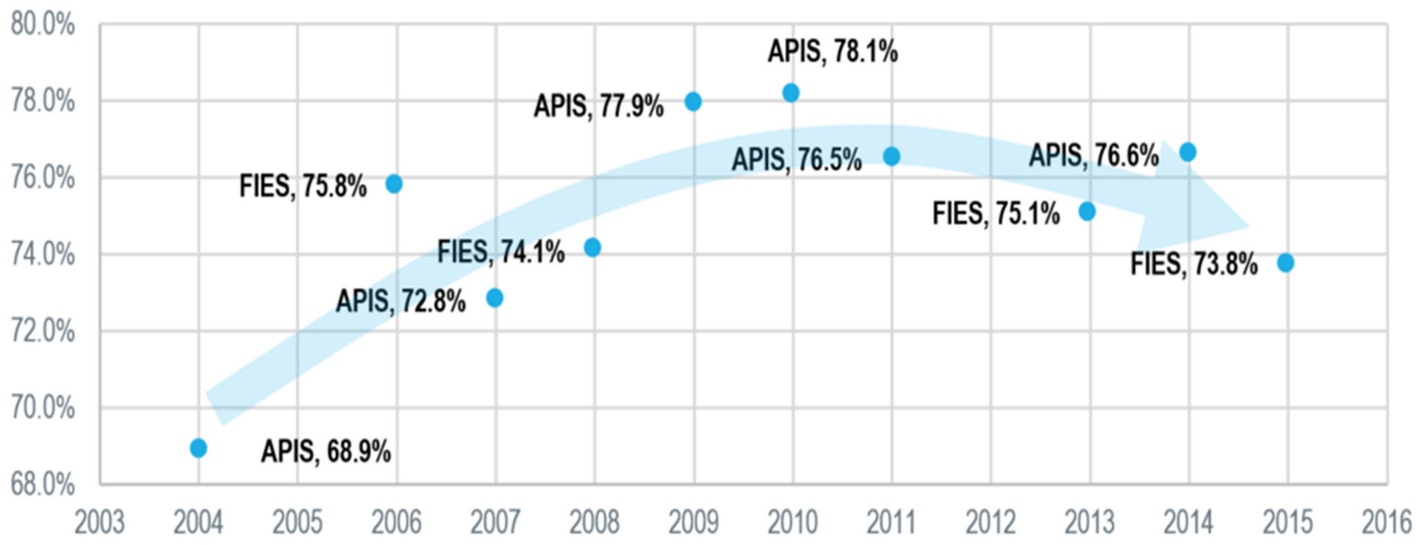


Figure 6: Trend of Access to Basic Sanitation Data

Unlike basic sanitation, safely managed sanitation requires proper management of excreta (i.e., disposal in situ or transported and treated off-site). Proper management may through:

- Through use of septic tanks – for disposal in situ;
- Through septage management – a comprehensive program for managing septic tanks and the procedure for desludging, transporting, treating, and disposing of septic tank contents; and
- Through sewerage management – a network of pipes, pumps, and force mains for the conveyance and collection of wastewater and sewage from a community.

Data on safely managed sanitation are available in the NDHS. Included in NDHS housing characteristics are the sanitation facilities of respondents as well as the management of excreta (i.e., to piped sewer system, to septic tank) (see data parameters used in Table 3). It is recommended, however, that PSA align its reporting with the SDGs.)

The methods used by PSA and JMP regarding their reports on national sanitation coverage do not differ significantly. With the alignment of the PSA figures with the SDGs, the table below shows the percentage per service level reported by the aforementioned entities.

Table 4: Percentage per Service Levels by PSA and JMP

Service Levels/ Source of Reporting	Philippine Statistics Authority	Joint Monitoring Programme
Improved Access	73.77%	74.98%
Limited Access/Basic	19.96%	16.54%
Unimproved Access	2.04%	2.74%
Open Defecation	4.23%	5.74%

Table 3: Sanitation Facilities by NDHS

NDHS Type of Toilet/Latrine Facility			Sanitation Service Level
Improved not shared facility	Flush/pour flush	to piped sewer system	Safely Managed Sanitation
		to septic tank	Safely Managed Sanitation
		to pit latrine	Basic Sanitation
	Ventilated improved pit (VIP) latrine		Unimproved Sanitation
	Pit latrine with slab		Unimproved Sanitation
	Composting toilet		Unimproved Sanitation
Shared facility	Flush/pour flush	to piped sewer system	Shared Sanitation
		to piped sewer system	Shared Sanitation
		to pit latrine	Shared Sanitation
	Ventilated improved pit (VIP) latrine		Unimproved Sanitation
	Pit latrine with slab		Unimproved Sanitation
Non-improved facility	Flush/pour flush	not to sewer/septic tank/ pit latrine	Unimproved Sanitation
	Pit latrine without slab/ open pit		Unimproved Sanitation
	Bucket		Unimproved Sanitation
	Hanging toilet/ hanging latrine		Unimproved Sanitation
	No facility/bush/field		No Service (Open Defecation)

About 74% of the population had access to improved sanitation.

Data on sanitation access down to the regional level are also available from PSA as shown in Figure 7.

ARMM significantly differs from the other regions when it comes to access to sanitation. It has the lowest percentage of population with access to improved sanitation at 21% and the highest percentage of open defecation without access) at 18%. Moreover, the Bicol Region is second at 12% without access to sanitation.

CALABARZON (88%) recorded the highest access to improved sanitation in 2015, followed by the NCR (85%), Central Luzon (82%), Northern Mindanao Region (80%), and Caraga Region (77%). These were all above the national average of 73.77%, the rest of the regions following behind and below the national average.

A thematic comparison of the access to basic and improved sanitation of all the regions is shown on the map on the right.

Septage Management System and Sewerage System

Septage management and sewerage systems are built to manage excreta at the community level.

Data on LGUs with developed septage management systems and HUCs with developed sewerage systems are collected from various projects and LGUs, and detailed in Chapter 5.

Septage Treatment Facilities and Sewerage Treatment Facilities

Septage treatment facilities and sewerage treatment facilities are part of the septage management system and sewerage system, respectively, which are also directly linked to sanitation access.

Data on access to septage treatment facilities and sewerage treatment facilities are also discussed in Chapter 5. This is part of the national master plan and the regional roadmaps.

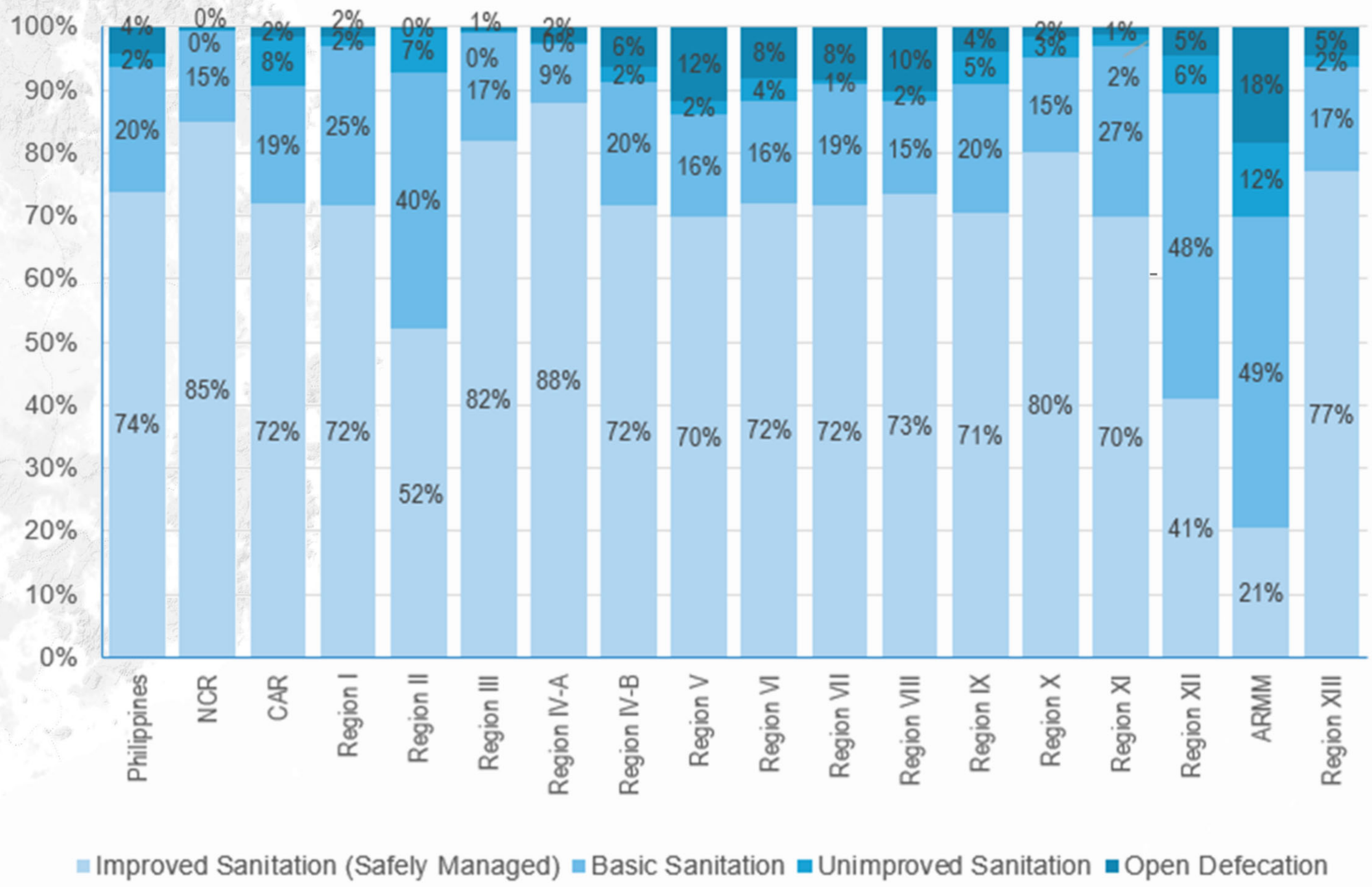
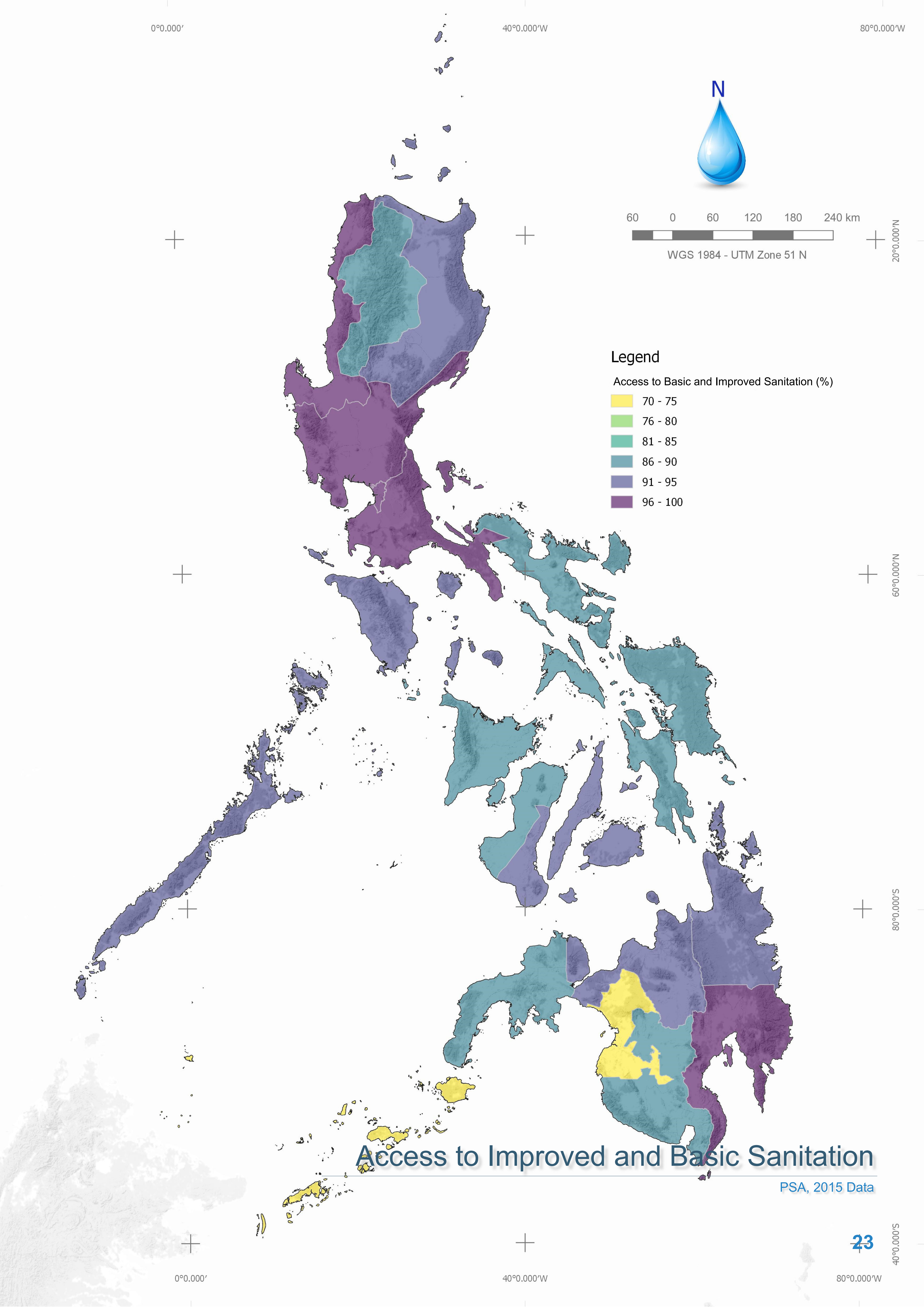


Figure 7: Regional Access to Sanitation



Access to Improved and Basic Sanitation

PSA, 2015 Data

2

Water Resources

The country is divided into 12 water resources regions (WRR).

Regionalization considered the hydrological boundaries defined by physiographic features and homogeneity in climate. The division (see map on the right) also caters to the purpose of comprehensive planning of water resources development. These water resources regions include:

- Ilocos (WRR 1),
- Cagayan Valley (WRR 2),
- Central Luzon (WRR 3),
- Southern Tagalog (WRR 4),
- Bicol (WRR 5),
- Western Visayas (WRR 6),
- Central Visayas (WRR 7),
- Eastern Visayas (WRR 8),
- Southwestern Mindanao (WRR 9),
- Northern Mindanao (WRR 10),
- Southeastern Mindanao (WRR 11), and
- Southern Mindanao (WRR 12).

Water Bodies

The Philippines is endowed with abundant water resources and bodies. These include inland freshwater (rivers, lakes, and groundwater), and marine bodies of water (bays, and coastal and oceanic waters).

Lakes and Swamps

The country has 79 natural lakes. The largest is the Laguna de Bay with an area of 922 km^2 and encompassing two regions – Metro Manila and Region IV.

Lakes in the country are generally used for aquaculture, while others are used for hydropower generation. A list of ten of the country's lakes that host aquaculture production is shown in the table below:

Table 5: Major Hosts for Aquaculture Production

Name of Lake	Location	Area (km^2)
Laguna de Bay	Laguna and Rizal	900
Lanao	Lanao del Sur	347
Taal	Batangas	234
Mainit	Agusan del Norte & Surigao del Norte	140
Naujan	Oriental Mindoro	110
Buluan	Sultan Kudarat & Maguindanao	65
Bato	Camarines Sur	38
Buhi	Camarines Sur	18
Dapao	Lanao del Sur	10
Sebu	South Cotabato	9.64
Total		1,871.64

In addition to that, the country also has more than 1,000 km^2 of freshwater swamps.

The National Wetland Action Plan (2011 – 2016), in response to the country's commitments to the Ramsar Convention, nominated and designated four major wetlands, with a total surface area of 684 km^2, 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, with an area of 148 km^2, 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.

Bays and Coastal Waters

Being an archipelago, the country's bays and coastal waters cover an area of 266,000 km^2. Oceanic waters, on the other hand, cover 1,934,000 km^2.

The Philippine coastline, having a total length of 36,289 km., is irregular, with numerous bays, gulfs, and islets. About 60% of Philippine municipalities and cities are coastal, with ten of the largest cities located along the coast.

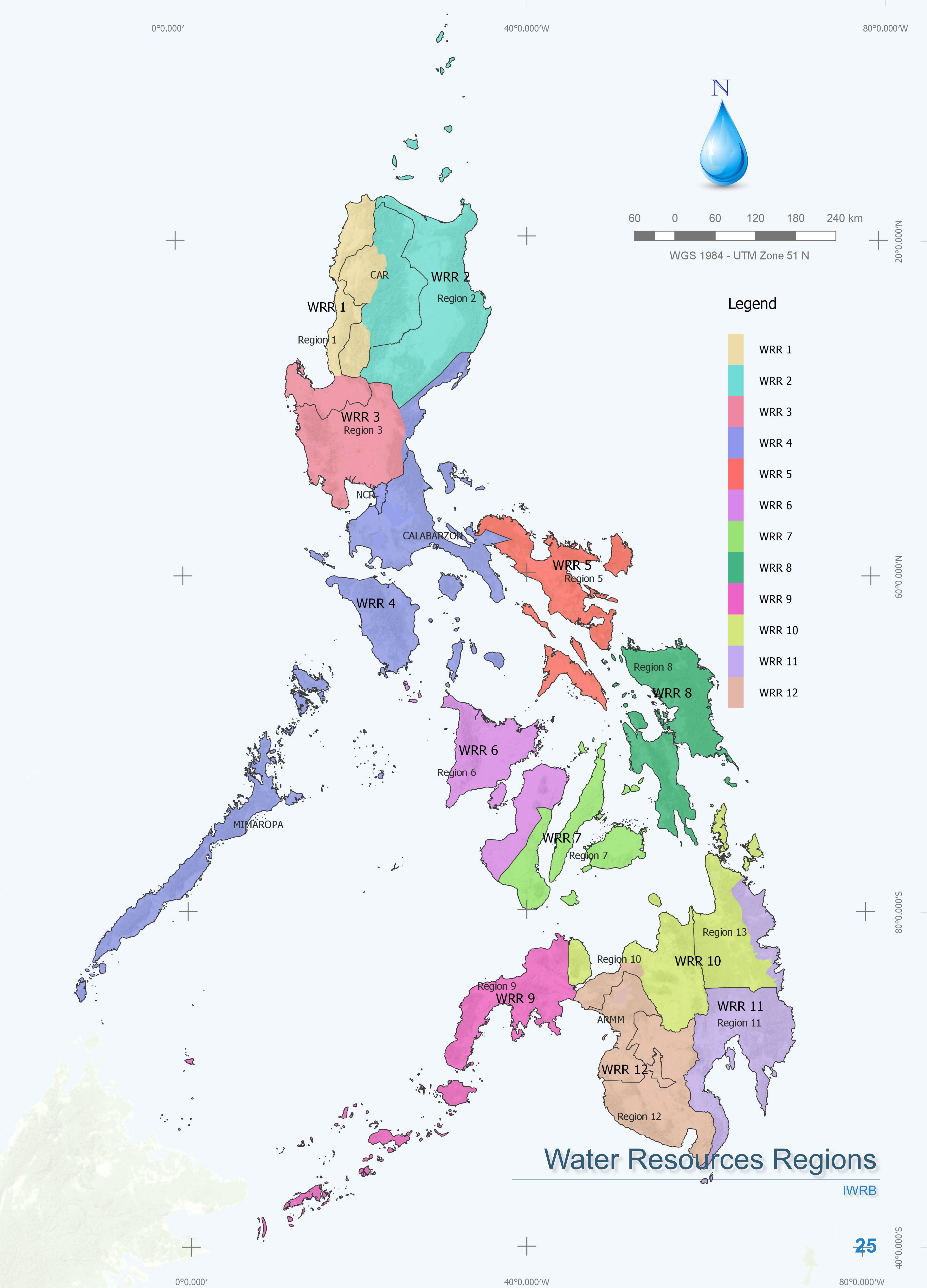
Rivers and River Basins

The Philippines has about 421 river basins, not counting small mountain streams, that sometimes can swell to three times their size during rainy months. Aside from being a valuable and primary source of irrigation water for fields and farms through which they pass, these rivers are now greatly considered as a viable and more sustainable source of water supply especially for urban areas where water demand is high and continuously increasing; while groundwater sources are slowly dwindling down and could not keep up.

Of the 421 principal river basins, 18 are considered major river basins with each having a drainage area of more than 1,400 km^2. The 18 major river basins occupy a total of 108,923 km^2 which is more than one-third of the country's total land area.

The largest river basin is the Cagayan River Basin which encompasses the CAR and Region II and the province of Aurora in Region III. It is utilized for hydroelectric power as several dams/ power plants are built within its proximity. The second largest river basin is Mindanao which encompasses Regions X, XII, and ARMM.

The locations of the major river basins are shown in the map on the next page.



Water Resources Regions

IWRB

Major River Basins

NWRB, DENR RBCO

Table 6: Major River Basins

River Basin	Catchment Area (km^2)	River Length (km)
Cagayan	25,649	505
Mindanao	23,169	373
Agusan	10,921	350
Pampanga	9,759	260
Agno	5,952	206
Abra	5,125	178
Pasig-Laguna de Bay	4,678	78
Bicol	3,771	136
Abulug	3,372	175
Tagum-Libuganon	3,064	89
Ilog-Hilabangan	1,945	124
Panay	1,843	132
Agus	1,890	36
Tagoloan	1,704	106
Davao	1,623	150
Cagayan de Oro	1,521	90
Jalaur	1,503	123
Buayan-Malungon	1,434	60
Total	108,923	3,171

Estimating the Country's Water Resources Potential

Recent data on the availability of water resources in the Philippines on a national scale (down to the regional and provincial levels) are limited. The PWSMMP employed secondary data from previous studies and available hydro-meteorological and hydrogeological data collected from different sources to estimate water resources potential. (These data are based on references tabulated below.)

Available data were also updated using applicable methods based on the most recent precipitation data, and surface and land areas. The water resources potential up to the provincial level was also approximated, as some data pertained only to each river basin or WRR.

Surface Water Potential

Hydrology is the study of the cycling of water through different reservoirs. It focuses on the distribution of water in the subsurface, surface and atmosphere, the chemistry of that water, and the effects of climate on the water cycle. Hydrology subdivides into surface water hydrology, groundwater hydrology (hydrogeology), and marine hydrology. For the purpose of this report, the study of surface waters will be referred to as "hydrology", while the study of groundwater will pertain to "hydrogeology".

The estimation of the country's surface water potential was based on hydrological studies and analyses of major river basins (which covered all WRR). Representative flow duration curves (FDCs) for each of the regions of Luzon, Visayas and Mindanao were constructed based on historical streamflow records. This was done by averaging the curves at the stream gauging stations selected.

> A Flow Duration Curve (FDC) represents the relationship between the magnitude and frequency of daily, weekly, monthly (or some other time interval of) streamflow for a particular river basin, providing an estimate of the percentage of time a given streamflow was equaled or exceeded over a historical period[5]. It provides a simple, yet comprehensive, graphical view of the overall historical variability associated with streamflow in a river basin.

Table 7: Data Availability of Water Resources Potential

Agency	Reference
Department of Environment and Natural Resources River Basin Control Office (DENR RBCO)	▪ Major River Basin Master Plans
Japan International Cooperation Agency (JICA)	▪ Master Plan Study on Water Resources Management in the Philippines
NWRB	▪ Groundwater Management Plan for Highly Urbanized Cities and Surrounding Areas (completed: Baguio, Angeles, Bacolod, Metro Manila and Cavite, Cagayan de Oro, Davao, and Iloilo) ▪ Study on Integrated Water Resources Management for Poverty Alleviation and Economic Development in the Pampanga River Basin ▪ Comprehensive Water Resources Assessment in Major River Basins (RB) (completed: Pampanga RB, Agno RB, Panay RB)
National Water Resources Council (NWRC)	▪ Provincial Groundwater Assessment ▪ River Basin Water Resources Assessment ▪ Philippine Water Resources
Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA)	▪ Historical rainfall and temperature records
Department of Public Works and Highways Bureau of Research and Standards (DPWH BRS)	▪ Historical streamflow records at existing gauging stations
Food and Agriculture Organization (FAO) of the United Nations	▪ Aquastat Data

The surface water potential for each WRR was estimated for the exceedance probability (or dependability) of 50% and 80% based on resulting FDCs with mean daily discharges per 100 km^2. Figures show that at 80% dependability, streamflow discharges in Mindanao are about two and three times those for Luzon and Visayas. This implies that the low flow in dry periods in Mindanao is comparatively more stable because of the relatively constant rainfall throughout the year. In Luzon, however, the streamflow is severely affected by the relatively lesser rainfall amount during the dry season[4].

The total surface water potential of the country is estimated at 206,230 MCM/year and 125,790 MCM/year, at 50% and 80% dependability, respectively.

WRR 10 has the largest surface water potential among all the regions comprising around 20% of the country's total. WRR 7, on the other hand, has the least with 2% of the total (see Figure 8). Generally, WRRs in Mindanao have a higher potential than those in Luzon and Visayas. WRRs 9, 10, 11, and 12 make up 57% of the Philippines' total surface water potential, followed by Luzon WRRs (1, 2, 3, 4, 5) with 23% and Visayas WRRs (6, 7, 8) with 20%.

[4] JICA Water Resources Management Master Plan, 1998
[5] Flow Duration Curves: New Interpretation and Confidence Intervals; Vogel and Fennessey (https://engineering.tufts.edu/cee/people/vogel/documents/flowDuration1.pdf)

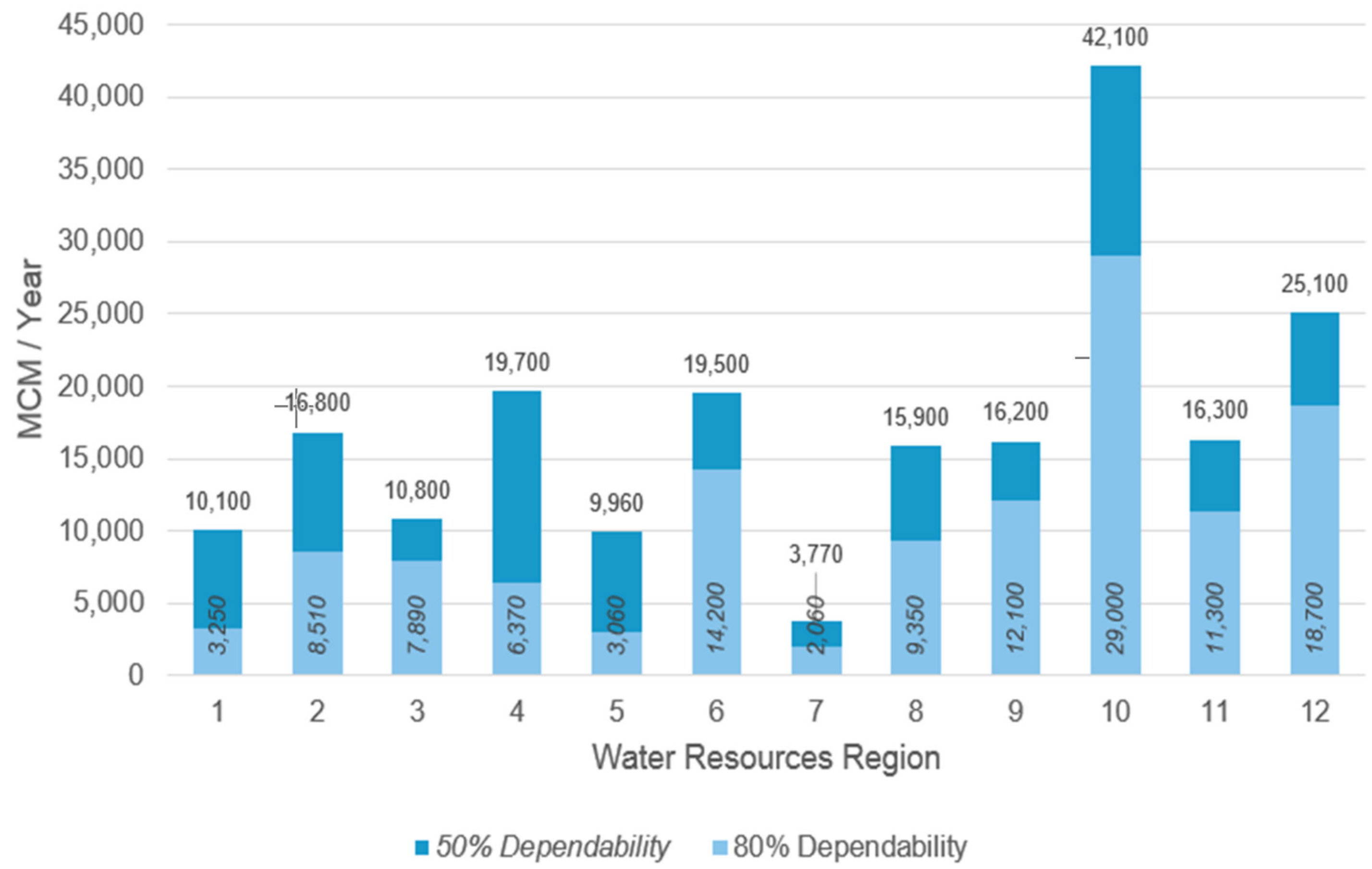


Figure 8: Surface Water Potential per WRR

Groundwater Potential

The country has an extensive groundwater reservoir with an aggregate area of about 50,000 km^2. It boasts four major groundwater reservoirs with areas ranging from 6,000 to 10,200 km^2. These are located in Cotabato, Agusan, Central Luzon, and Cagayan (listed in increasing order of covered areas). Groundwater resources are continuously recharged by rain and seepage from rivers and lakes. Groundwater is extensively used for domestic purposes (primarily as drinking water) and irrigation.

The hydrogeological conditions of the country play a big part in groundwater availability. The groundwater conditions are predominantly controlled by geology, topography and the structure of the groundwater basin. The latter consists of distribution and hydrogeological conditions such as the aquifer structure and aquicludes, and is endowed with the physical characteristics of the formations as per transmissibility, and storage coefficient and chemical characteristics of groundwater.

In addition to its hydrogeological conditions, the extent of groundwater availability in any given area depends on its surface area and the amount of precipitation it receives. Using these basic data, the groundwater potential may be estimated.

Recharge is often the most important quantity in a groundwater resource estimation. Possible groundwater recharge is estimated at 5% of the annual precipitation volume. Results were coupled with the land use patterns of the study areas to further refine calculations.

Urbanization of the study areas is also considered as it reduces the amount of groundwater recharge resulting from the expansion of the land area covered with concrete, asphalt and other non-porous materials, in addition to the water-dependent requirements of human habitation including industrial activities.

Groundwater availability is also tied to groundwater storage which was estimated based on the type and class of aquifers found in a study area (Table 8).

The map on the right shows the groundwater availability map of the Philippines delineated as per the aforementioned types.

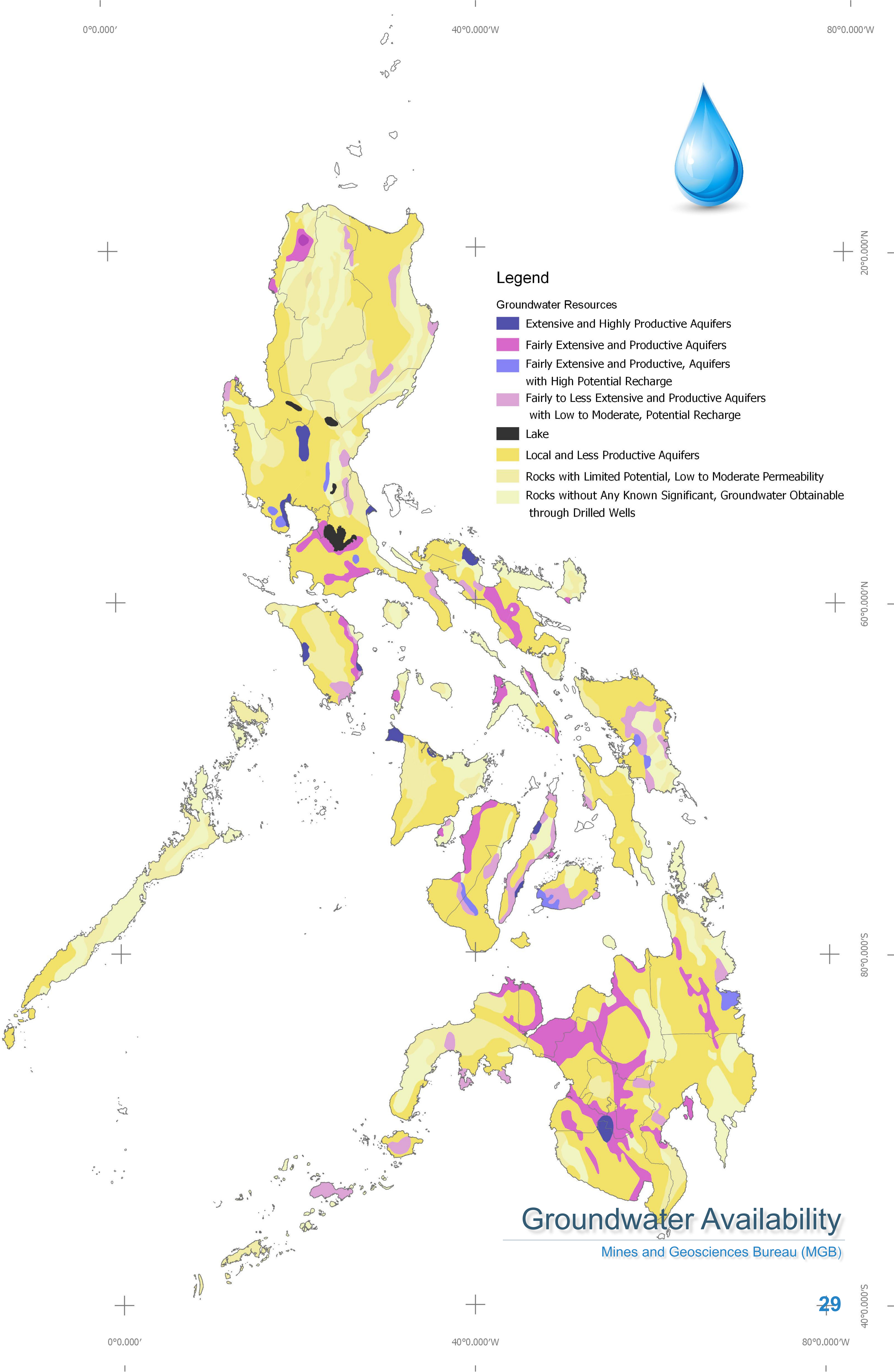
The country's total groundwater potential is estimated at 20,200 million cubic meters (MCM)/year.

Potential per WRR is shown in Figure 9. WRR 2 has the largest groundwater potential comprising 14% (2,825 MCM/year) of the country's total, while WRR 7 has the least potential with 4% (879 MCM/year).

Table 8: Aquifer Classes based on MGB Aquifer Types

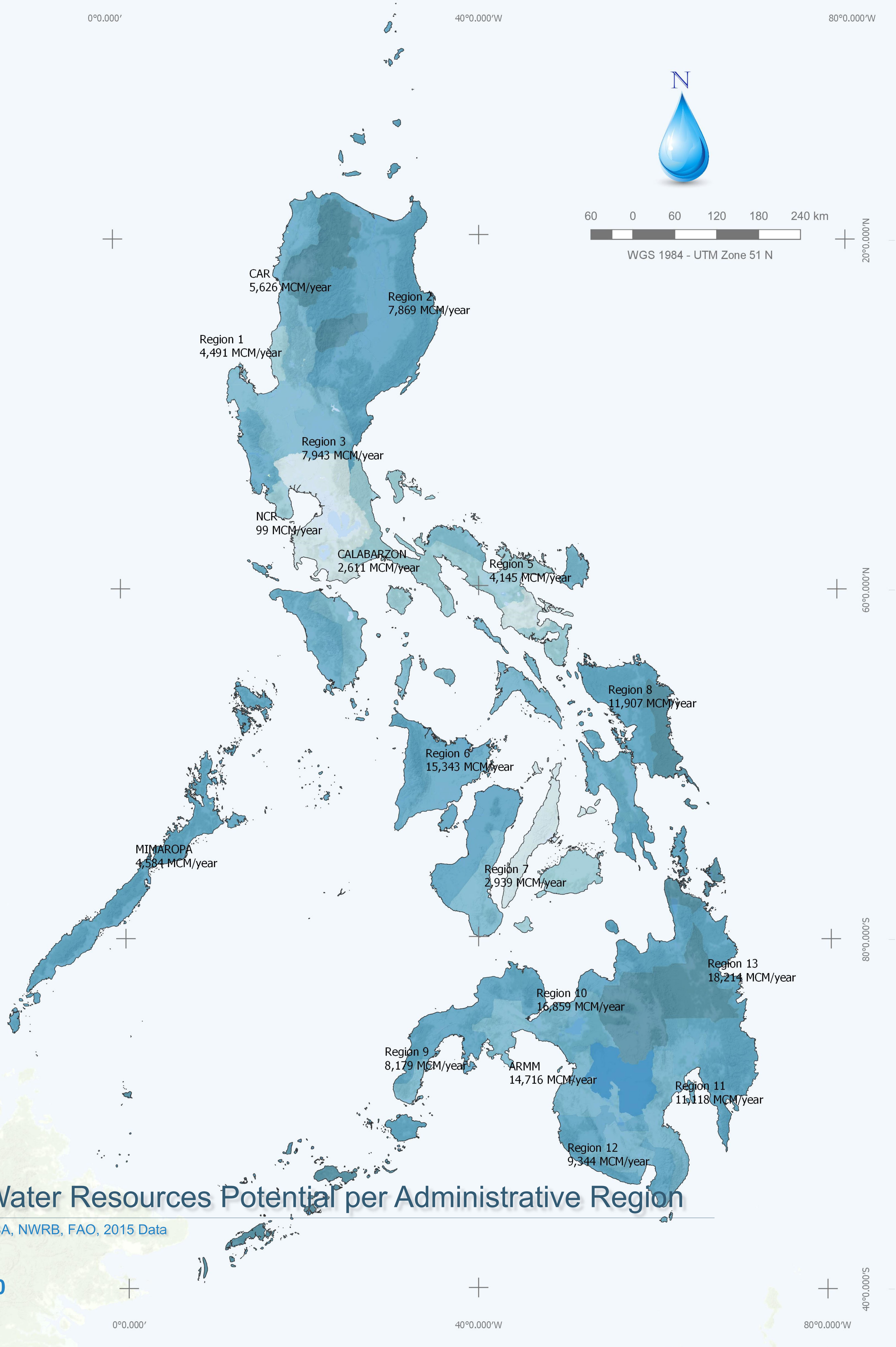
Aquifer Class	MGB Aquifer Type	Estimated Yields (boreholes unless stated)
Major Aquifer (Highly permeable)	Intergranular: extensive and highly productive Fractured: fairly extensive and productive (aquifers with high potential recharge)	Mostly 50-100 liters per second (lps) 3-50 lps, spring yields up to 1000 lps
Minor Aquifer (Variably permeable)	Intergranular: fairly extensive and productive Intergranular: local and less productive Fractured: less extensive and productive	About 20 lps Mostly 2-20 lps Well yields up to 3 lps
Non-aquifer (Negligibly permeable)	Rocks with limited groundwater potential Rocks without any significant known groundwater	Yields mostly less than 1 lps Yields mostly less than 1 lps

Source: MGB



Groundwater Availability

Mines and Geosciences Bureau (MGB)



Water Resources Potential per Administrative Region

PSA, NWRB, FAO, 2015 Data

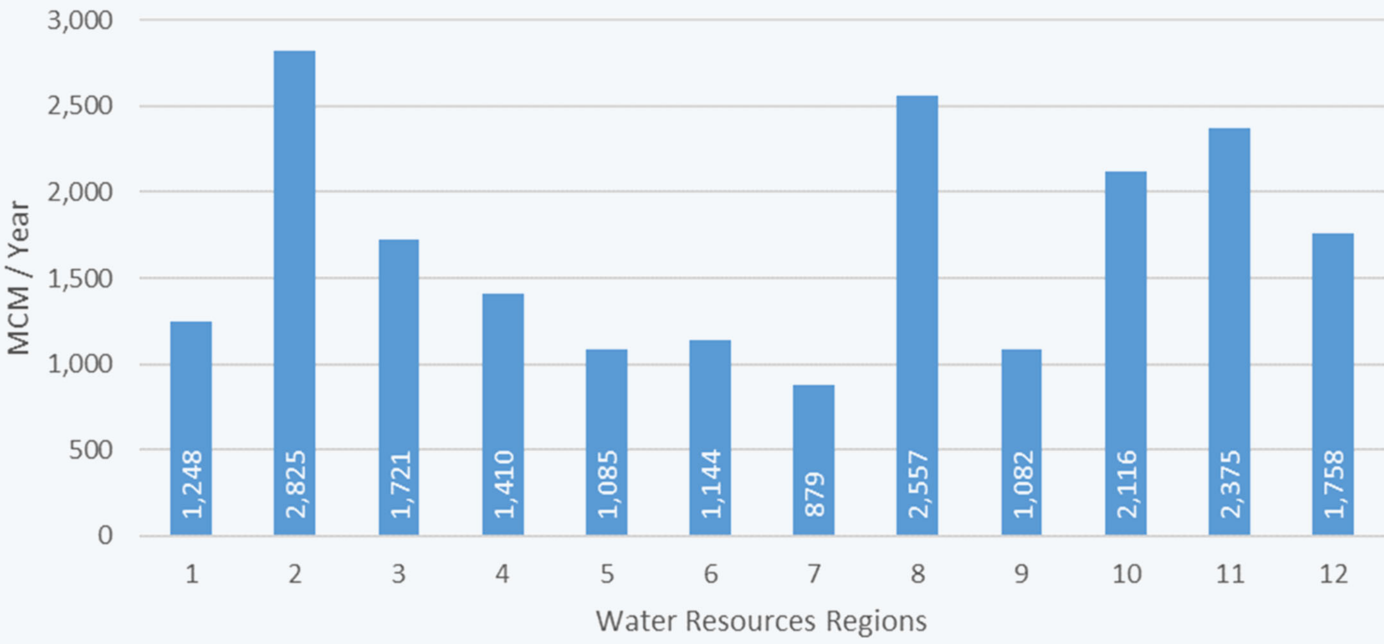


Figure 9: Groundwater Potential per Water Resources Region (in MCM/Year)

Considering the total surface water potential of 125,790 MCM/year (taken at 80% dependability) and the total groundwater potential of 20,200 MCM/year, the Philippines has a total water resources potential of 145,990 MCM/year.

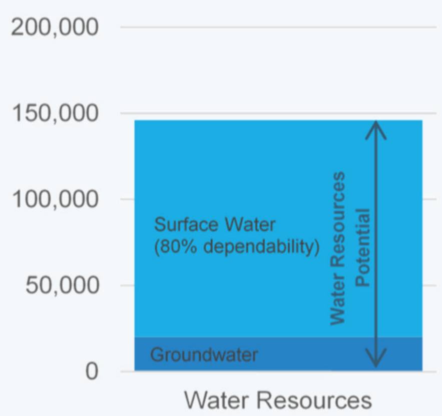


Figure 10: Total Water Resources Potential of the Philippines

Translating these from a per-WRR basis to a per-administrative region basis gives us the corresponding water resources potential (as shown in Figure 11).

The Caraga Region has the greatest water resources potential out of all administrative regions, taking up around 12.5% (around 18,000 MCM/year) of the country's total. Being the most urbanized region, Metro Manila has the lowest potential with less than 0.5% of the total (98 MCM/year).

Water Use

As the water resource regulator, NWRB grants water rights of a water resource before applicants utilize a water source. Granted water rights data are stored in NWRB's database with respect to the purpose of water use, quantity of water, etc.

The NWRB's database is the only source of information on the state of use of water resources on a nationwide scale. The propriety of each water right application is evaluated by the NWRB based on registered data on available water sources and the standard criterion for each water use sector.

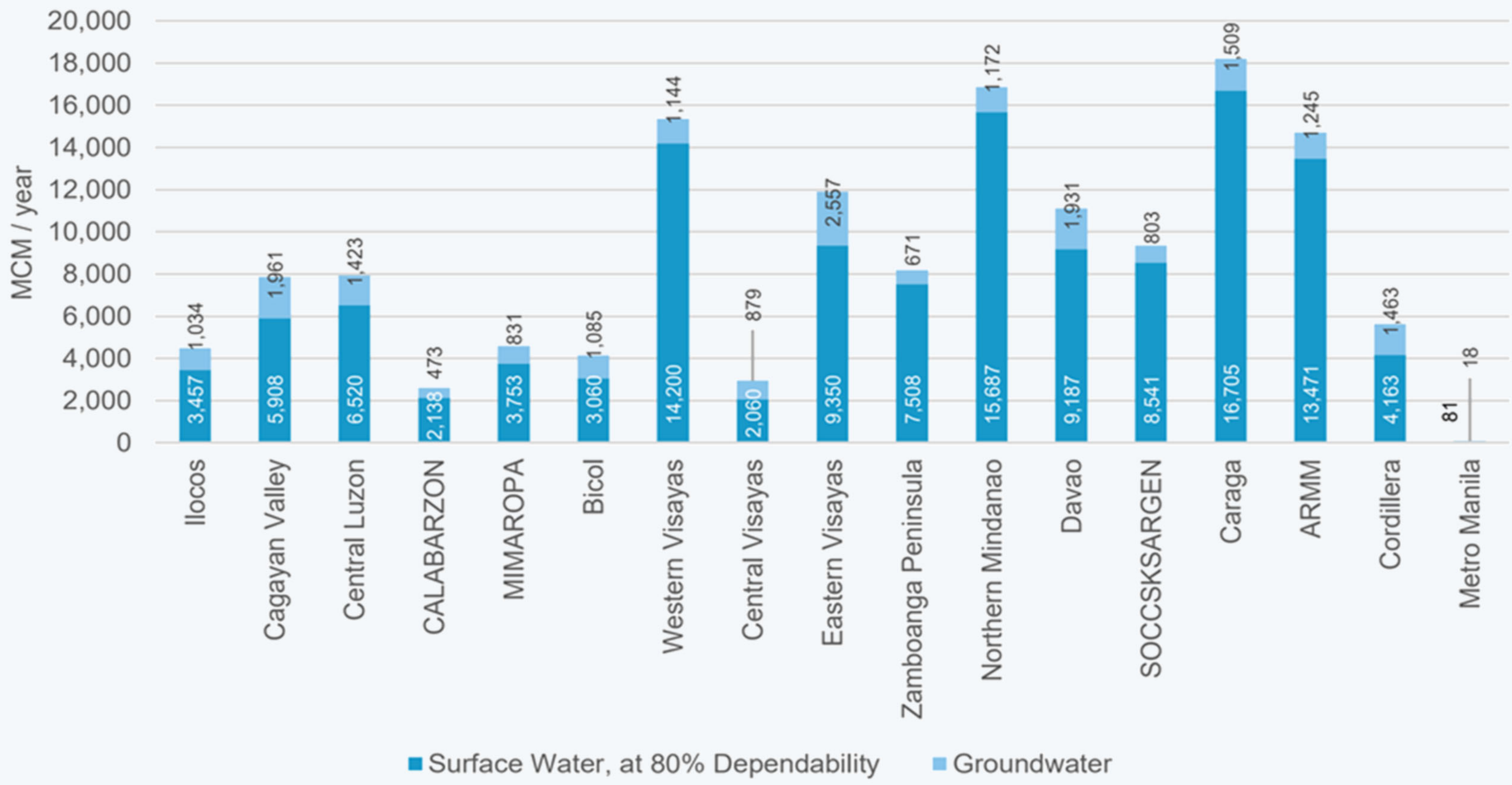


Figure 11: Total Water Resources Potential per Administrative Region

Source: Japan International Cooperation Agency (JICA) Master Plan on Water Resources Management in the Philippines, 1998; NWRB; Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) Rainfall Data; Food and Agriculture Organization (FAO) of the United Nations Aquastat Data; Department of Environment and Natural Resources (DENR) River Basin Control Office (RBCO) Major River Basin Master Plans

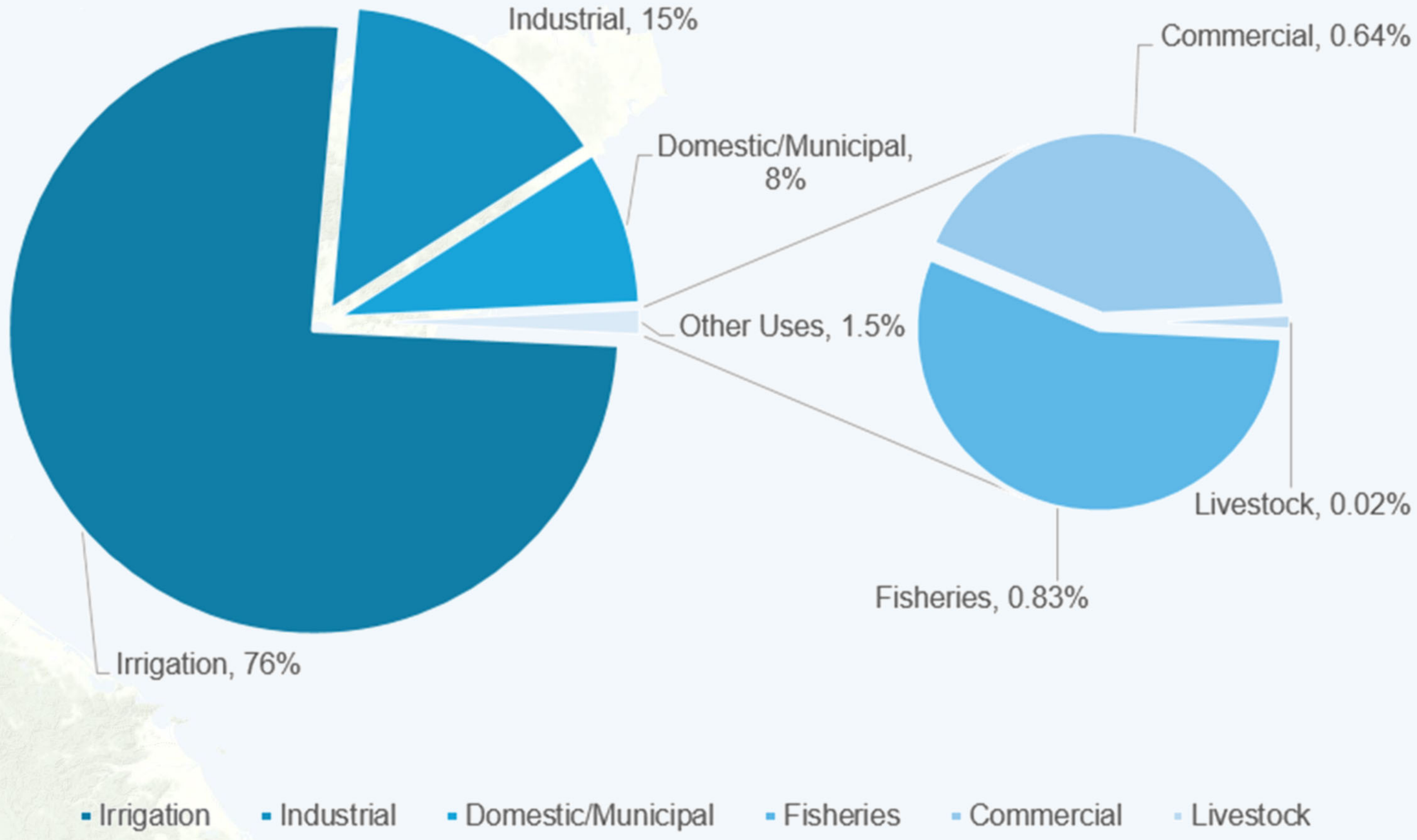


Figure 12 : Water Use per Sector

As of 2017, water use based on awarded water permits was estimated at 212,800 MCM annually. Of this figure, about 130,500 MCM (or 61.3%) was allocated for power generation and was categorized as non-consumptive use, along with recreational use amounting to about 350 MCM. The remaining 82,000 MCM was reserved for consumptive use (Figure 12).

The irrigation sector still consumes the most water among all the sectors with 76% allocation, while domestic consumption was recorded at 8%.

Source-wise, water rights to surface water resources are significantly larger than rights to groundwater as shown in Figure 13.

Groundwater is classified into “wells” and “springs” according to the mode of extraction. It might be advantageous for water rights applicants to develop surface water, if its quantity is sufficient and its quality desirable. Especially in large-scale municipal, industrial and irrigation water supply, development of surface water is preferred to that of groundwater because the latter costs less, is more in demand, and can be sustained for longer periods.

Generally, groundwater is of higher quality (i.e., suitable as drinking water) than surface water and is distributed more widely. This is especially true where only surface water development is possible because of certain topographical disadvantages e.g., an area which has no capacity to allow water supply by gravity flow. In this case, groundwater chiefly sourced from springs could be developed at reasonable costs.

Note, however, that these findings are based on NWRB’s database of awarded water permits dating back to 1975. Permits and allocated rights remain valid for as long the “owners” are able to settle their annual fees. Data on the actual and existing water withdrawal of these entities (which may be less or more than what was allotted to them) are lacking (as of this writing). Furthermore, many water users (especially of groundwater) across the country, are also unregistered, resulting in indiscriminate withdrawal.

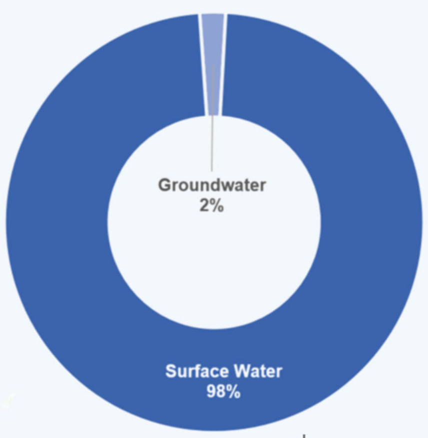


Figure 13 : Water Use by Type of Source (2017, NWRB)

Water Availability, Water Stress, and Water Scarcity

“Hydrologists typically assess scarcity by looking at the population-water equation. An area is experiencing water stress when annual water supplies drop below 1,700 m^3 per person. When annual water supplies drop below 1,000 m^3 per person, the population faces water scarcity, and below 500 m^3 ‘absolute scarcity.’” (UN Water, n.d.)[6]

A 2001 study[7] ranks the Philippines as having the second lowest per capita water availability per year among Southeast Asian countries. The country had been estimated to have 1,907 m^3 per person – lower than the Asia and global averages. While the national value is higher than the threshold of areas considered experiencing water stress or water scarcity, this is not true with respect to each WRR or administrative region.

The map on the right shows the per capita water availability per year by region and highlights the level of water availability, stress, and scarcity. Based on 2015 population statistics, water availability in the Philippines is only 1,446 m^3 per capita per year nationwide — a sign that the country is experiencing water stress.

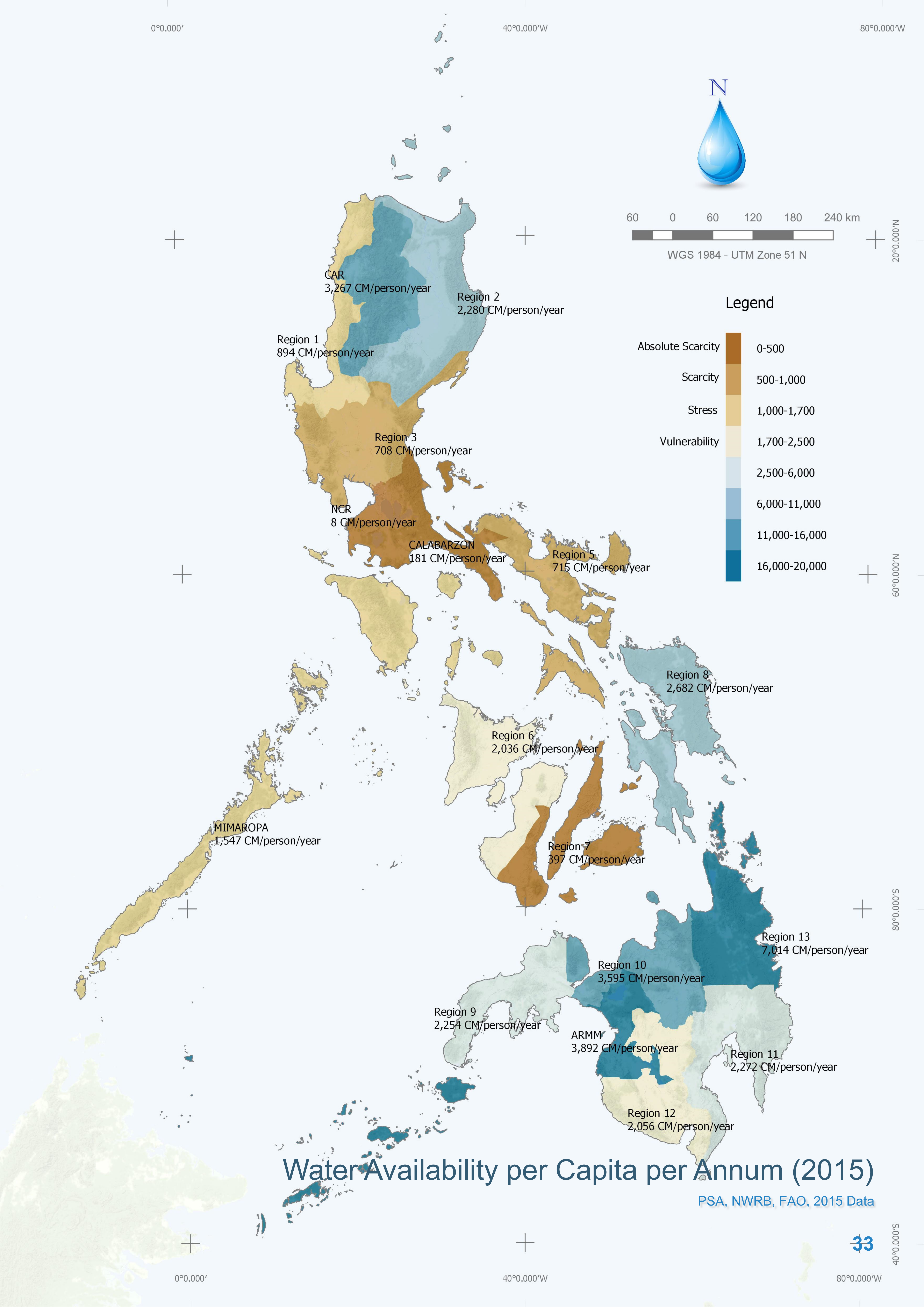
MIMAROPA falls under this condition. Regions I, III, and V are facing water scarcity, and NCR, CALABARZON, and Region VII are facing absolute scarcity. The values for the water availability per capita per year cover domestic water supply and water uses for other sectors (e.g., agricultural, industrial, commercial, power).

In addition, the NWRB has also identified nine water-critical urban areas where water is consumed intensively. These include Metro Manila, Metro Cebu, Davao, Baguio City, Angeles City, Bacolod City, Iloilo City, Cagayan de Oro City, and Zamboanga City.

Future water availability in the country would be further affected by climate change, economic development, urbanization, and population growth. A recent study[8] of the World Resources Institute (WRI) predicts the Philippines will experience a high degree of water shortage in 2040, assuming a business-as-usual scenario continues.

The Philippines is ranked as the 57th in the list of 167 countries most likely to experience water stress by 2040. The study evaluated projected water withdrawals by the industrial, domestic, and agricultural sectors against available renewable resources. The three sectors scored high in the projected water stress index, with the agricultural sector having the highest score.

[6] Managing Water Report under Uncertainty and Risk, UN World Water Development Report 4 (Volume 1)
[7] World Resources Institute 2000-2001
[8] Tianyi Luo, R.Y. (August 2015). Aqueduct Projected Water Stress Country Rankings



Water Availability per Capita per Annum (2015)

PSA, NWRB, FAO, 2015 Data

Climate and Rainfall

The Philippines has a tropical and maritime climate with relatively high temperature and humidity, and with seasonal and spatial variability in rainfall. The climate is mainly influenced by the country's location, physical geography, and by large-scale systems, such as monsoons, tropical cyclones, and the El Niño-Southern Oscillation (ENSO).

On average, the seasonal temperature varies from about 25.5°C in January (the coolest month) to 28.3°C in May (the hottest month). Station data indicate that altitude, not latitude, is the more significant factor affecting the spatial variability in temperature.

Rainfall is an important driver of climate variability in the Philippines. The country's climate is influenced by its geographical position and wind system prevalent in different localities at certain times of the year. The country's climate is classified according to the Modified Coronas Classification which is based on the seasonal variability of rainfall combined with the influence of the country's topography, and air stream direction. These are:

- **Type I** – Two pronounced seasons dry from November to April and wet the rest of the year.
- **Type II** – No dry season with very pronounced maximum rainfall from November to April and wet the rest of the year.
- **Type III**– Seasons not very pronounced: relatively dry from November to April and wet the rest of the year.
- **Type IV**– Rainfall more or less evenly distributed throughout the year.

Figure 14 and Figure 15 show the recorded monthly average temperature and rainfall in selected areas[9] and gauging stations for each type of climate.

Monsoons also influence climate variability. The country experiences two monsoon seasons — the southwest monsoon (habagat) and the northeast monsoon (amihan). The former, experienced from May to September, brings abundant rainfall over the western coast of the country; the latter affects the eastern side from October to March.

Tropical cyclones also contribute to rainfall in the Philippines, and can bring strong winds and heavy rains with destructive impacts. Every year, an average of 19 to 20 tropical cyclones enter the Philippine Area of Responsibility (PAR) and about seven to nine make landfall[10].

Additionally, the ENSO affects interannual climate variability and seasonal rainfall in the country through its warm (El Niño) and cold (La Niña) phases. El Niño lasts from 8-12 months, occurs every 2-7 years and is strongest every 10-15 years. La Niña lasts for 1-3 years and occurs every 3-4 years.

Climate Projections

The Philippine's water resources greatly depend on rainfall for recharge. However, the prevailing effects of climate change have had significant implications on the country's water sources and WSS infrastructure that may affect water supply at present and in the future.

The PAGASA has generated projections of temperature increase and rainfall change in the Philippines. Its projections were based on climate trends and historical records from 1971-2000 as the reference value. Key findings[11] include the following:

- There has been an increase in annual mean temperature by 0.57°C.
- In terms of maximum and minimum temperatures, the increases have been recorded at 0.35°C and 0.94°C.
- An average of 20 tropical cyclones form and/or cross the PAR per year with strong multi-decadal variability. There still is no indication of increase in the frequency, but rather a very slight increase in the number of tropical cyclones with maximum sustained winds of greater than 150 kilometers per hour (kph) and above (typhoon category) being exhibited during the El Niño period.
- The analysis of the trends of extreme daily temperatures and extreme daily rainfall indicates a significant increase in the number of hot days and decrease in the number of cool nights. Rainfall patterns (extreme rainfall intensity and frequency) are not clear, both in magnitude and direction (whether increasing or decreasing), with very little spatial coherence.

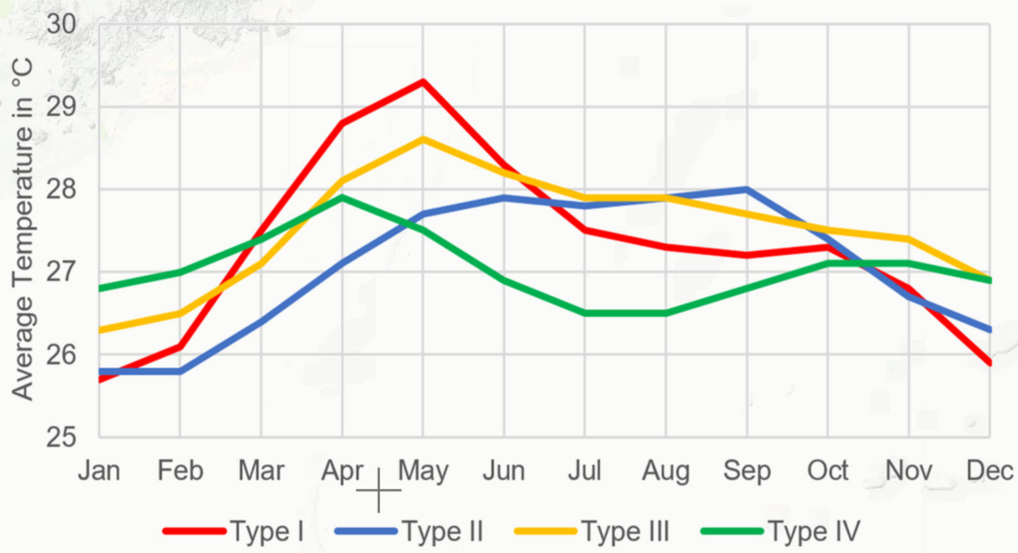


Figure 14: Average Temperature per Climate Type[12]

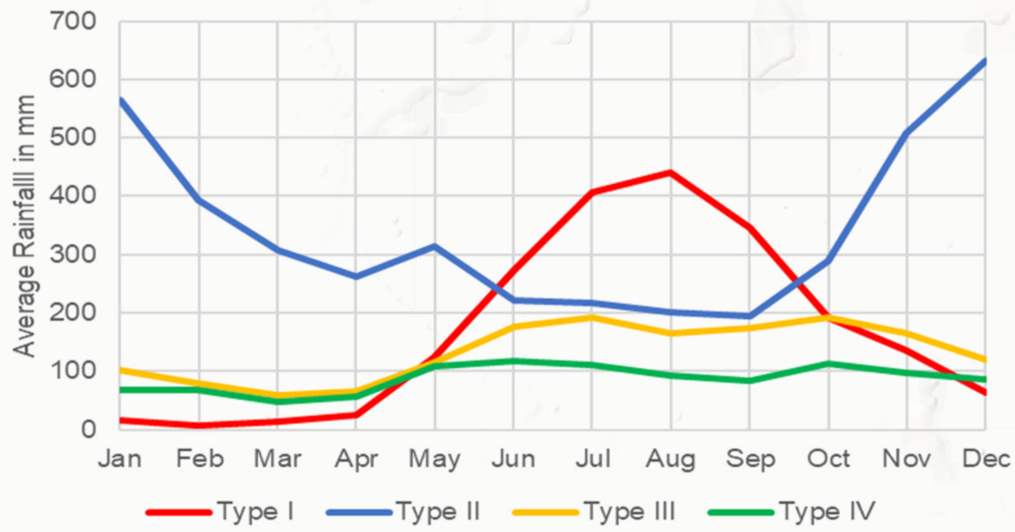
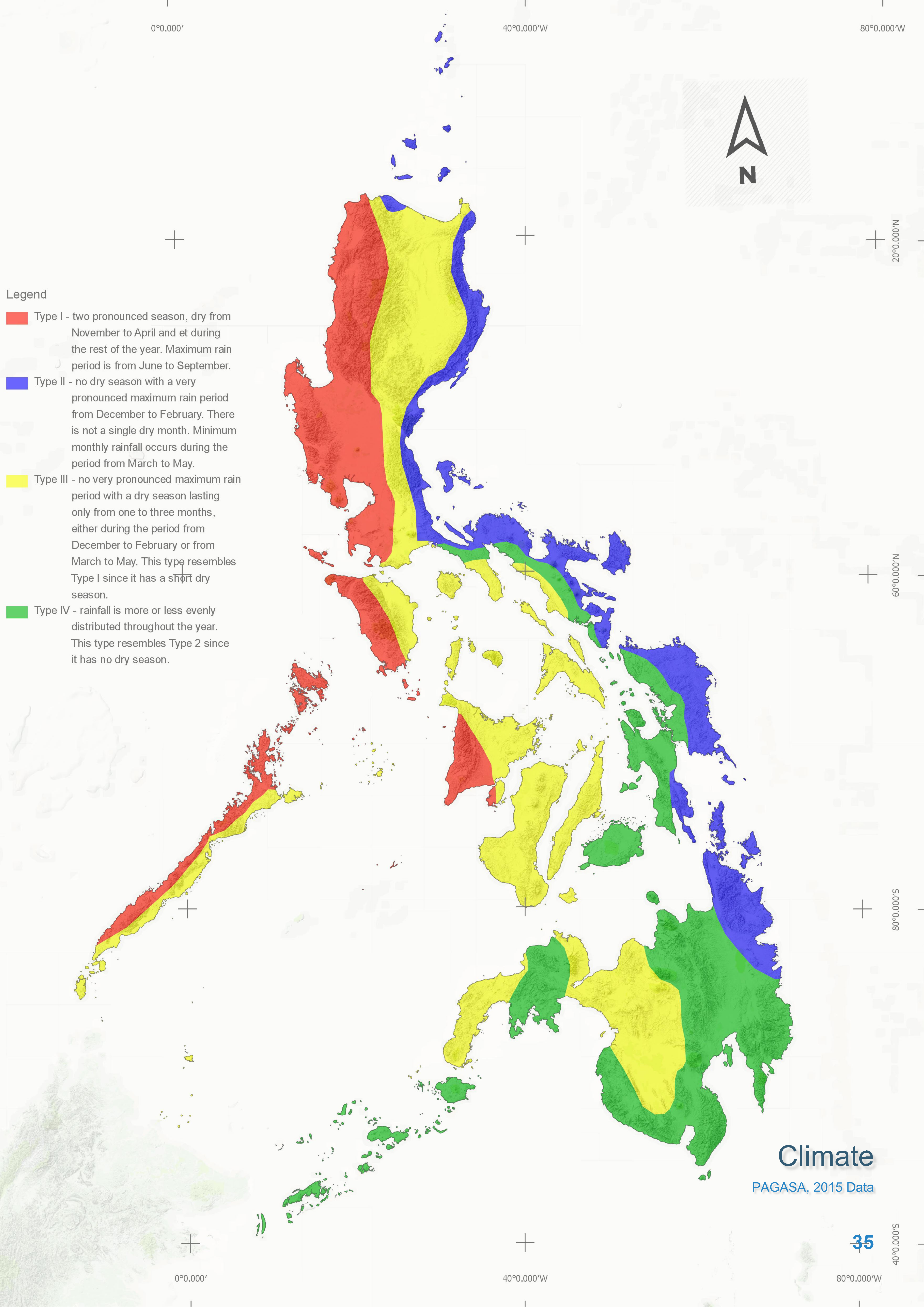


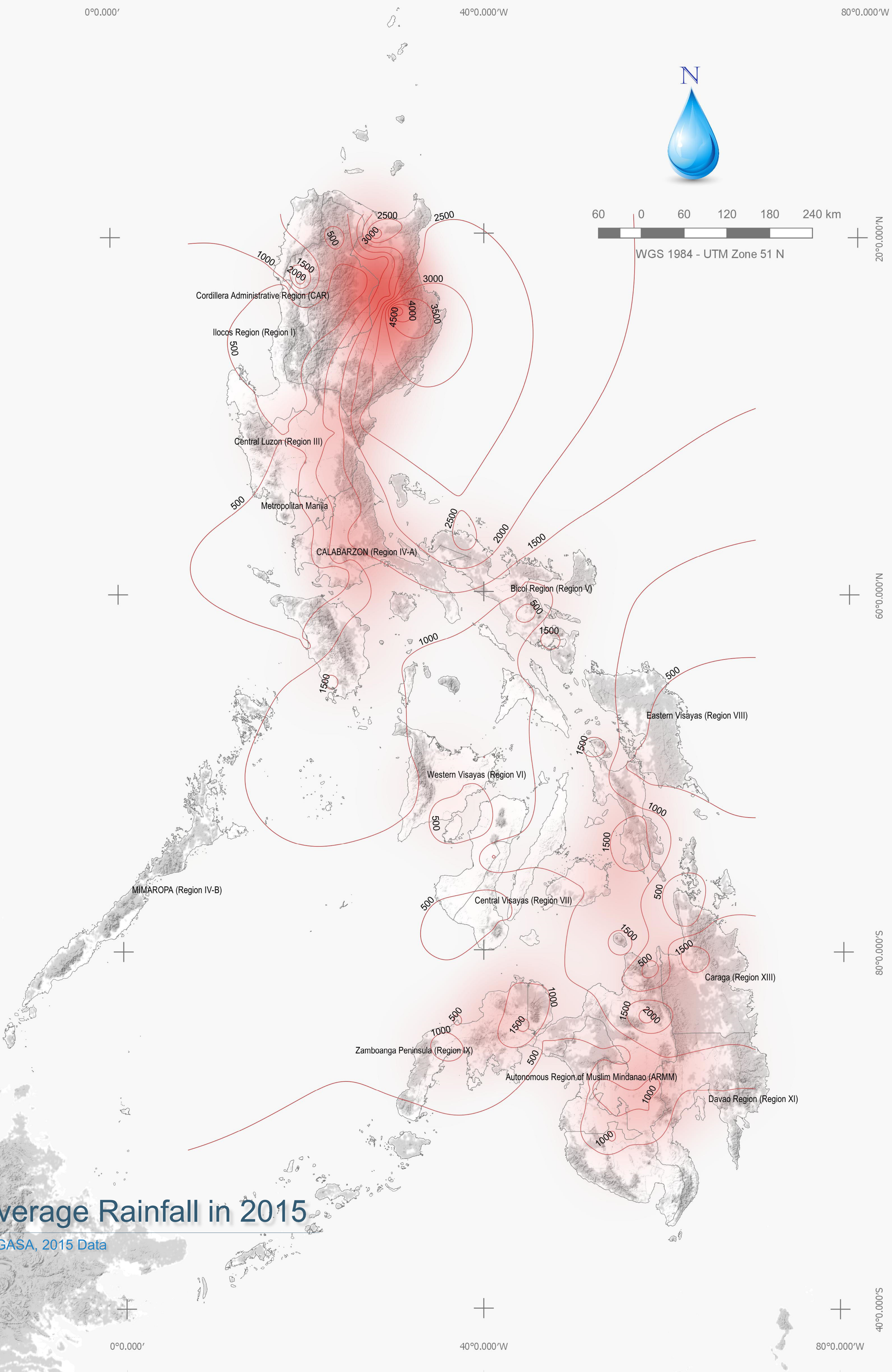
Figure 15: Average Rainfall per Climate Type[13]

[9] *Manila (Type I), Borongan, Eastern Samar (Type II), Cebu City (Type III), and General Santos City (Type IV)*
[10] *Climate Change in the Philippines, Feb 2011, PAGASA*
[11] *Ibid.*
[12] *climate-data.org*
[13] *Ibid.*



Climate

PAGASA, 2015 Data



Average Rainfall in 2015

PAGASA, 2015 Data

Climate projections for 2020 and 2050 were simulated under a medium range emission scenario (although high- and low-range scenarios were also thought up). The medium range scenario has been included considering that climates in the next 30 to 40 years will be greatly influenced by past greenhouse gas emissions already there (i.e., the lifetimes of carbon dioxide are a hundred years or more).

PAGASA's key findings[14] and the implication thereof on water resources, as well as supply and demand include the following:

- All areas of the Philippines will get warmer, more so in the relatively warmer summer months.
- Annual mean temperatures (average of maximum and minimum temperatures) in all areas in the country are expected to rise by 0.9°C to 1.1°C in 2020 and by 1.8°C to 2.2°C in 2050.

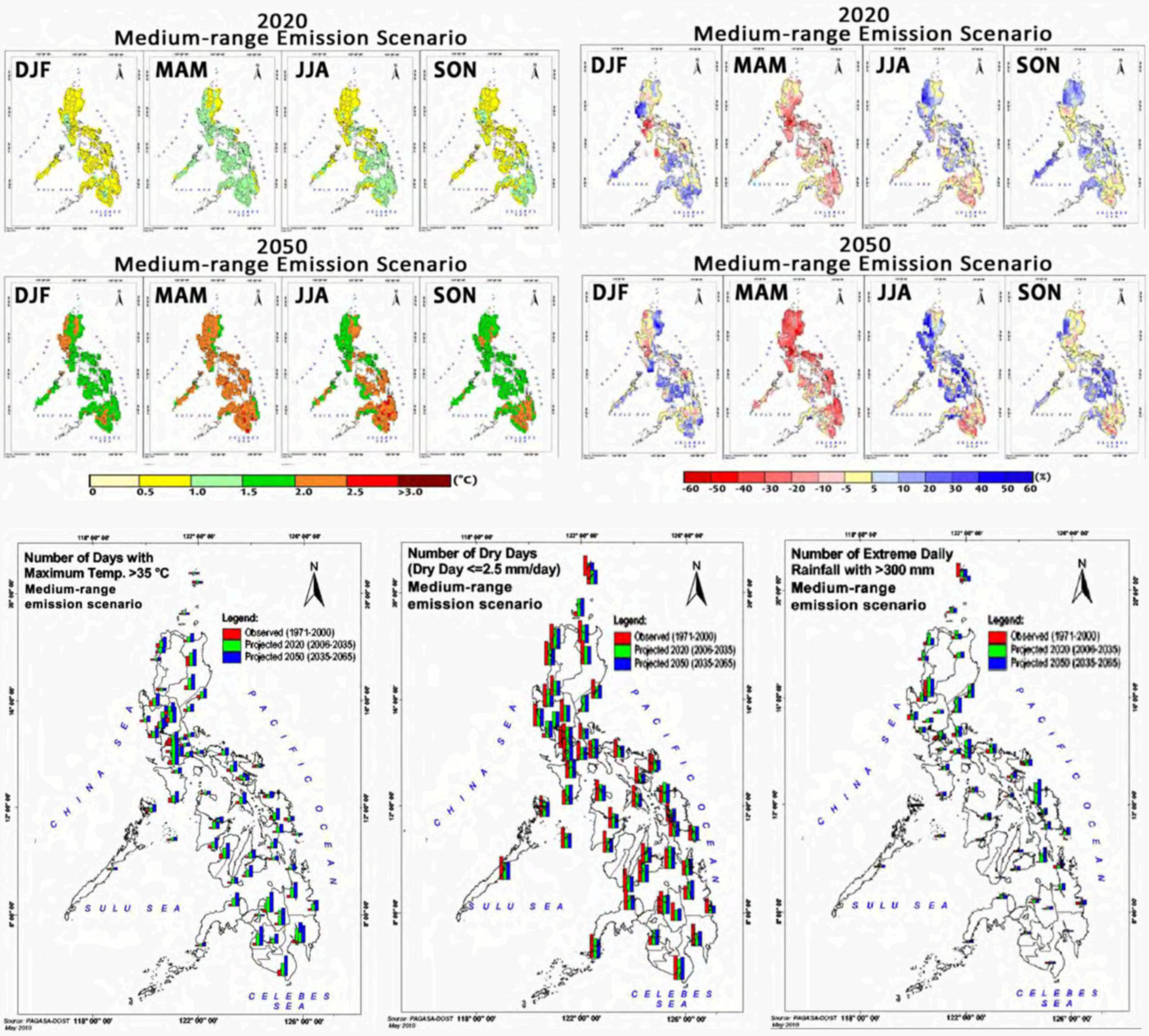
Increased temperatures also increase water use and demand of the population. In addition, the highest temperatures will likely occur during the dry season when water sources are typically depleted, furthering widening the gap between supply and demand.

- Likewise, all seasonal mean temperatures will increase during the four seasons (e.g., Dec-Jan-Feb [DJF], Mar-Apr-May [MAM], Jun-Jul-Aug [JJA] and Sep-Oct-Nov [SON]) and will be quite consistent in all the provinces.
- In terms of seasonal rainfall change, generally, there is a substantial spatial difference in the projected changes in rainfall in 2020 and 2050 in most parts of the Philippines, with reduction in rainfall in most provinces during the summer season (MAM) making the usually dry season drier*. Rainfall increases are likely in most areas of Luzon and Visayas during the southwest monsoon (JJA) and the SON seasons, making these seasons still wetter**, hence the likelihood of both droughts and floods in areas where these are projected.

** The already diminished yield of water sources during the dry season will be further reduced.*

*** Increased rainfall brings significant excess run-off which should be strategically stored (i.e., in impounding reservoirs, retention and detention basins) for future use. Flooding, a likely result of heavy rainfall, also poses various risks to WSS infrastructure and water supply delivery.*

- The northeast monsoon (DJF) season rainfall is projected to increase, particularly for areas with a Type II climate thus enhancing the potential for flooding.
- During the southwest monsoon season (JJA), significant increases in rainfall are expected in provinces in Luzon (0.9% to 63%) and Visayas (2% to 22%) but there will be generally decreasing trends in most provinces in Mindanao in 2050;
- Projections for extreme events in 2020 and 2050 show, however, that hot temperatures (indicated by the number of days with maximum temperature exceeding 35°C) will continue to become more frequent. The number of dry days (days with less than 2.5 mm of rain) will increase in all parts of the country. Heavy daily rainfall events (with rains exceeding 300mm) will also continue to increase in number in Luzon and Visayas.



(c) (d) (e)

Figure 16: PAGASA Projection Maps in 2020 and 2050[15]
(a) Projected seasonal temperature increase (in °C)
(b) Projected rainfall change (increase/decrease) in %
(c) Number of days with maximum temperatures exceeding 35 °C (current or observed)
(d) Current and projected number of dry days
(e) Current and projected extreme rainfall

[14] Climate Change in the Philippines, Feb 2011, PAGASA
[15] Ibid.

3

Demand

Philippine population stood at about 100,981,437 as of 2015.

A large percentage of the country's population is concentrated in Luzon.

The annual population growth rate for 2010 – 2015 was registered at 1.72%. From the 1.90% from 2000 – 2010, population growth has shown signs of slowing down.

At the regional level, CALABARZON has the largest population reaching 14.4 million, followed by NCR at 12.9 million, and Central Luzon with 11.2 million. On the other hand, the least populated regions are MIMAROPA with only 3 million, Caraga with 2.6 million and Cordillera Administrative Region (CAR) with only 1.7 million.

In regard to the population growth of the 33 highly-urbanized cities, four have been identified to have exceeded the one million mark. These are Quezon City, Manila, Davao City and Caloocan City. The least populated HUC's are Tacloban City, Olongapo City and City of San Juan.

Population Projection

Population projection is an important factor in estimating the future water and sanitation demand of a study area. It is a study of a recorded pattern of population growth seeking to establish future trends.

Population projections for the PWSSMP used PSA's 2010 Census-based projections as a primary basis. Available data were updated and adjusted to reflect the latest 2015 Census population figures from which quantitative data on future population were estimated.

PSA's projections employed the Cohort-Component Method based on the fact that demographic processes such as fertility, mortality, and migration affect and change population.

Projected growth rates up to the province levels are available until the year 2040. These figures were employed, updated and adjusted with the 2015 Census as the baseline date. Historical trends analyses were also conducted in the population projections.

Moreover, the percentage of rural and urban population is based on the 2010 Census of Population and Housing's classification of each barangay in the entire country. Based on the most recent release, a barangay is classified as urban if it meets any of the following:

- It has a population size of 5,000 or more.
- It has at least one establishment with a minimum of 100 employees.
- It has five or more establishments with 10 to 99 employees, and five or more facilities within the two-kilometer radius from the barangay hall.

A barangay which does not satisfy any of the criteria above is classified as rural.

In the absence of data, the percentage of urban and rural population determined from the 2010 CPH is assumed to be constant and is applied on the projected population until 2040.

Figure 17 shows the projected population per region by 2040. The country's total population is projected reach approximately 137 million by 2040.

The succeeding maps shows the projected increasing population per city/municipality in five-year intervals from the baseline 2015 to 2040.

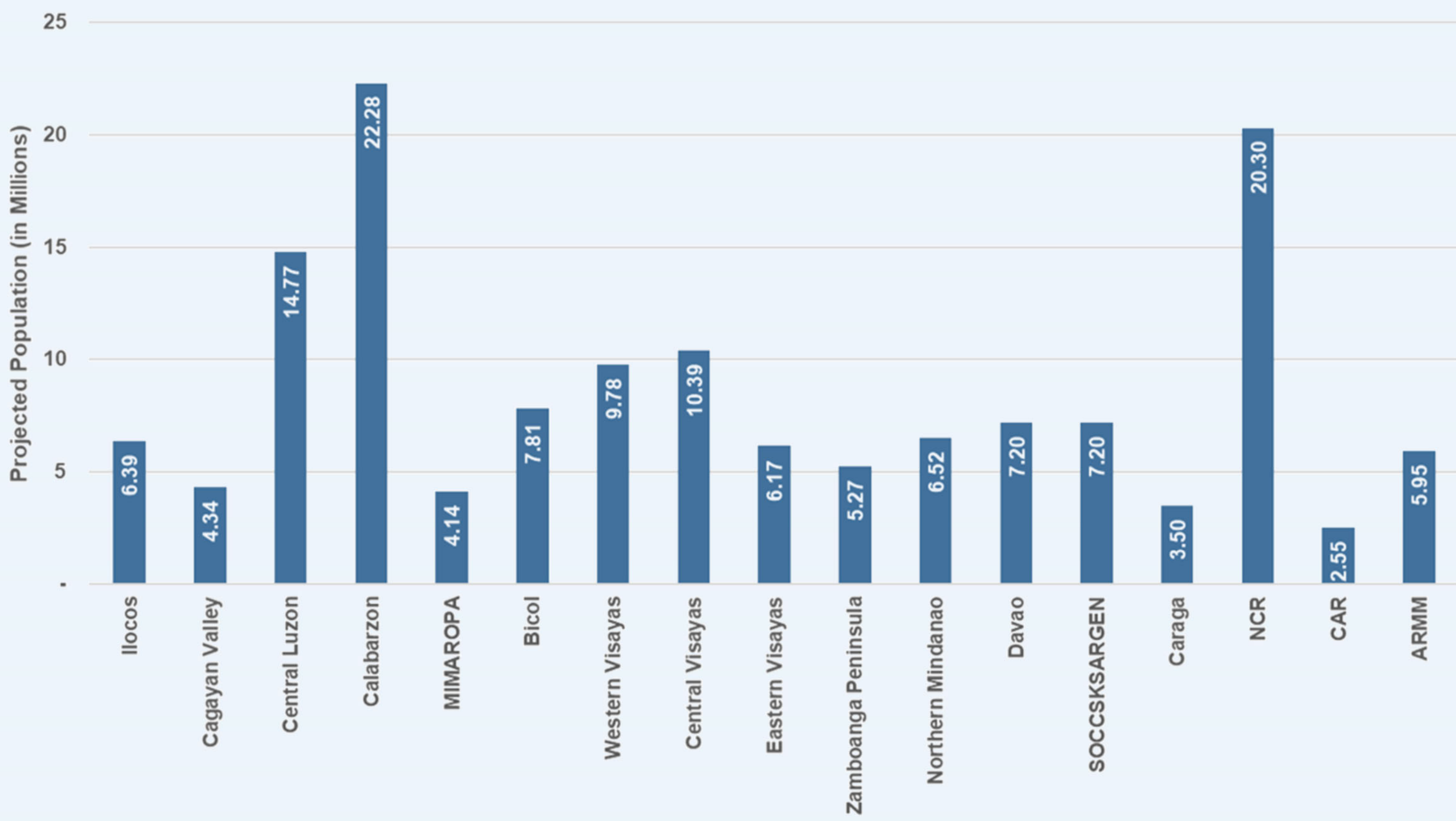
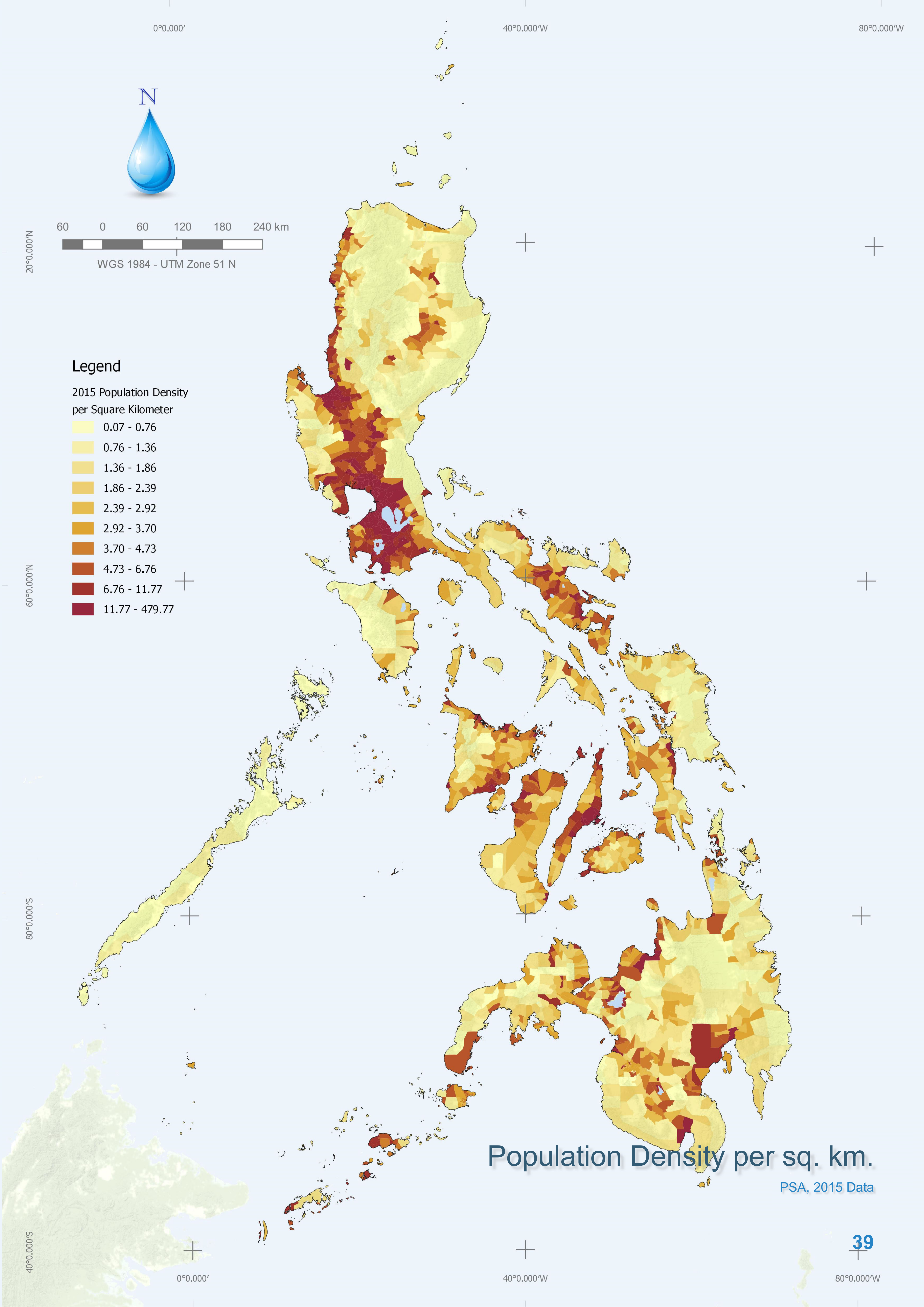
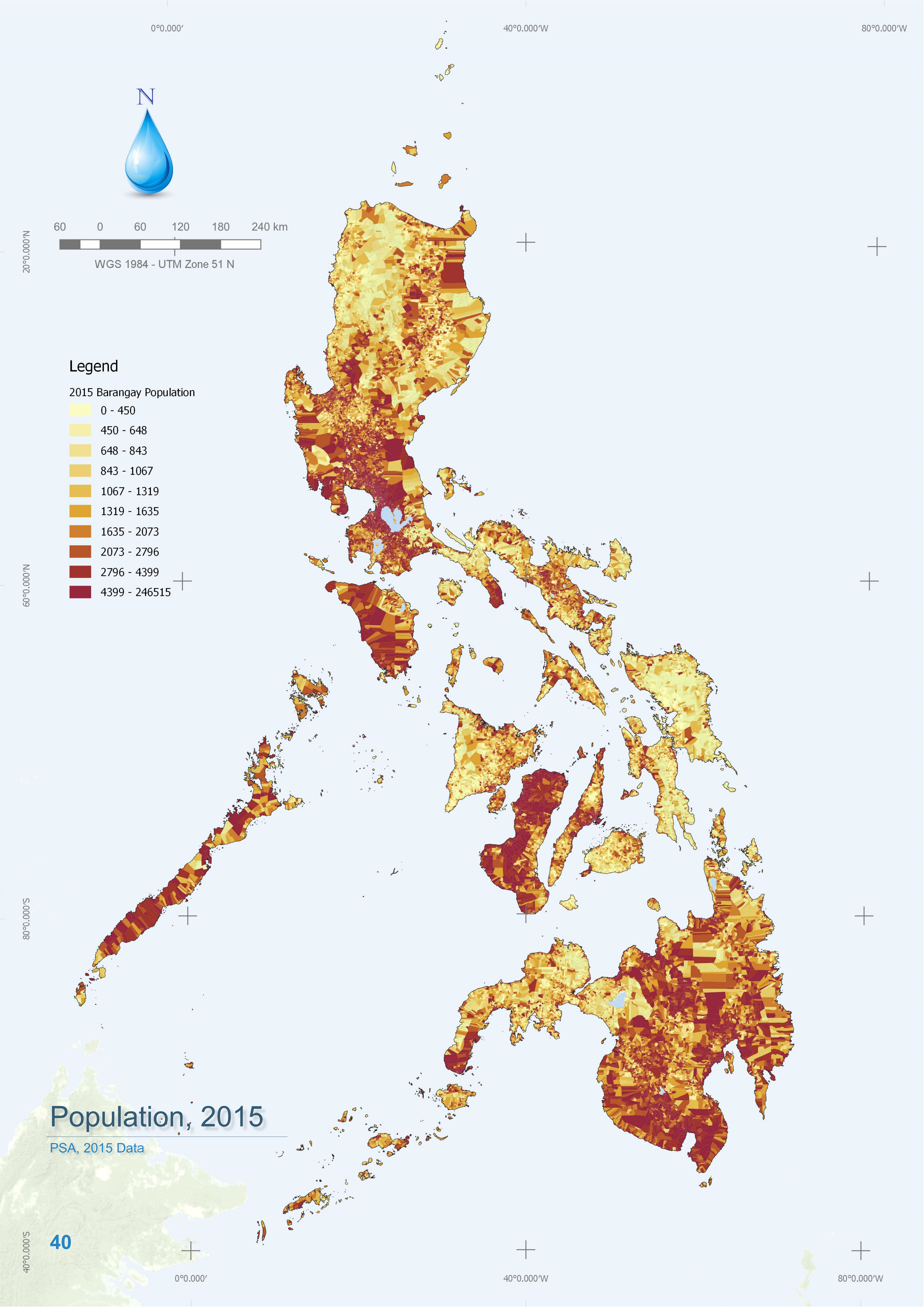


Figure 17: Population Projection per Region, 2040



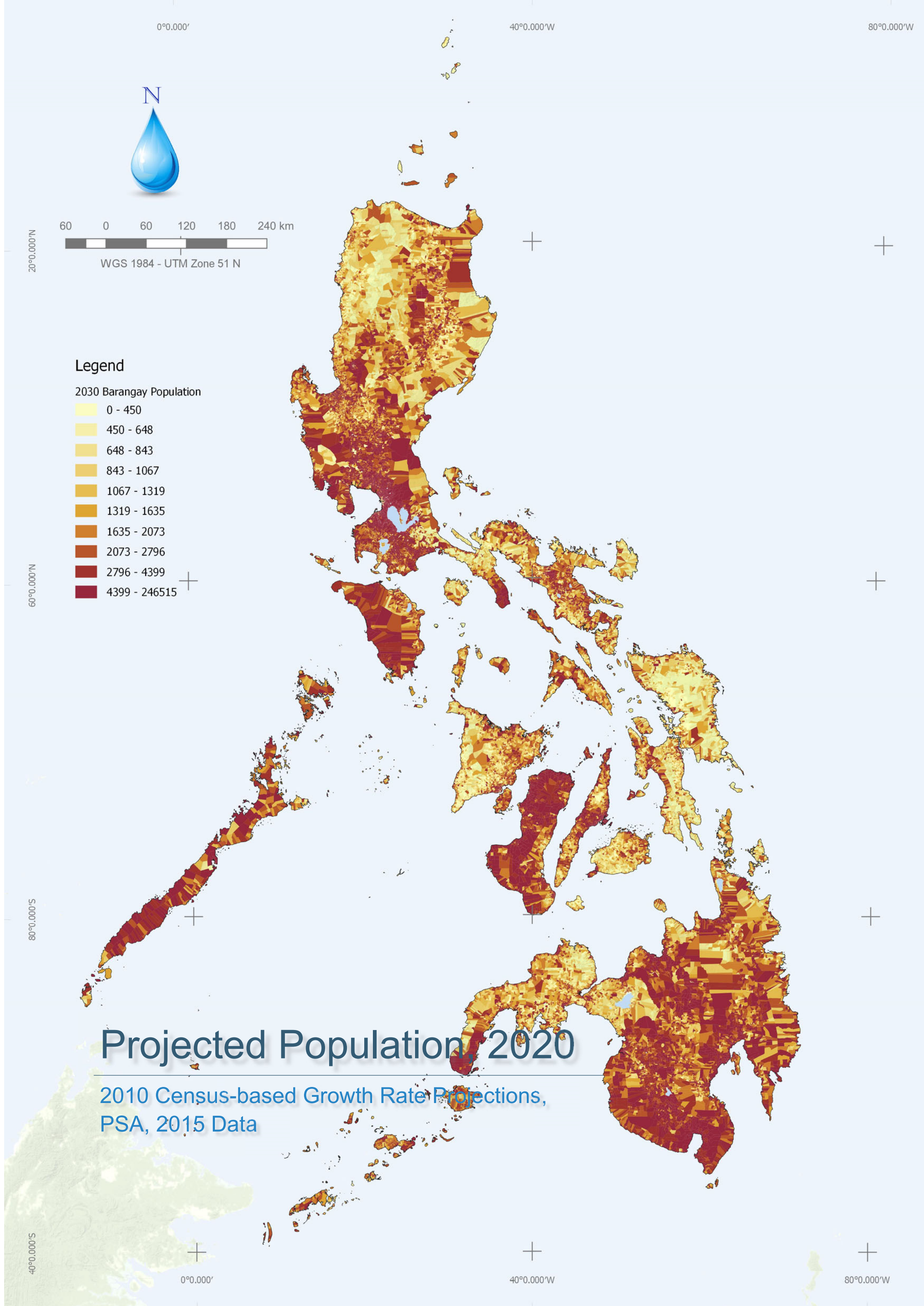
Population Density per sq. km.

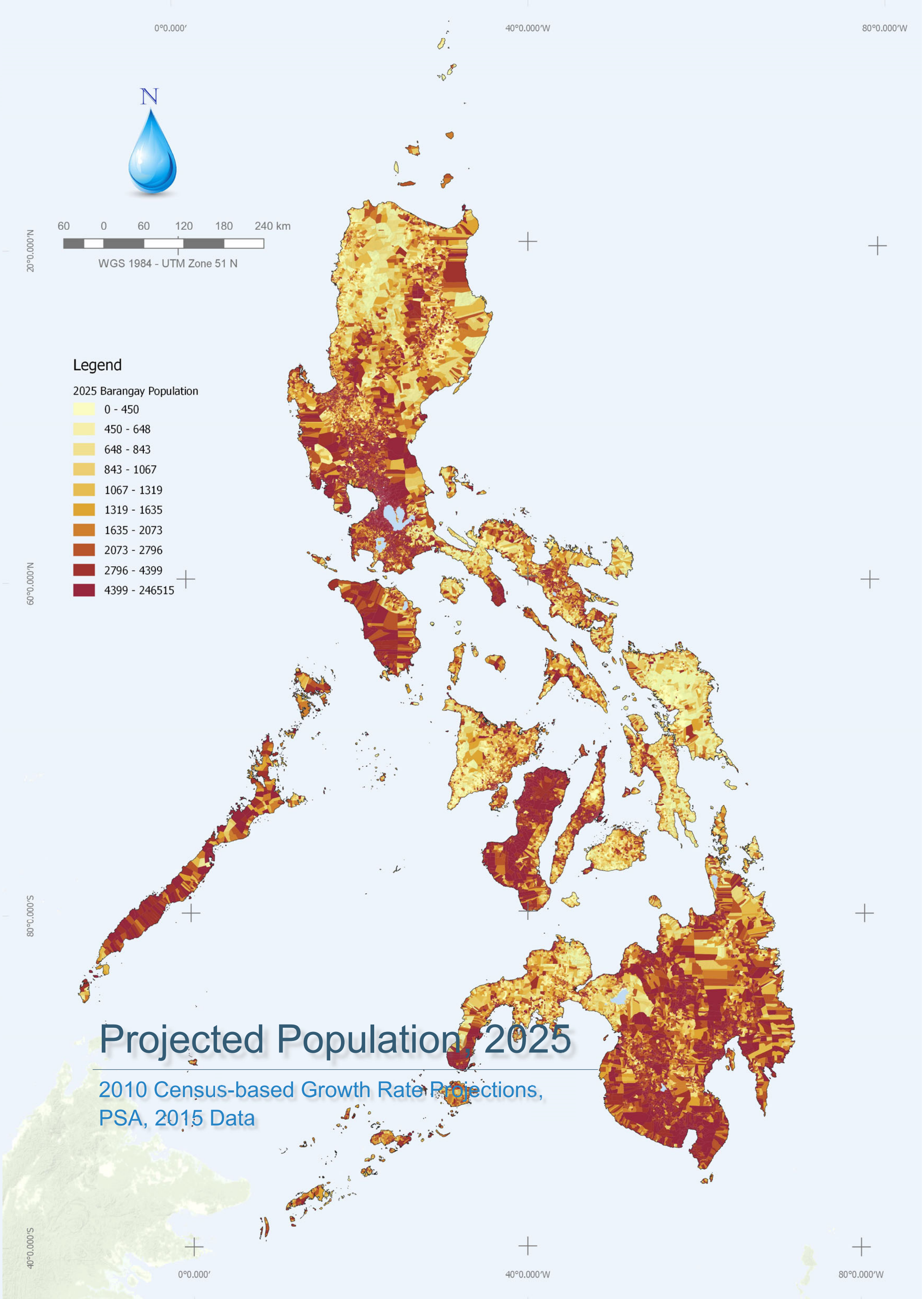
PSA, 2015 Data

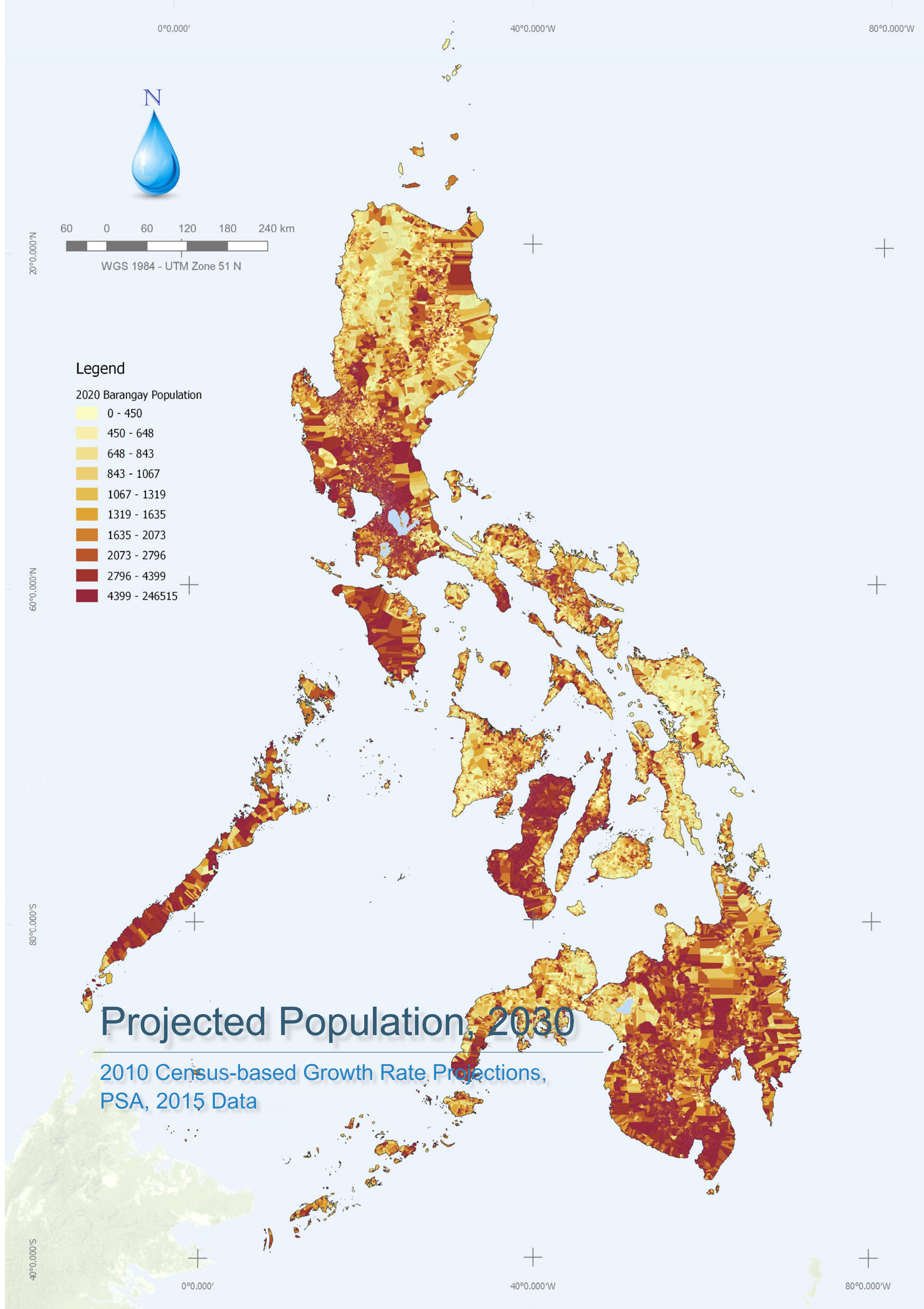


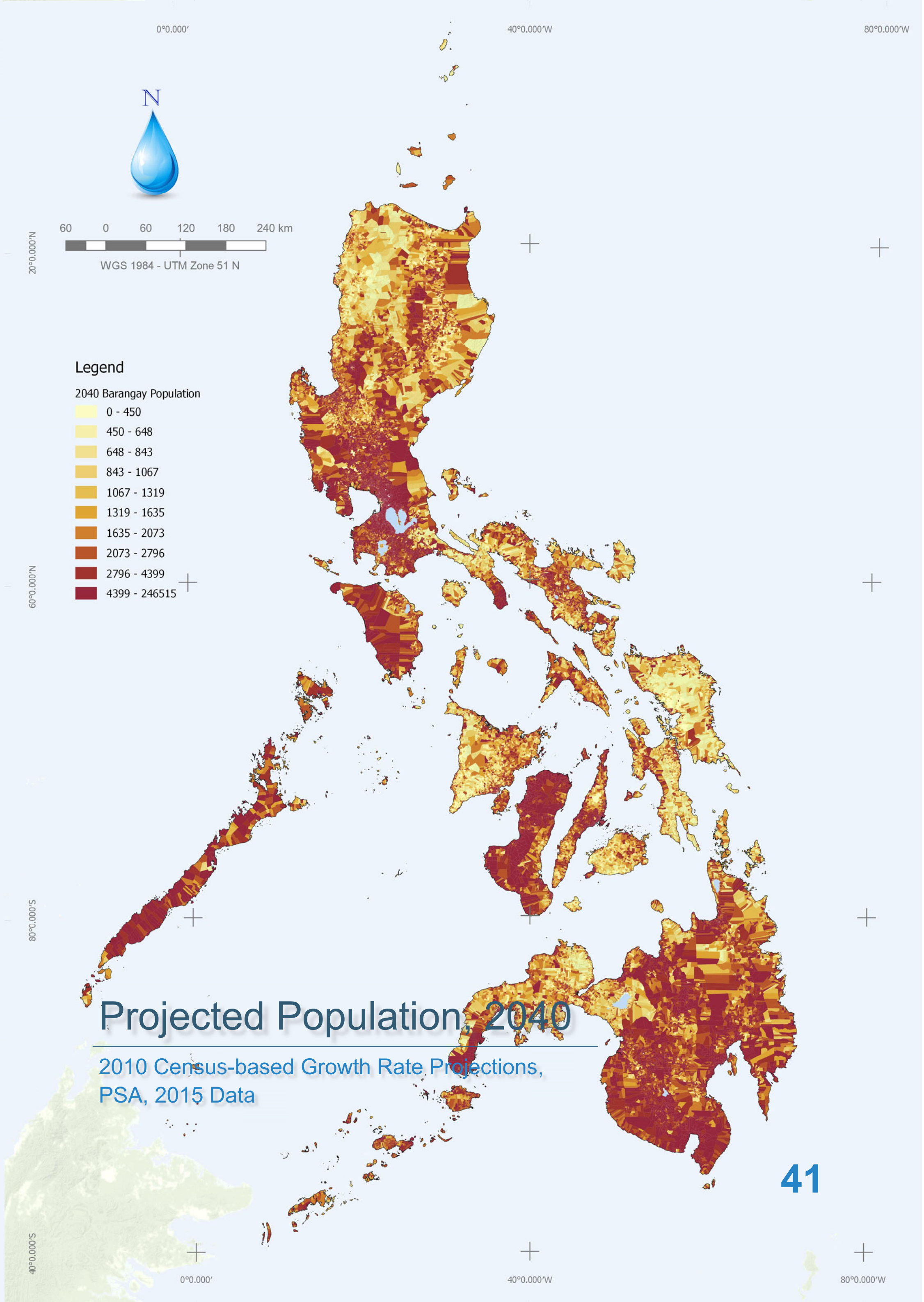
Population, 2015

PSA, 2015 Data


N
60 0 60 120 180 240 km
WGS 1984 - UTM Zone 51 N
Legend
2030 Barangay Population
0 - 450
450 - 648
648 - 843
843 - 1067
1067 - 1319
1319 - 1635
1635 - 2073
2073 - 2796
2796 - 4399
4399 - 246515
Projected Population, 2020
2010 Census-based Growth Rate Projections,
PSA, 2015 Data


N
60 0 60 120 180 240 km
WGS 1984 - UTM Zone 51 N
Legend
2025 Barangay Population
0 - 450
450 - 648
648 - 843
843 - 1067
1067 - 1319
1319 - 1635
1635 - 2073
2073 - 2796
2796 - 4399
4399 - 246515
Projected Population, 2025
2010 Census-based Growth Rate Projections,
PSA, 2015 Data


N
60 0 60 120 180 240 km
WGS 1984 - UTM Zone 51 N
Legend
2020 Barangay Population
0 - 450
450 - 648
648 - 843
843 - 1067
1067 - 1319
1319 - 1635
1635 - 2073
2073 - 2796
2796 - 4399
4399 - 246515
Projected Population, 2030
2010 Census-based Growth Rate Projections,
PSA, 2015 Data


N
60 0 60 120 180 240 km
WGS 1984 - UTM Zone 51 N
Legend
2040 Barangay Population
0 - 450
450 - 648
648 - 843
843 - 1067
1067 - 1319
1319 - 1635
1635 - 2073
2073 - 2796
2796 - 4399
4399 - 246515
Projected Population, 2040
2010 Census-based Growth Rate Projections,
PSA, 2015 Data

Water Demand Projection

Water demand projection is fundamental in preparing water supply feasibility studies and preliminary engineering designs. It also serves as an important tool in the preparation of master plans, considering the future needs of the growing population.

In general, the total water demand projected for the PWSSMP is equal to the sum of the domestic, commercial, institutional, and unaccounted-for water.

Primary considerations in the water demand projection for PWSSMP included population and the degree of urbanization in the study area. Additionally, the level of commercialization was also taken account.

Domestic Water Demand

Unit consumption for domestic water demand is expressed in per capita consumption per day. The commonly used unit is liters per capita per day (lpcd). Generally, urban areas are most commonly served by Level III water system facilities which ideally would have a better level of service, higher water pressure, and longer (if not round-the-clock) water availability. Hence, an urban population typically has higher water demand than a rural population relying mostly on Level I and Level II water systems and sources.

In projecting water demand, the unit consumption used is 120 lpcd for an urban population, and 60 lpcd for a rural population.

For highly urbanized areas, 150 lpcd and 80 lpcd are used for urban and rural populations, respectively.

As of 2015, the estimated demand for domestic use per day was recorded at 9.39 MCM.

Commercial Water Demand

To estimate commercial water demand, the relationship between the extent of commercial activities and the service area population is considered. Commercial demand varies from a minimum of 0.3 to a maximum of 1.2 cubic meters per day (m^3/day) per connection per 100 inhabitants with the more developed areas having the higher level of connection density. Unit consumption is estimated to increase until 2040.

This study assumed the range of 0.6 m^3/day to 1.6 m^3/day for an urban population and 0.5 m^3/day to 1.3 m^3/day for a rural population.

Estimated commercial water demand per day for 2015 was 0.71 MCM.

Institutional Water Demand

Institutional water consumers include schools, churches, public administration edifices, buildings, and hospitals. The present and proposed institutional establishments in the coverage areas should be considered in projecting institutional connections. With the lack of a complete and comprehensive inventory of institutions and establishments that would represent institutional connections, it can be assumed that for every 2,000 inhabitants in an area, one institutional connection exists.

Records of average consumption per institutional connection are also lacking, if not scarce. So unit consumption per connection may be assumed to have a demand of 7.5 m^3/day as suggested by LWUA.

Estimated institutional water demand per day for 2015 was recorded at 0.31 MCM.

Unaccounted-for Water

Usually, when projecting water demand in a study and in planning water supply projects, unaccounted-for water is considered. This usually represents wastage, leakage, and water losses, and is estimated as a fraction of the total water production of a water utility. For this study, unaccounted-for water is estimated at 25% of the total water demand, which is the percentage typically and universally used in water demand projections.

Totaling the 2015 domestic, commercial and institutional water demand figures, it is equivalent to about 10.41 MCM per day. Adding up the unaccounted-for water (25%), the total water demand per day for 2015 reached approximately 13.86 MCM.

By 2040, the country's total water demand is projected to be approximately 21.4 MCM per day.

The succeeding maps shows the projected water demand per city/municipality in five-year intervals from the baseline 2015 to 2040.

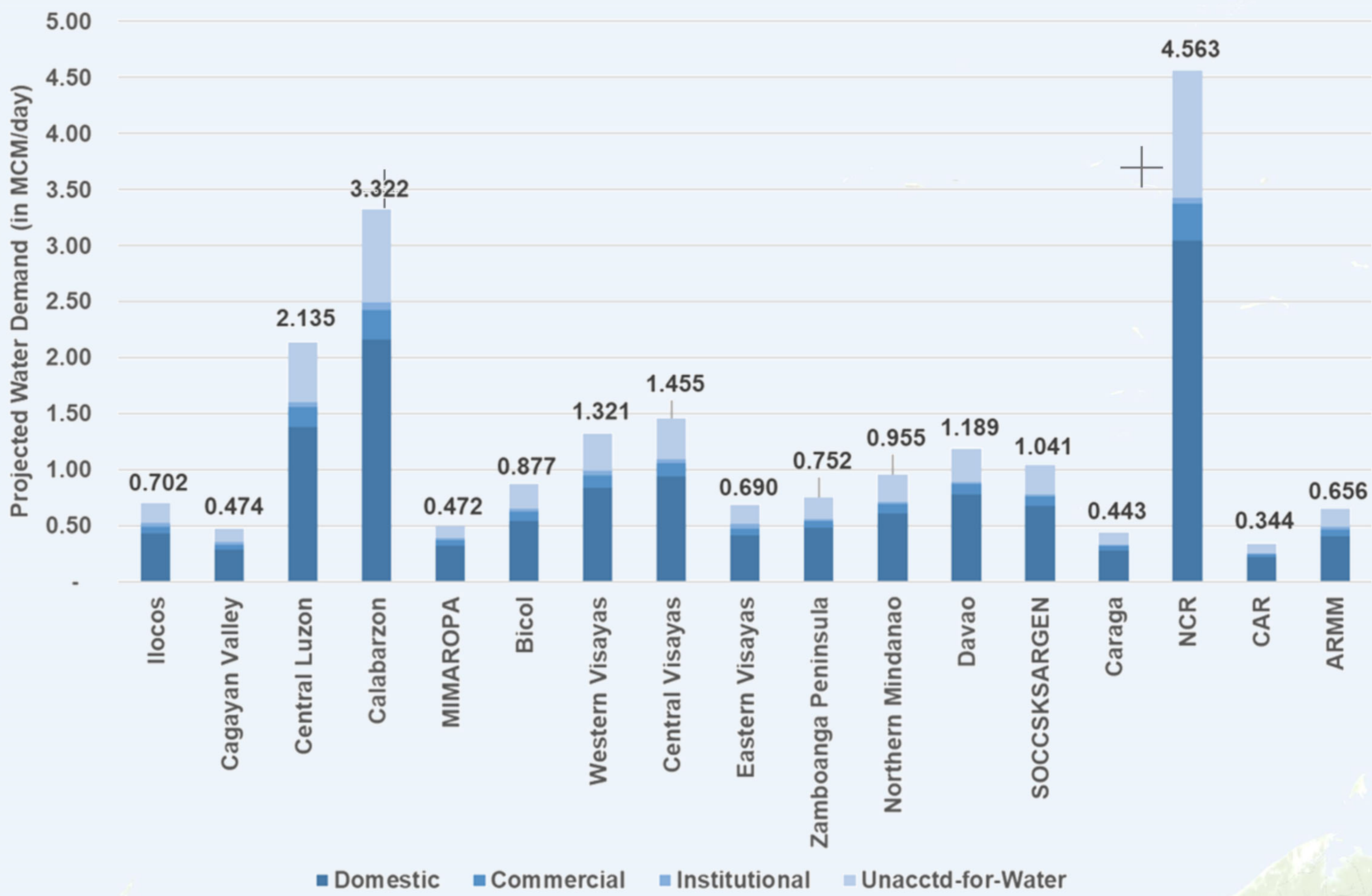
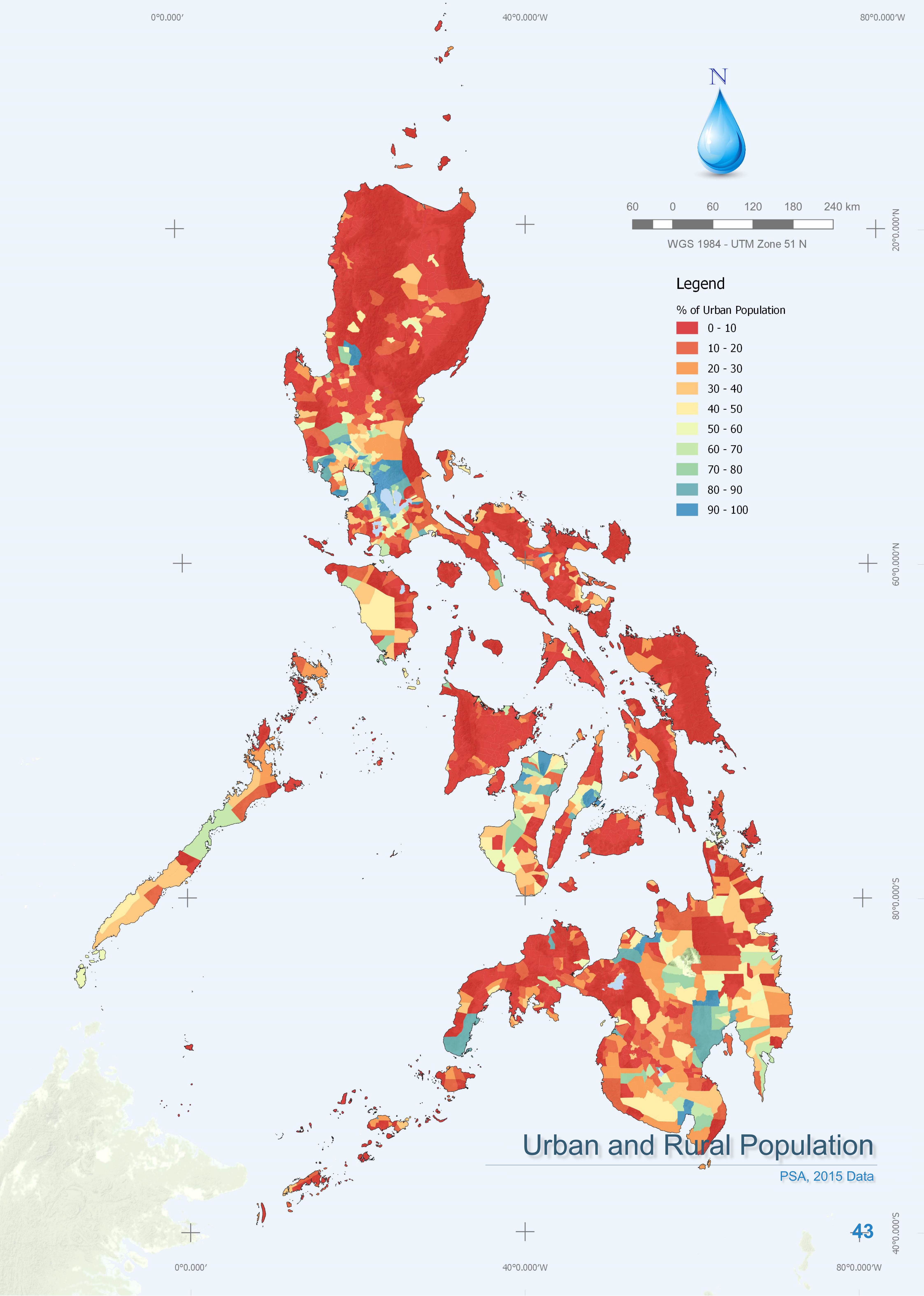
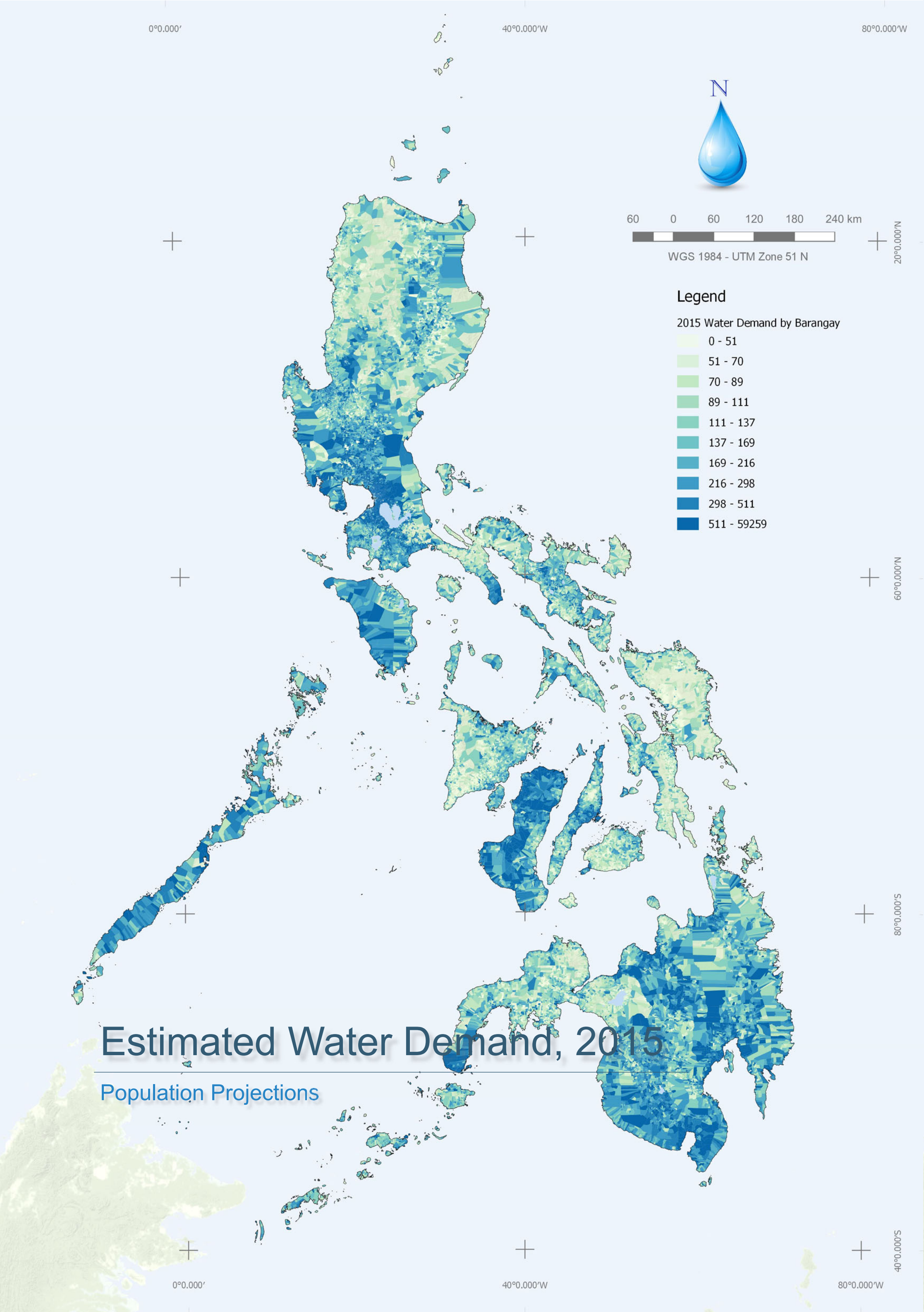


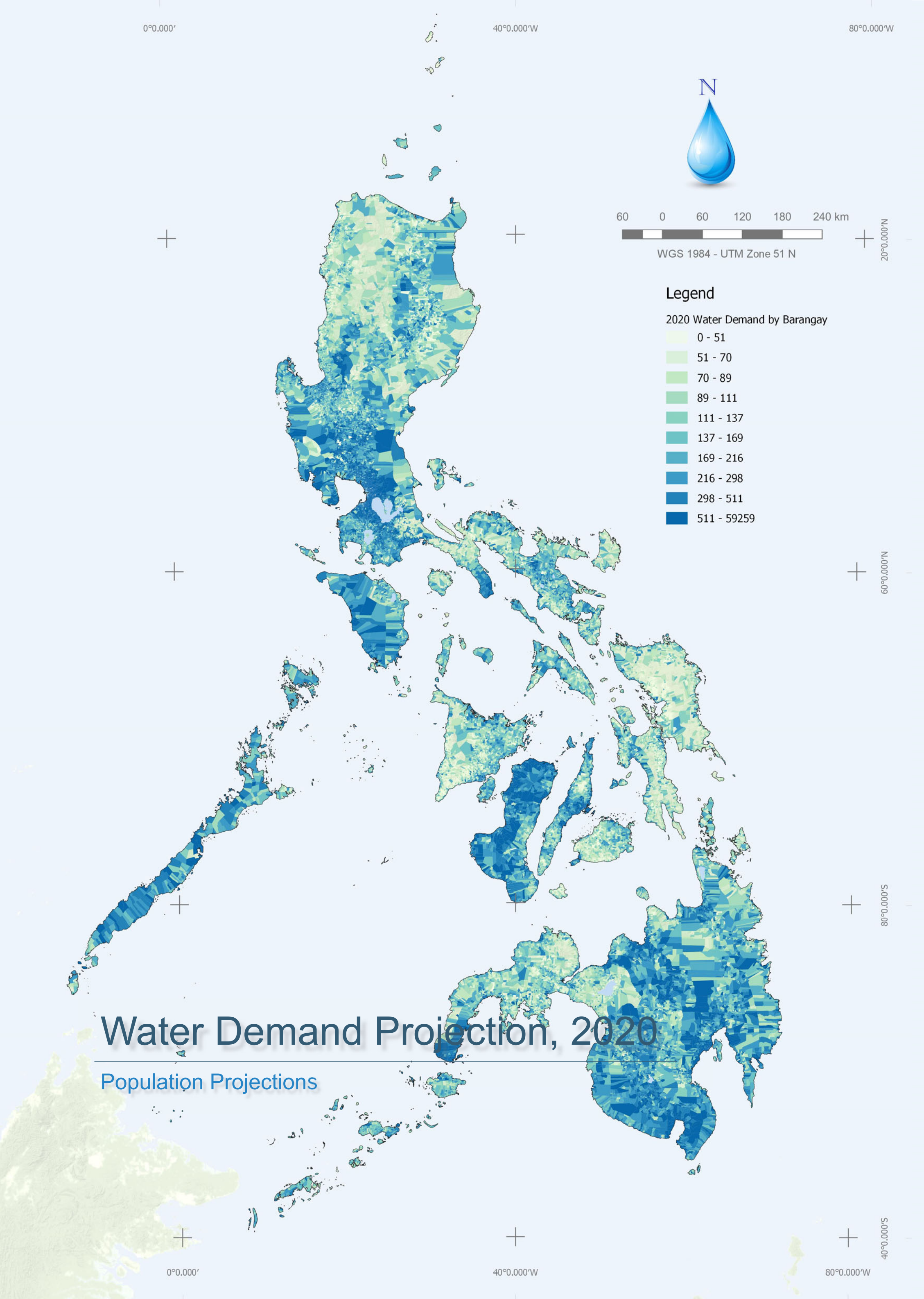
Figure 18: Water Demand Projection, 2040

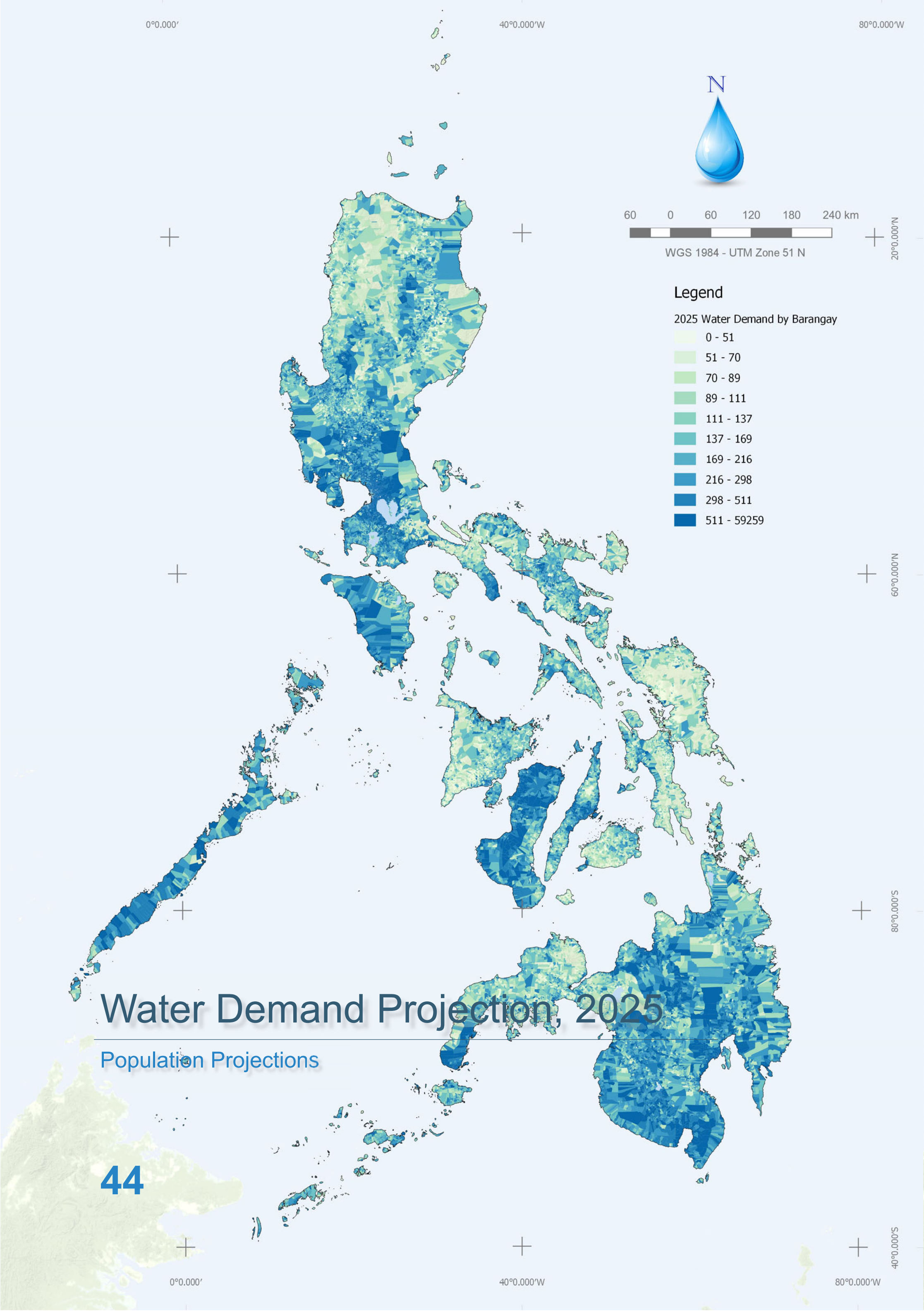


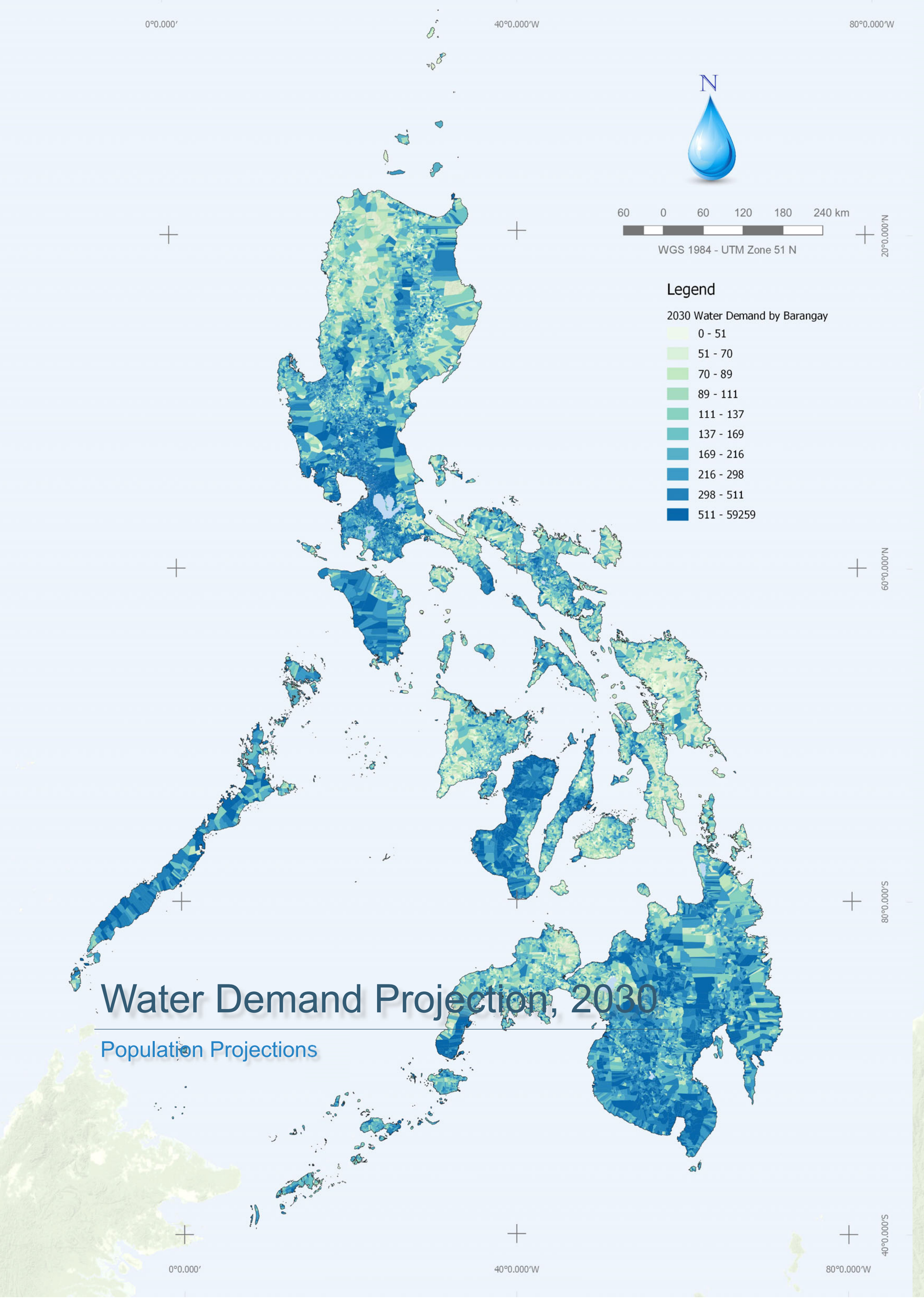
Urban and Rural Population

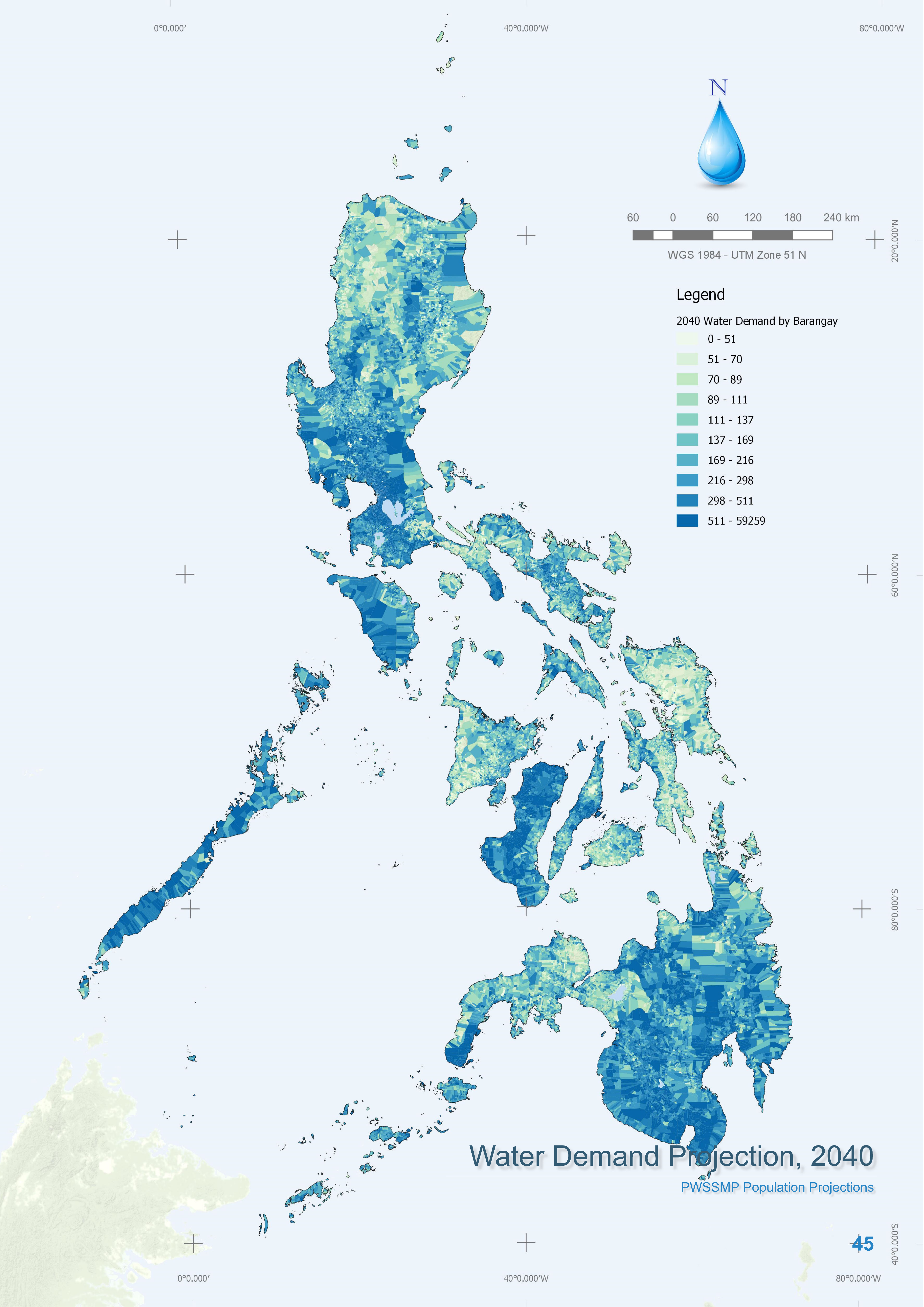
PSA, 2015 Data


N
60 0 60 120 180 240 km
WGS 1984 - UTM Zone 51 N
Legend
2015 Water Demand by Barangay
0 - 51
51 - 70
70 - 89
89 - 111
111 - 137
137 - 169
169 - 216
216 - 298
298 - 511
511 - 59259
Estimated Water Demand, 2015
Population Projections


N
60 0 60 120 180 240 km
WGS 1984 - UTM Zone 51 N
Legend
2020 Water Demand by Barangay
0 - 51
51 - 70
70 - 89
89 - 111
111 - 137
137 - 169
169 - 216
216 - 298
298 - 511
511 - 59259
Water Demand Projection, 2020
Population Projections


N
60 0 60 120 180 240 km
WGS 1984 - UTM Zone 51 N
Legend
2025 Water Demand by Barangay
0 - 51
51 - 70
70 - 89
89 - 111
111 - 137
137 - 169
169 - 216
216 - 298
298 - 511
511 - 59259
Water Demand Projection, 2025
Population Projections


N
60 0 60 120 180 240 km
WGS 1984 - UTM Zone 51 N
Legend
2030 Water Demand by Barangay
0 - 51
51 - 70
70 - 89
89 - 111
111 - 137
137 - 169
169 - 216
216 - 298
298 - 511
511 - 59259
Water Demand Projection, 2030
Population Projections



Water Demand Projection, 2040

PWSSMP Population Projections

4

Sanitation

Open Defecation

The Joint Monitoring Programme (JMP) for Water Supply, Sanitation and Hygiene of the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) defines open defecation as "the practice of defecating in fields, forests, bushes, bodies of water or other open spaces".

Open defecation can pollute the environment and cause health problems. According to the JMP, high levels of open defecation are linked to high child mortality, poor nutrition, poverty, and large disparities between rich and poor. It perpetuates the vicious cycle of disease and poverty and is widely regarded as an affront to human dignity. It poses risks to children's health and well-being and to public health.

The elimination of open defecation is recognized as a top priority for improving health, nutrition and productivity of developing country populations and is explicitly mentioned in SDG target 6.2. It is a challenge affecting millions of households nationwide.

The reasons for open defecation are varied. It can be a voluntary, semi-voluntary or involuntary choice. Most of the time, a lack of access to a toilet is the main reason. However, in some places even people with toilets in their homes prefer to defecate in the open.[16]

A few broad factors that result in the practice of open defecation are listed below:

- **Absence of Toilets** - People in most rural areas often have no toilets in their homes, or in the areas where they live. Lack of toilets in places away from people's homes, such as in schools or in the farms, compels people to defecate in the open. Also, in some rural communities, toilets are used for other purposes, such as storing household items, animals, and farm products or used as kitchens. Another example is a lack of public toilets in cities which can be a big problem for homeless people.
- **Uncomfortable or Unsafe Toilets** - Toilets in many rural homes and public toilets are broken or of poor quality. Some toilets are installed with no doors or cubicles hence the absence of privacy. In some communities, only unisex public toilets (i.e., those not separated by gender) can be accessed. The absence of running water inside or next to toilets forces people to fetch water somewhere else.
- **A "social norm"** - In some rural communities, people have preferred to defecate in the open (e.g., beside a river or stream, or among bushes) despite their access to toilets. In most cases, open defecation has become a way of life and a part of their cultural upbringing or ethnic tradition.

These issues concerning open defecation have been taken up in workshops conducted in all regions except NCR.

National Status

As of 2015, 4.23% of the country's population, or 4.27 million Filipinos, still practiced open defecation.

As of May 2015, the Philippines has triggered 677 barangays of which 473 (70%) have been certified Open Defecation-Free (ODF). The areas affected by super typhoon "Yolanda" in 2013 have been most successful with 364 barangays declared Zero Open Defecation (ZOD) out of 431 triggered (with an 84% success rate) at 2015.

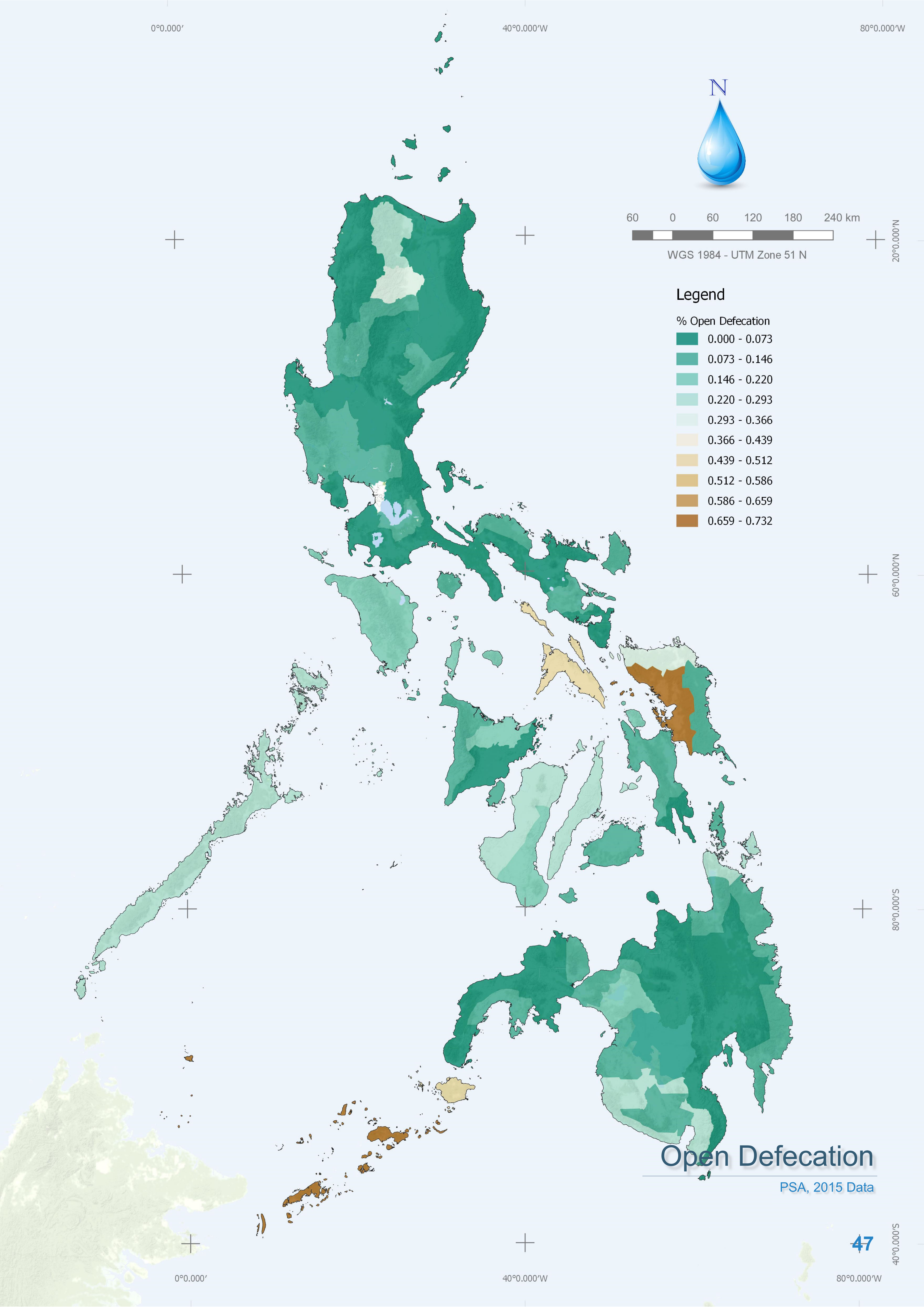
UNICEF's development program has a 29% success rate (101 triggered, 30 ODF). The Water and Sanitation Program has a 54% success rate (145 triggered, 79 ODF). Average triggering to ODF lasts from two to five months, but is longer for "difficult" barangays.

Development was accelerated by strictly enforcing sanitation action plans at the barangay level and focusing on LGU service delivery. In Yolanda-affected areas, where advocates of the Phased Approach to Total Sanitation (PhATS) are appointed to barangay positions, triggering to ODF self-declaration can be achieved in two to six weeks – but these areas have reaped benefits from massive investment and support from civil society organizations (CSOs), which are also UNICEF implementing partners, to achieve these results.

ARMM has constantly topped the list of regions where open defecation is practiced. As of 2015, about 18% of its population had no access to sanitation facilities. The Bicol Region and Eastern Visayas ranked second and third with 12% and 10%, respectively, of their population practicing open defecation.

Regions with less than 1% of the population practicing open defecation include NCR, Cagayan Valley, and Central Luzon. The map on the right gives a quick view of areas in the country's regions where open defecation is most prevalent.

[16] *Sustainability and CLTS: Taking Stock Frontiers of CLTS: Innovations and Insights Issue 4*



0°0.000′
40°0.000′W
80°0.000′W
N
60
0
60
120
180
240 km
WGS 1984 - UTM Zone 51 N
20°0.000′N
Legend
% Open Defecation
0.000 - 0.073
0.073 - 0.146
0.146 - 0.220
0.220 - 0.293
0.293 - 0.366
0.366 - 0.439
0.439 - 0.512
0.512 - 0.586
0.586 - 0.659
0.659 - 0.732
60°0.000′N
80°0.000′S
Open Defecation
PSA, 2015 Data
40°0.000′S
0°0.000′
40°0.000′W
80°0.000′W

Wastewater and Domestic Biological Oxygen Demand

Wastewater produced by the domestic, industrial and agriculture sectors contributes significantly to environmental and water pollution. But wastewater is now regarded as a resource (rather than a waste product) to meet the huge water requirements of households, businesses and industries.

By using treated wastewater, the amount of waste that is usually released to the environment is cut down thus enabling the government not only to reduce health risks but also to use fewer water resources.

A measure of the organic strength of wastes in water is biological oxygen demand (BOD), which is the rate at which organisms use the oxygen in water or wastewater while stabilizing decomposable organic matter under aerobic conditions. The greater the BOD, the greater the degree of organic pollution.

Wastewater generation can generally be estimated per sector. Domestic wastewater, for example, is estimated to be 80% of the total domestic water demand for both urban and rural areas. Domestic BOD generation, on the other hand, is calculated by multiplying the population with a BOD factor of 37 grams per person per day (unit pollution load). This BOD factor is assumed to be the national average and is applied to all regions except Metro Manila. Owing to the much more extensive activities in the country's business center, a BOD factor of 53 grams per person per day is used for Metro Manila.

Industrial and agricultural wastewater generation may be estimated using the guidelines provided by the WHO Rapid Assessment of Sources of Air, Water, and Land Pollution. Estimations, however, heavily depend on sectoral data not currently available to the Consulting Team. Industrial wastewater is computed by industry type and is dependent on the present and future annual volume of production output per type. Agricultural wastewater generation and BOD estimation, on the other hand, are based on the present and future annual number of heads of livestock and poultry produced.

In view of this, the sanitation demand of the latter two sectors could not be projected owing to a lack of relevant data. The domestic sanitation demand, though, is adequately projected.

Total wastewater by 2040 is projected to amount to 17 MCM per day (see Figure 19). On the other hand, domestic BOD is estimated at 5,876 metric tons per day (see Figure 20).

The succeeding maps shows the projected wastewater and domestic biological oxygen demand per city/ municipality in five-year intervals from the baseline 2015 to 2040.

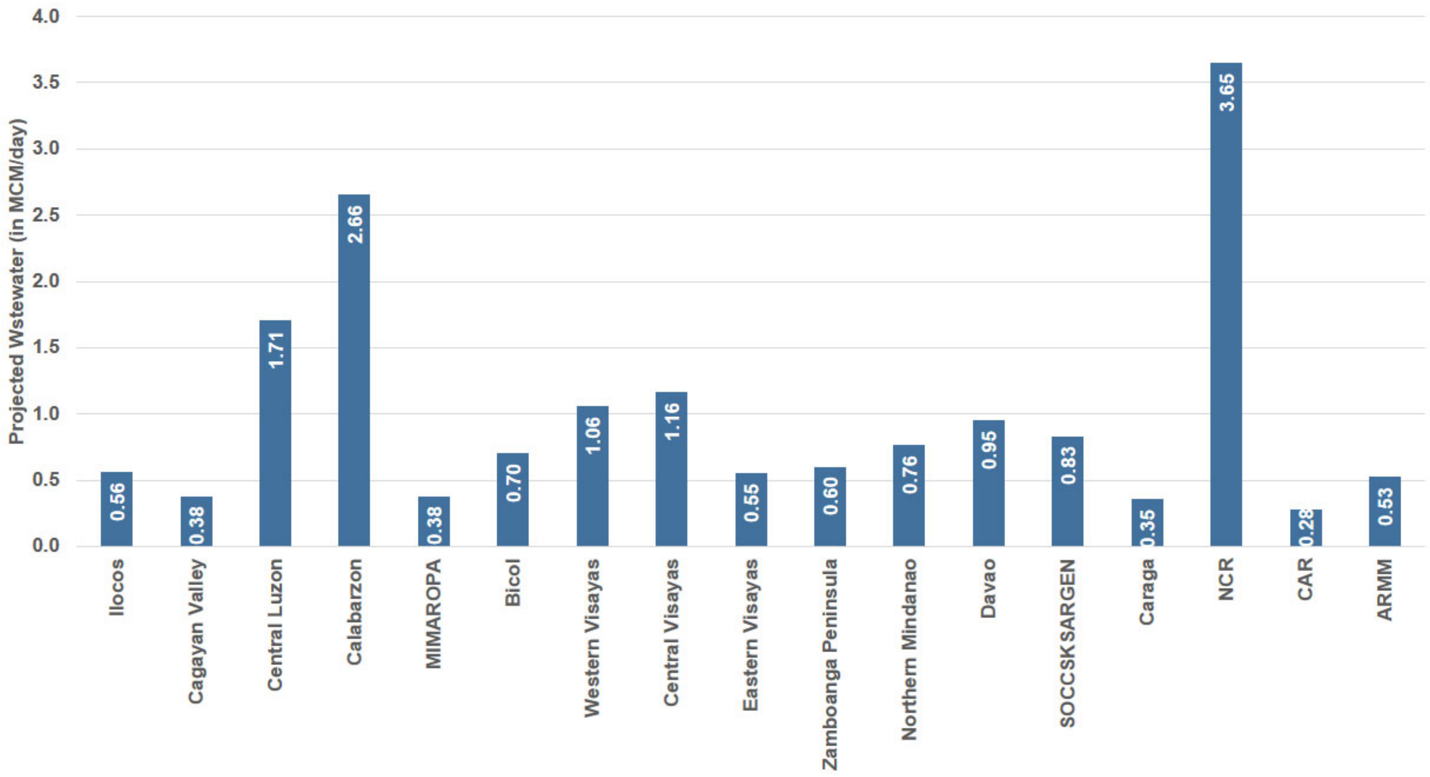


Figure 19: Wastewater Projection Per Region, 2040

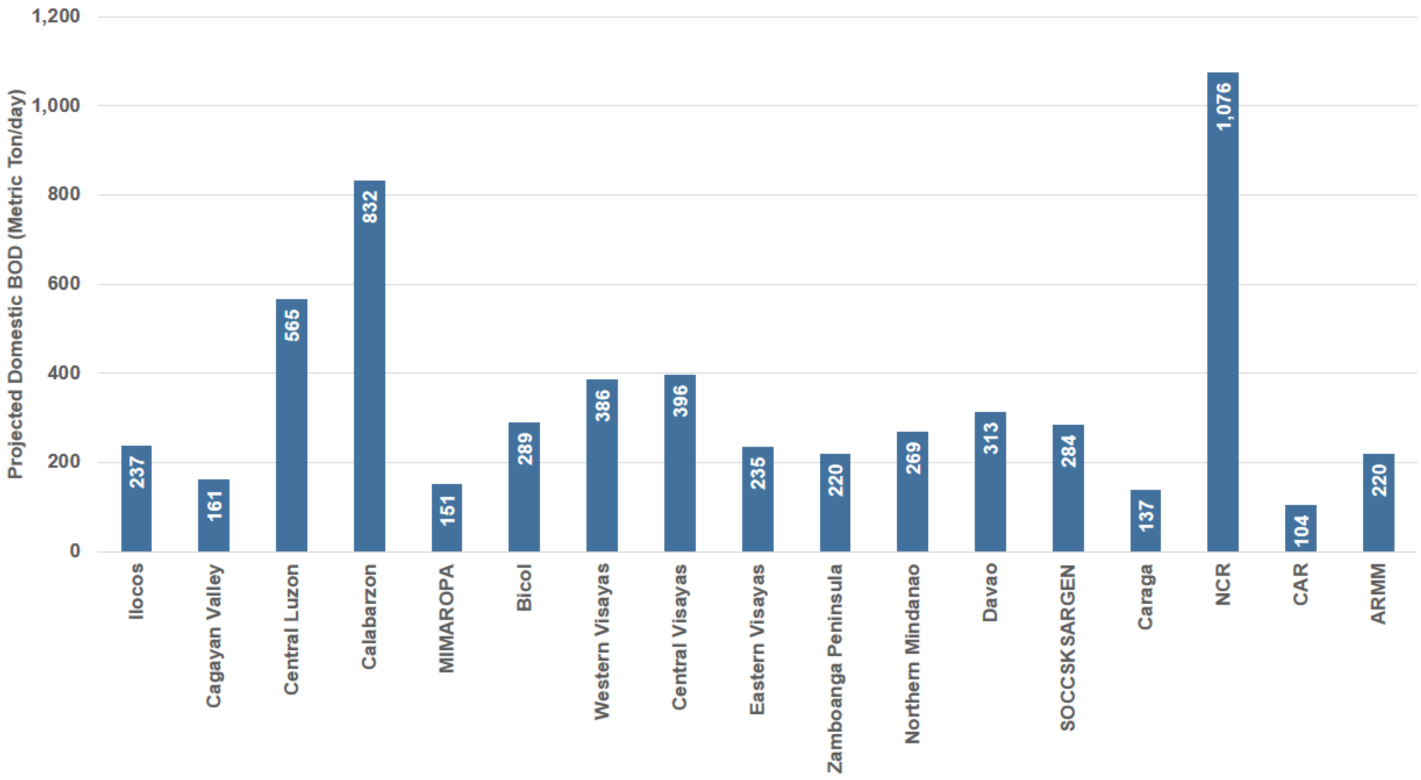
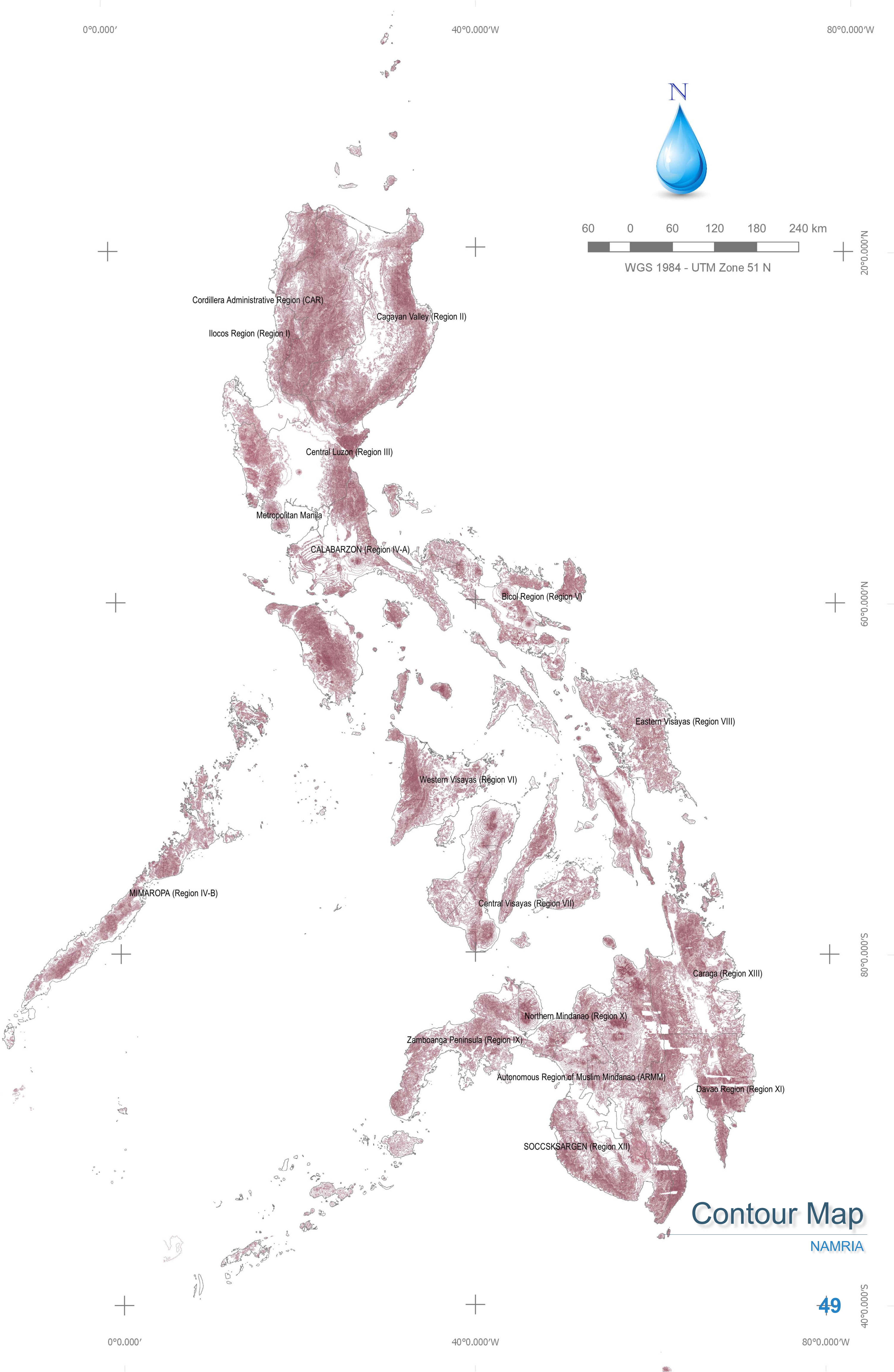
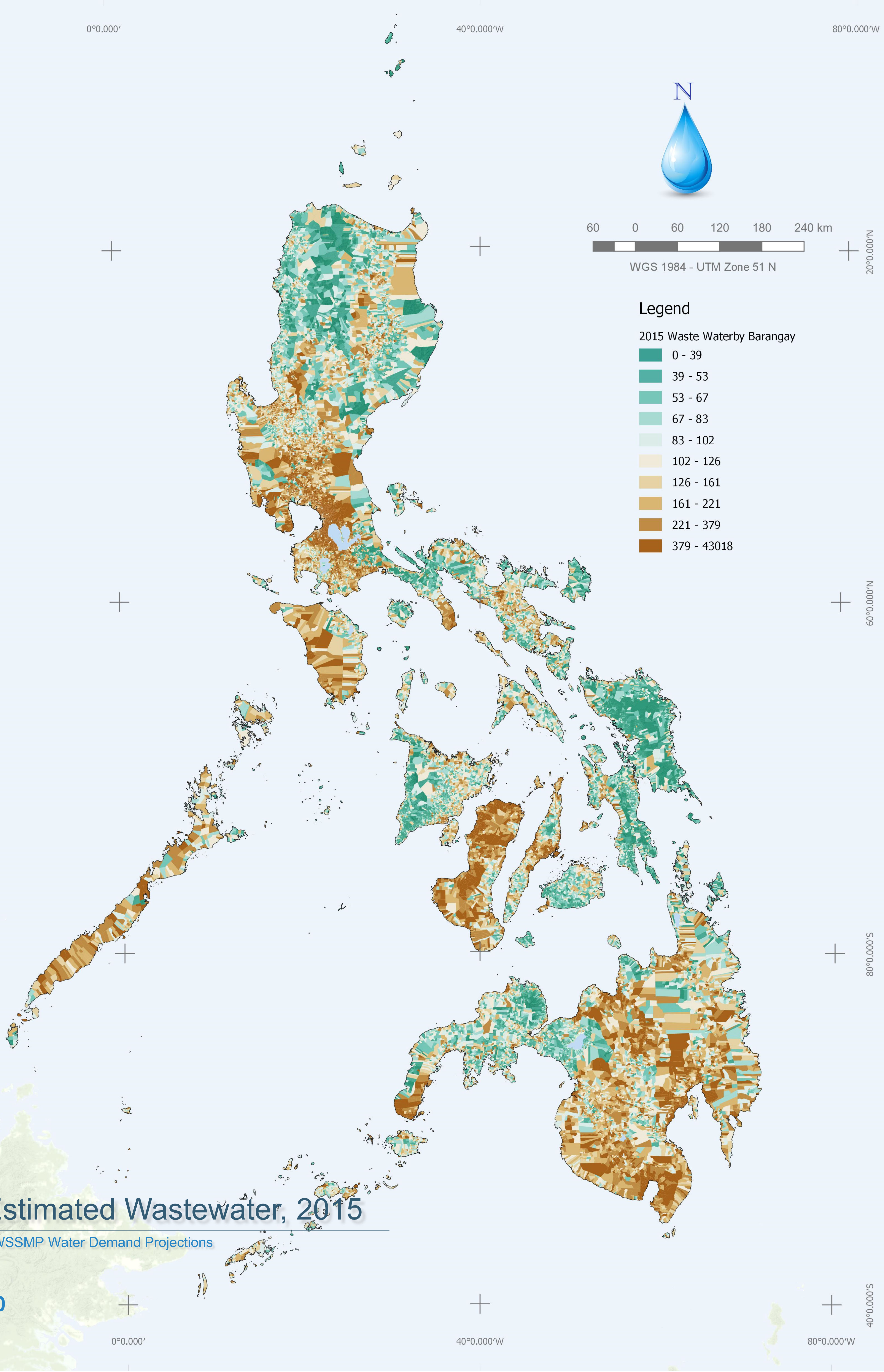


Figure 20: Domestic BOD Projection per Region, 2040



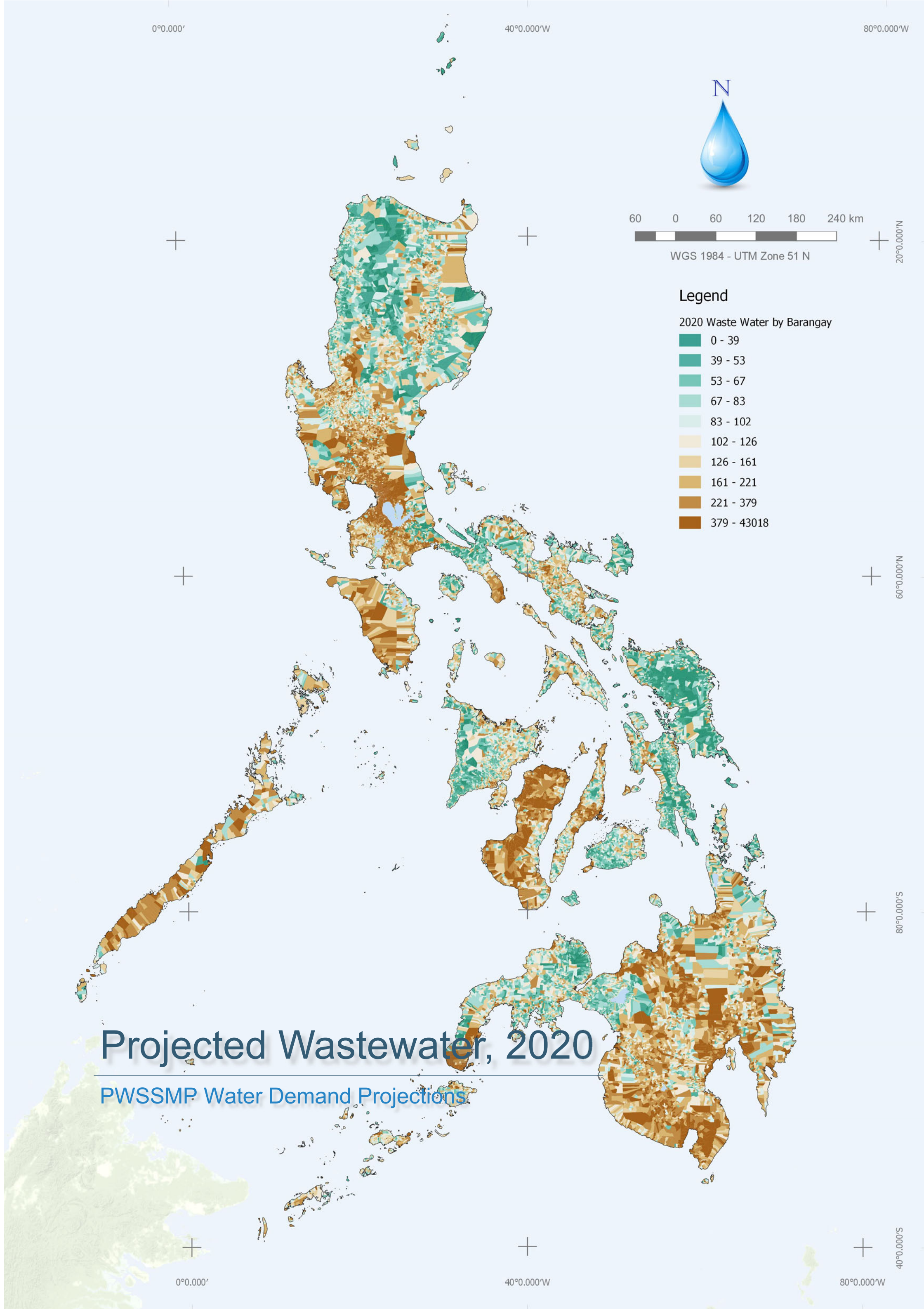
Contour Map

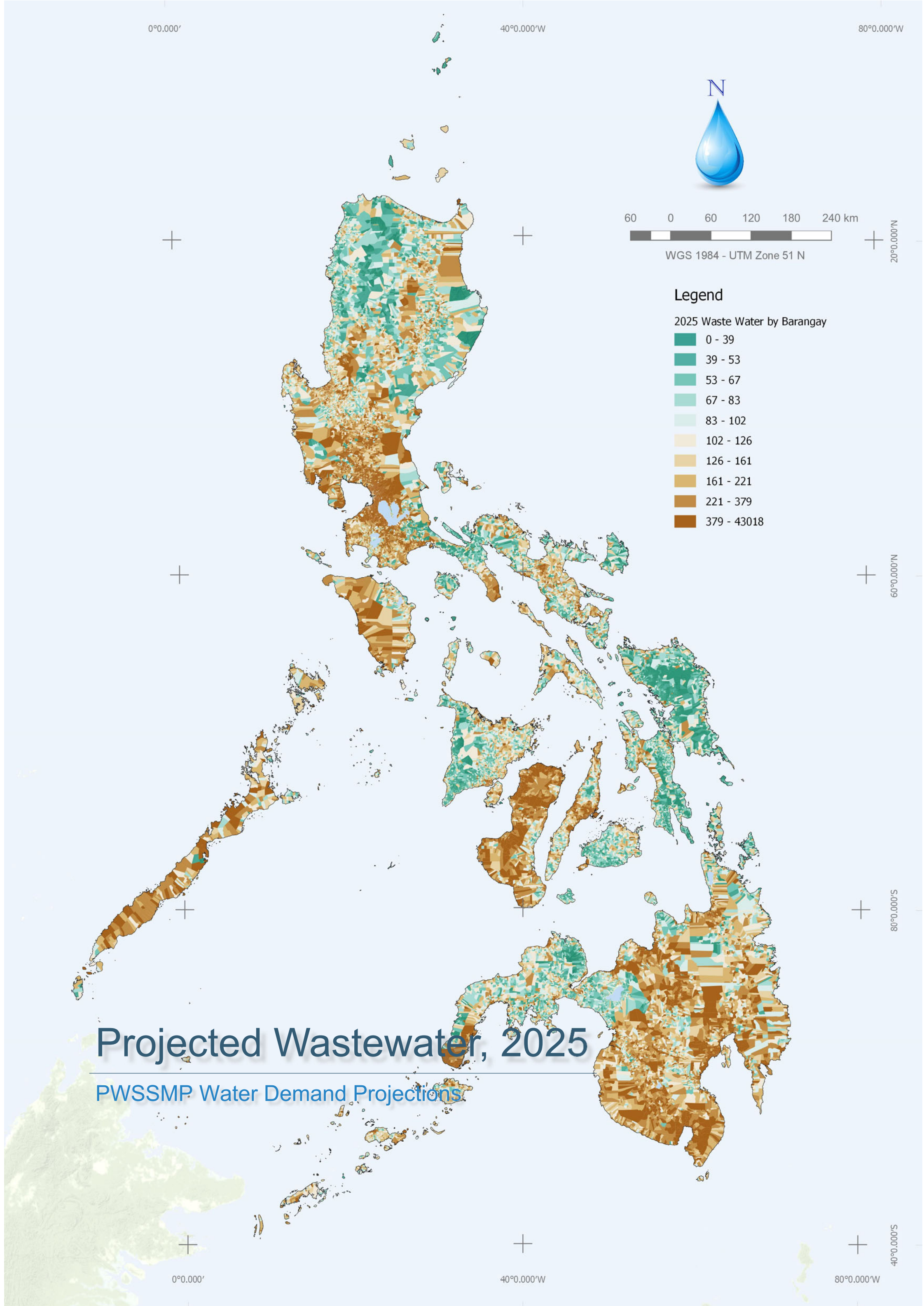
NAMRIA



Estimated Wastewater, 2015

PWSSMP Water Demand Projections


Projected Wastewater, 2020
PWSSMP Water Demand Projections
N
60 0 60 120 180 240 km
WGS 1984 - UTM Zone 51 N
Legend
2020 Waste Water by Barangay
0 - 39
39 - 53
53 - 67
67 - 83
83 - 102
102 - 126
126 - 161
161 - 221
221 - 379
379 - 43018


Projected Wastewater, 2025
PWSSMP Water Demand Projections
N
60 0 60 120 180 240 km
WGS 1984 - UTM Zone 51 N
Legend
2025 Waste Water by Barangay
0 - 39
39 - 53
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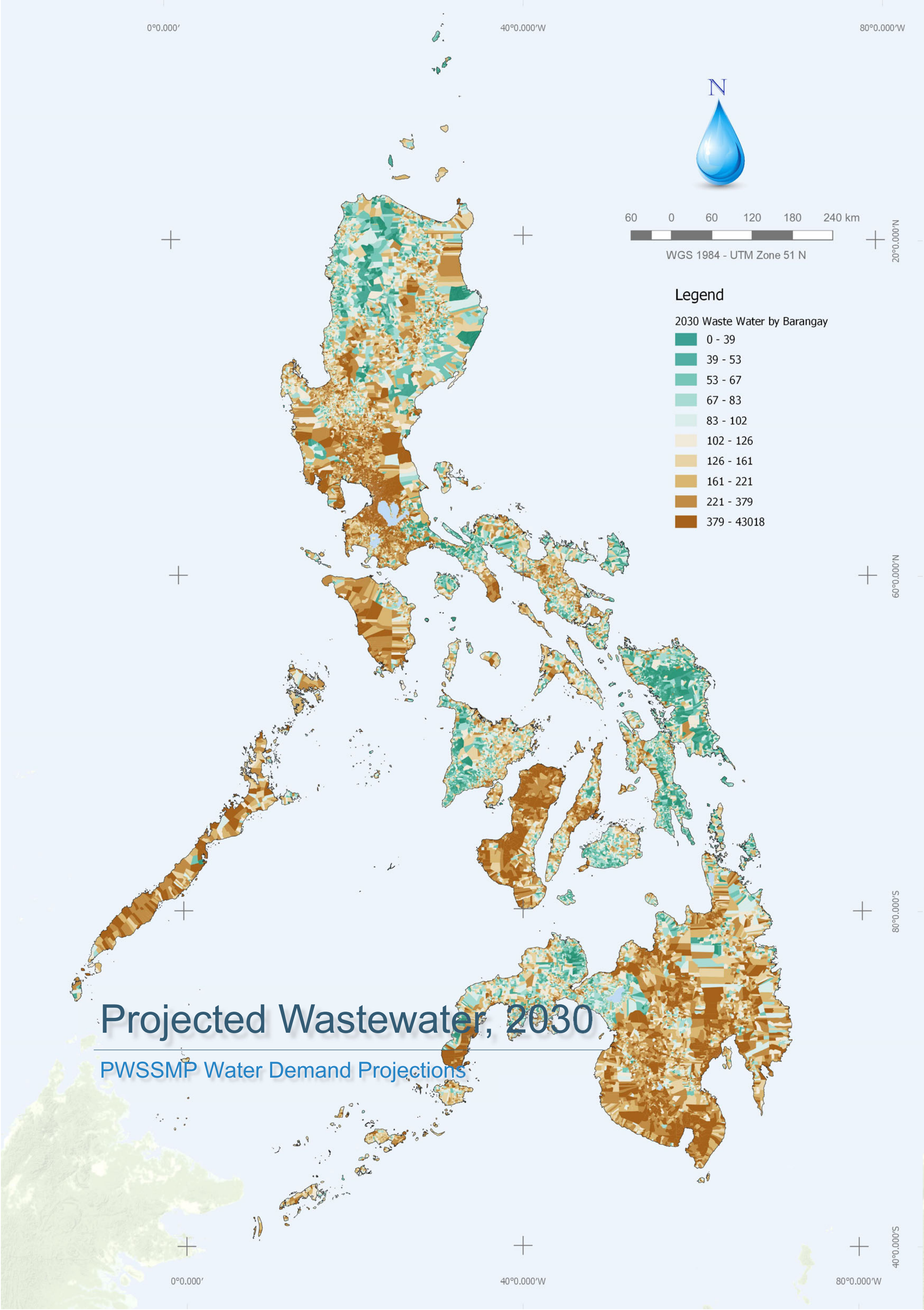
221 - 379
379 - 43018


Projected Wastewater, 2030
PWSSMP Water Demand Projections
N
60 0 60 120 180 240 km
WGS 1984 - UTM Zone 51 N
Legend
2030 Waste Water by Barangay
0 - 39
39 - 53
53 - 67
67 - 83
83 - 102
102 - 126
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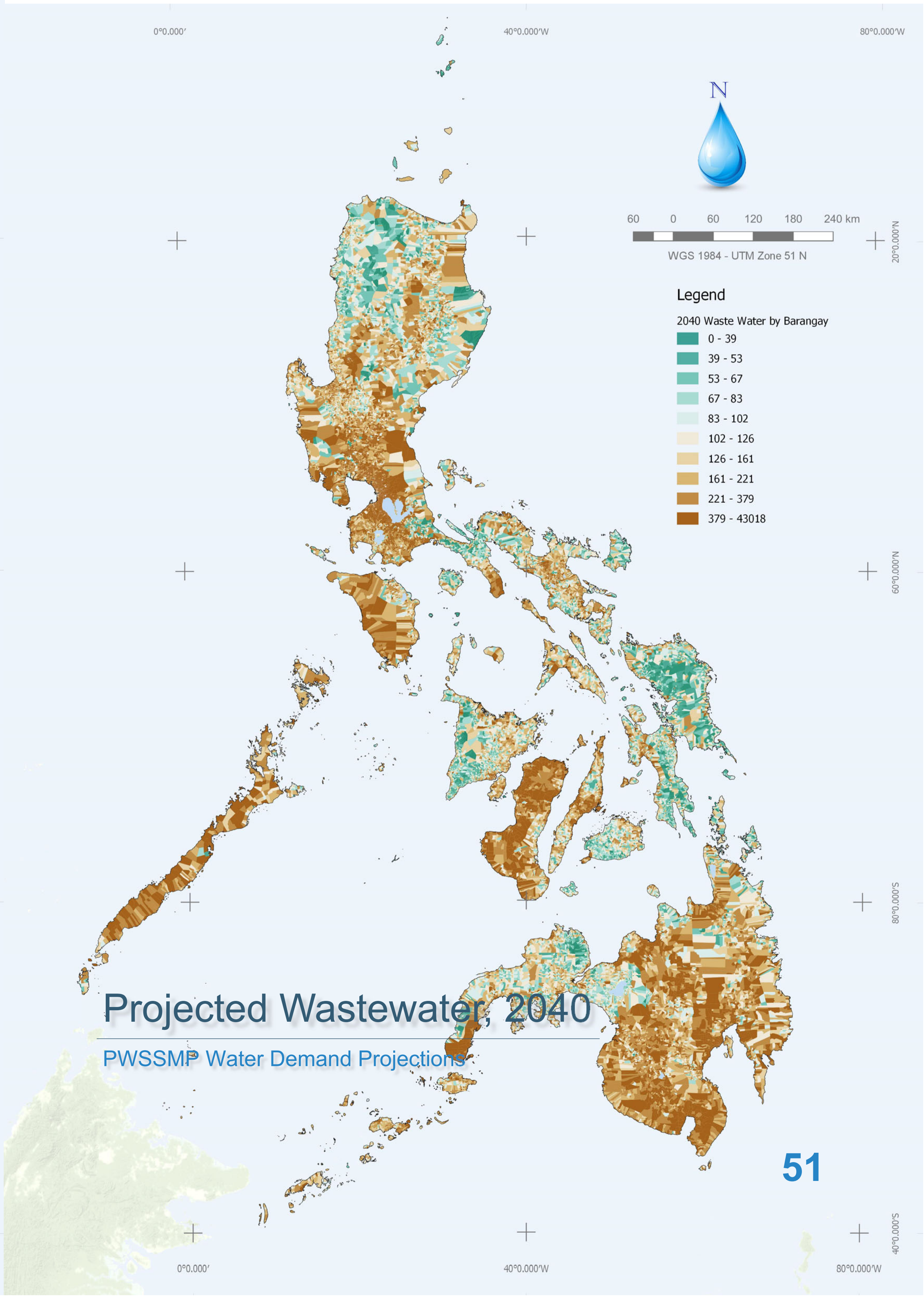
Projected Wastewater, 2040
PWSSMP Water Demand Projections
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Legend
2040 Waste Water by Barangay
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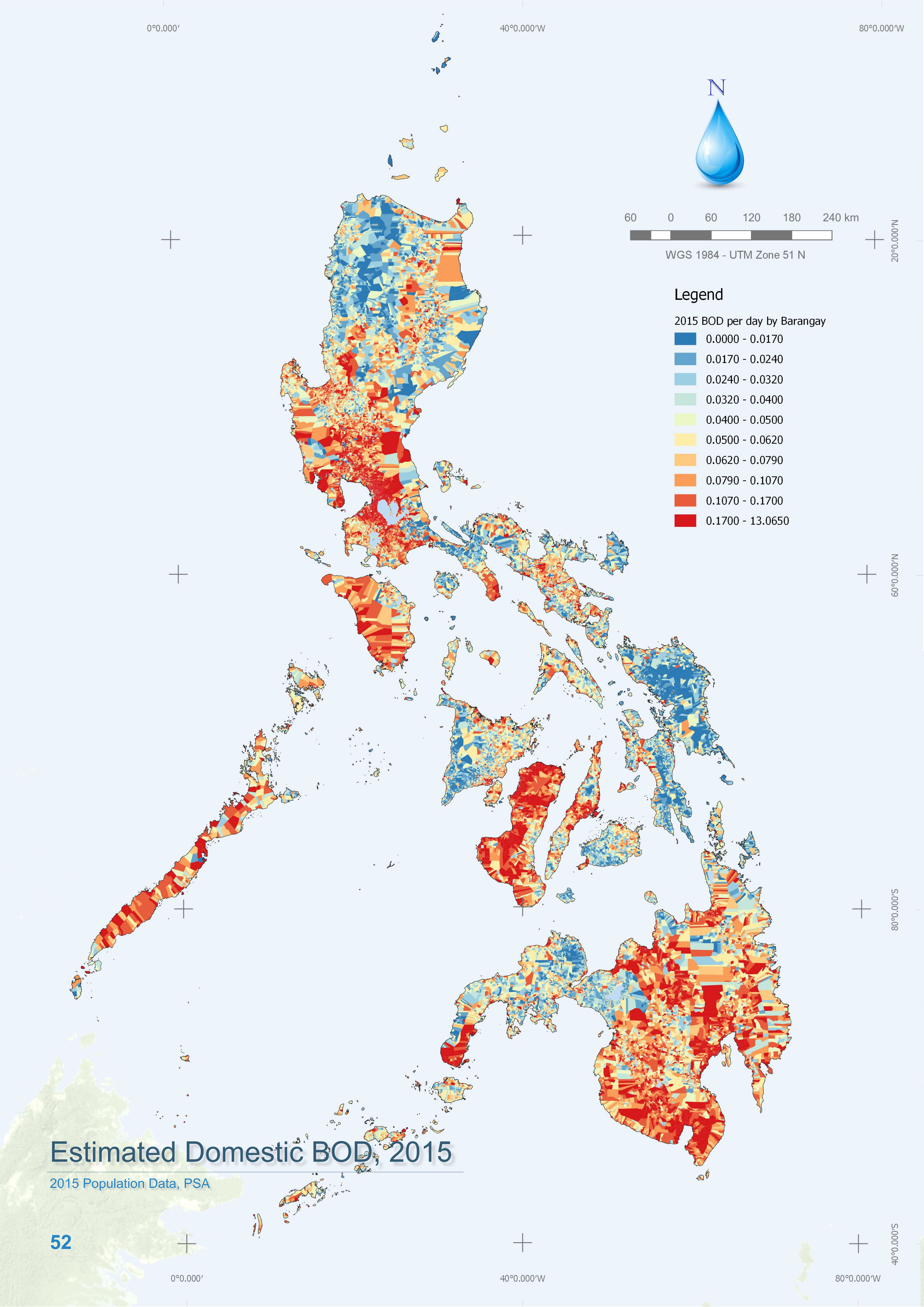
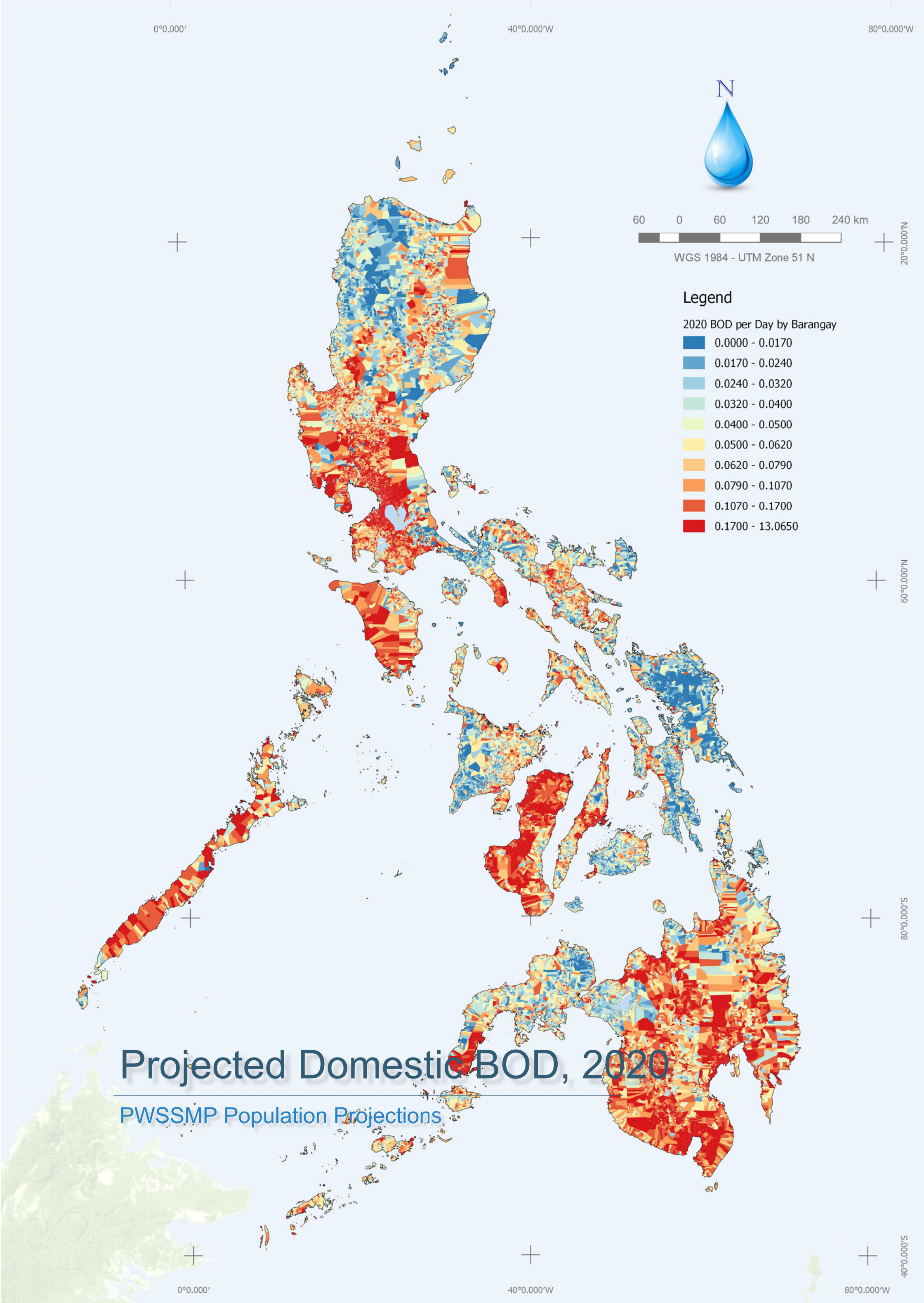
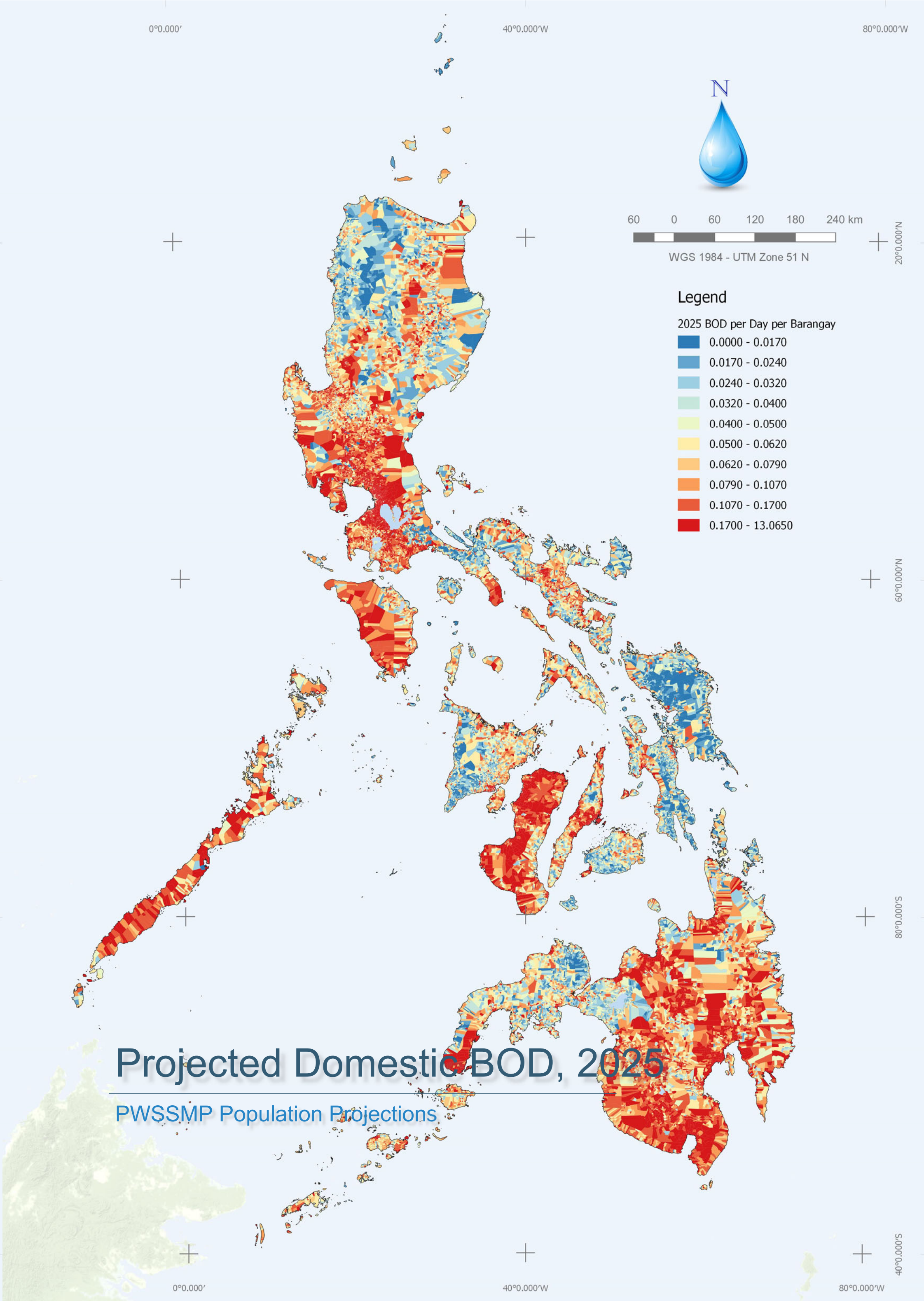
221 - 379
379 - 43018



Estimated Domestic BOD, 2015

2015 Population Data, PSA


N
60 0 60 120 180 240 km
WGS 1984 - UTM Zone 51 N
Legend
2020 BOD per Day by Barangay
0.0000 - 0.0170
0.0170 - 0.0240
0.0240 - 0.0320
0.0320 - 0.0400
0.0400 - 0.0500
0.0500 - 0.0620
0.0620 - 0.0790
0.0790 - 0.1070
0.1070 - 0.1700
0.1700 - 13.0650
Projected Domestic BOD, 2020
PWSSMP Population Projections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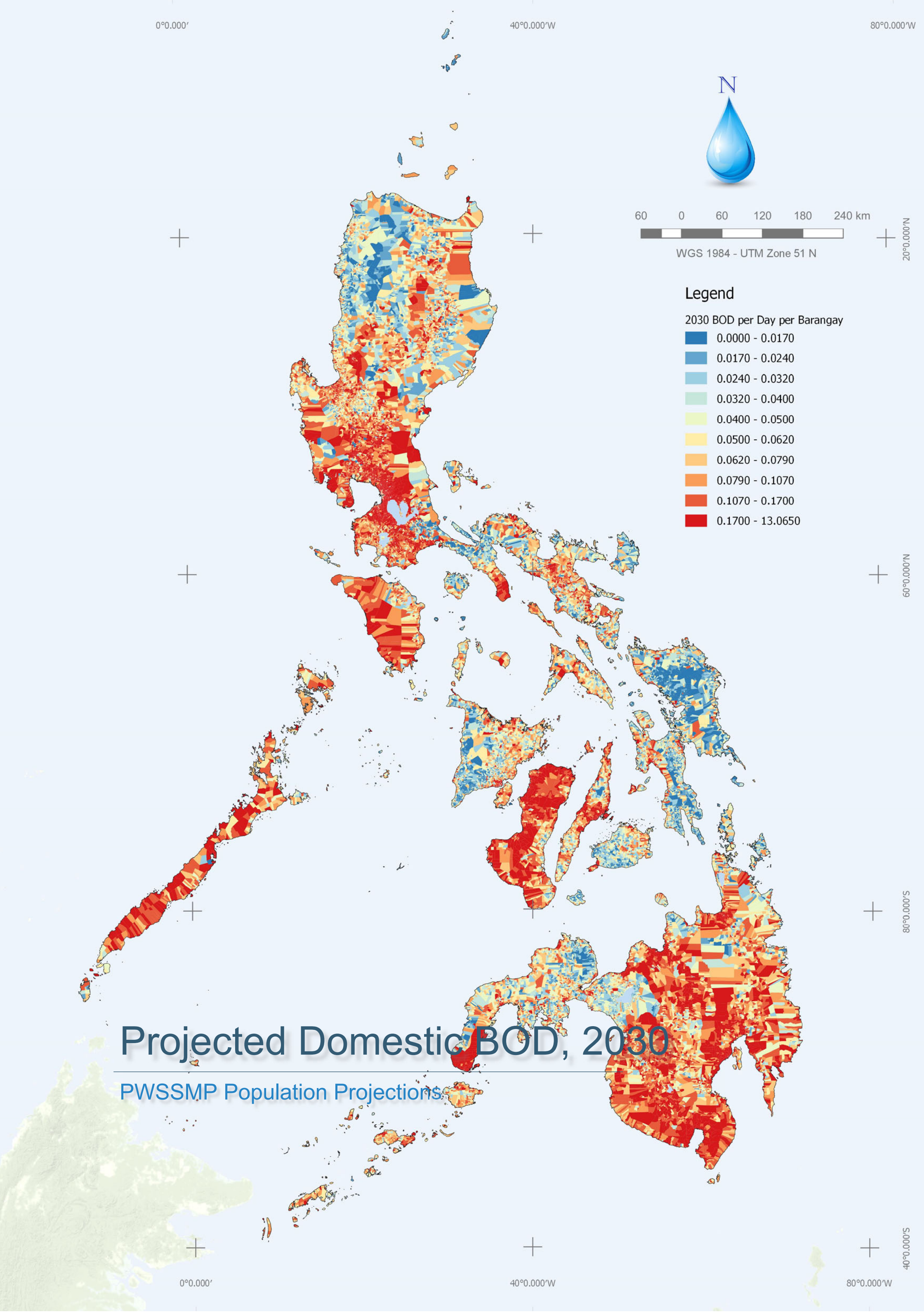
60 0 60 120 180 240 km
WGS 1984 - UTM Zone 51 N
Legend
2025 BOD per Day per Barangay
0.0000 - 0.0170
0.0170 - 0.0240
0.0240 - 0.0320
0.0320 - 0.0400
0.0400 - 0.0500
0.0500 - 0.0620
0.0620 - 0.0790
0.0790 - 0.1070
0.1070 - 0.1700
0.1700 - 13.0650
Projected Domestic BOD, 2025
PWSSMP Population Projections


N
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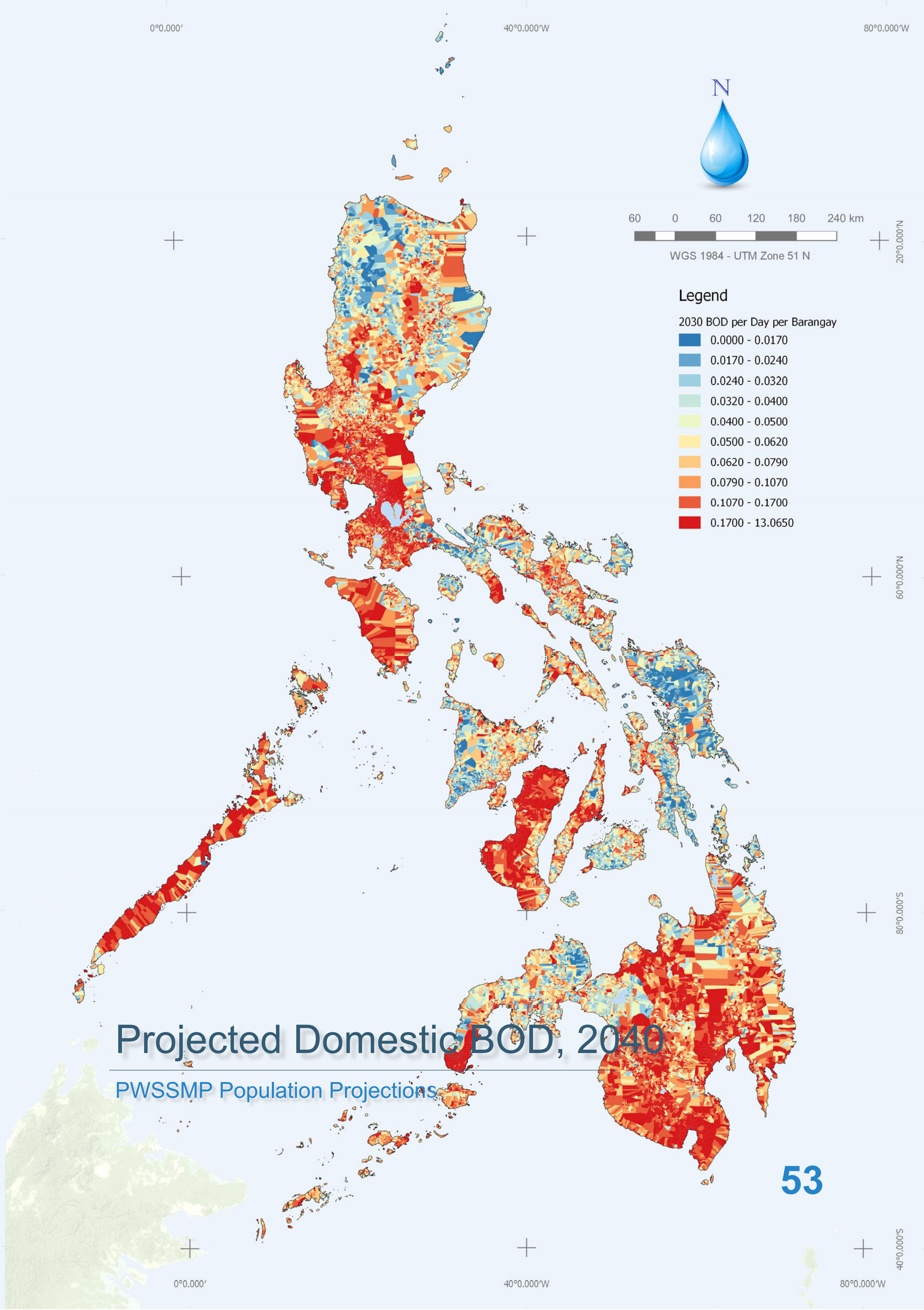
WGS 1984 - UTM Zone 51 N
Legend
2030 BOD per Day per Barangay
0.0000 - 0.0170
0.0170 - 0.0240
0.0240 - 0.0320
0.0320 - 0.0400
0.0400 - 0.0500
0.0500 - 0.0620
0.0620 - 0.0790
0.0790 - 0.1070
0.1070 - 0.1700
0.1700 - 13.0650
Projected Domestic BOD, 2030
PWSSMP Population Projections


N
60 0 60 120 180 240 km
WGS 1984 - UTM Zone 51 N
Legend
2030 BOD per Day per Barangay
0.0000 - 0.0170
0.0170 - 0.0240
0.0240 - 0.0320
0.0320 - 0.0400
0.0400 - 0.0500
0.0500 - 0.0620
0.0620 - 0.0790
0.0790 - 0.1070
0.1070 - 0.1700
0.1700 - 13.0650
Projected Domestic BOD, 2040
PWSSMP Population Projections

Water Quality

Water quality refers to the condition of water in terms of its physical, chemical, biological and radiological characteristics. It is measured with respect to its suitability for a specific purpose based on a set of standards against which compliance can be assessed.

The WHO uses the term "water quality" to express the suitability of water to sustain various uses or processes. Any particular use will have certain requirements for the physical, chemical or biological characteristics of water.[17]

Safe Drinking Water

The safety and accessibility of drinking water are major concerns throughout the world. Health risks are associated with the consumption of water contaminated with infectious agents, toxic chemicals, and radiological substances. Improving access to safe drinking water can result in tangible improvements to health.

Parameters that determine the quality of drinking water typically fall within three categories namely: physical, chemical and microbiological.

Physical and chemical parameters include heavy metals, trace organic compounds, total suspended solids (TSS), and turbidity. Microbiological parameters include coliform bacteria, *E. coli*, and specific pathogenic species of bacteria (such as the cholera-causing *Vibrio cholerae*), viruses, and protozoan parasites.

In most parts of the world, the most common contaminant of raw water sources is human sewage — in particular, human fecal pathogens and parasites.

Safe drinking water should have the following microbiological, chemical and physical qualities:

- free of pathogens
- low in concentrations of toxic chemicals
- clear
- tasteless and colorless.

Thus, to meet these standards, water quality is tested before utilizing water sources for particular purpose. If these standards are not met, water treatment is necessary.

Status of Water Quality in the Philippines

The Philippines is a developing country trying to catch up with the rapid pace of urbanization and industrialization taking place in many parts of the world. The sad truth, however, is that out of more than 100 million Filipinos, around 12 million rely on unsafe water sources. In fact, according to The Borgen Project (a non-profit organization seeking to fight global poverty and hunger),

water pollution and a lack of proper sewage in the country kills 55 people every day.

Access to adequate sanitation facilities is a problem for more than 6 million[18] Filipinos. This portion of the population is forced to spend considerable time, effort, and energy in procuring water. Families without sanitary toilets often face the embarrassment of venturing outside to answer the call of nature. Others have to approach their neighbors to use their restrooms.

Water pollution in the Philippines is dominated by domestic and industrial sources. Untreated wastewater affects health by spreading disease-causing bacteria and viruses, making water unfit for drinking and recreational use, threatening biodiversity, and lowering the overall quality of life. Known diseases caused by poor water include gastroenteritis, diarrhea, typhoid, cholera, dysentery, and hepatitis. However, the level of public awareness regarding the need for improved sanitation and water pollution control, as reflected by the willingness and capacity to pay for a connection to a sewerage system is very low.

Based on studies and water quality monitoring activities, critical regions have been identified based on the state of their water quality and quantity. These include the NCR (Metro Manila), Region IV-A (Southern Tagalog), Region III (Central Luzon), and Region VII (Central Visayas).

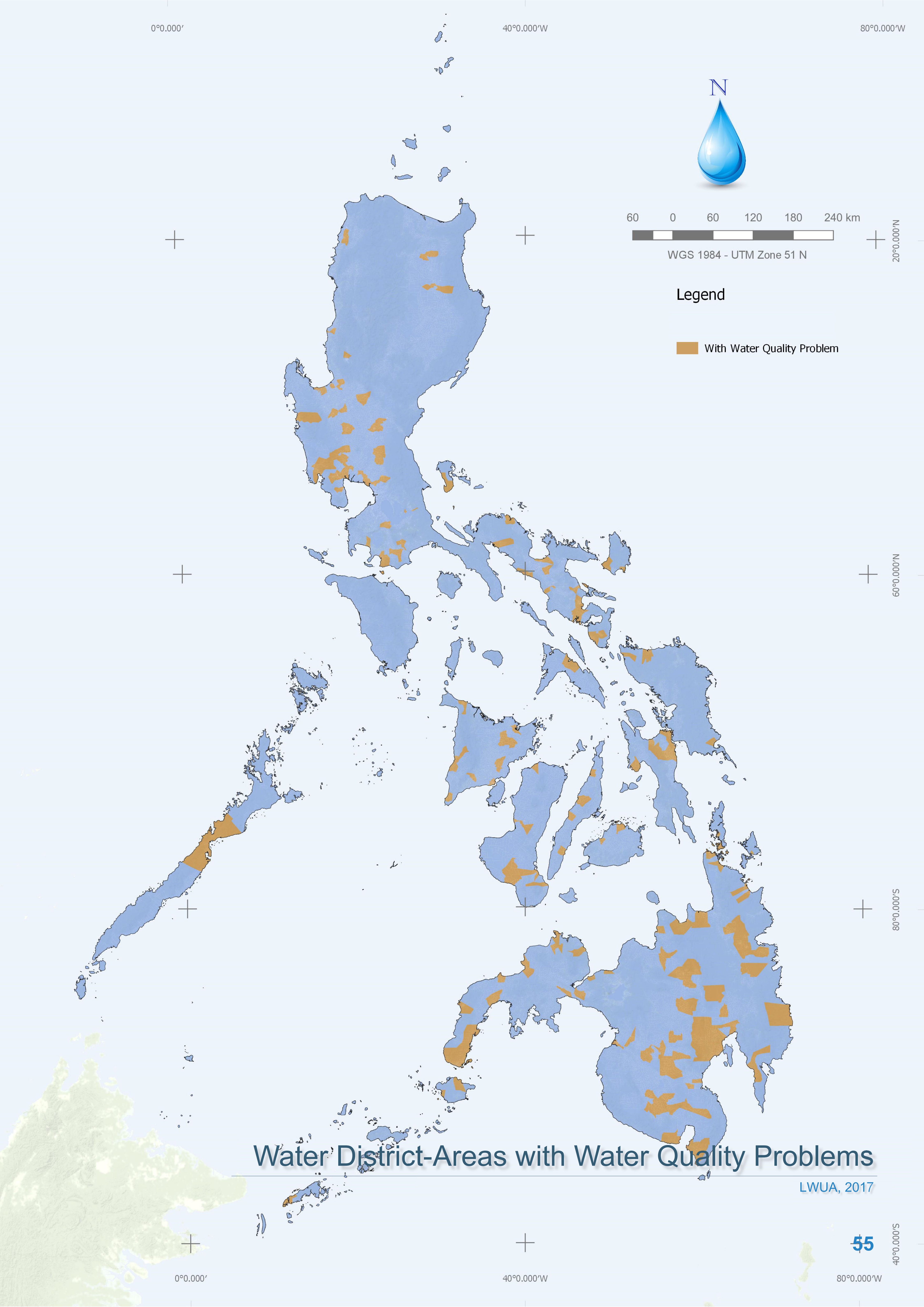
- NCR - Metro Manila has the biggest population among the country's 16 regions. It is the "hub of Philippine business and industry" facing the challenge of meeting its huge water supply need through improved water and sanitation infrastructure. The region's water resources from where water of good quality can be extracted have remained in a dismal state. Most, if not all, of its rivers (Parañaque, San Juan, Marikina, Pasig, and Navotas) sampled by the DENR Environment Management Bureau (EMB) for a period of six years have been found to be "biologically dead" during certain periods. The largest body of water — the Laguna de Bay — is under threat with rivers discharging large amounts of pollutants. (NCR belongs to the Pasig-Laguna River Basin and WRR 4.) In the collective view of regional water resource planners, the available water resource potential of the WRR and the river basin (as compared against the projected water demand[19] of the region) determines a ratio of 0.61, a number deemed very low and critical, according to a World Bank study.
- Region IV-A - Southern Tagalog (also known as CALABARZON) has the largest land area. Special economic and industrial zones have been put up in three of its provinces. It has the biggest population surpassing that of NCR since 2000 and shares the same water resources with NCR. Water demand projections for the region show that a shortfall of water supply will take place if no water management intervention is put in place. The Pasig-Laguna River Basin occupies a large part of NCR and parts of Rizal, Laguna, and Cavite. Moreover, only a small number of the wells tested in Laguna passed the drinking water criterion for total dissolved solids and coliform content.
- Region III - This region has the third highest number of manufacturing establishments and households. The Agno and Pampanga River Basins found in this region have a combined water potential which is far less than the region's projected water demand. The ratio of water demand to potential averages 0.54, which means water demand is two times more than the water potential. Moreover, a high percentage of the wells tested by NWRB and LWUA were positive for coliform bacteria.
- Region VII - This region has a small land area but is the fourth largest in terms of population. Its regional center is Cebu City, which is also the region's largest city and the second largest metropolis in the country. Because it is an international commercial and business hub, the region boasts a number of manufacturing establishments. The region as a whole, however, has no large rivers and has little water resources potential. In fact, it has been threatened by absolute water scarcity based on its computed water availability of 397 m^3 per capita per year. In particular, the island of Cebu has a potential to demand ratio of 0.76, and will most likely face grave water shortage unless its water infrastructure is improved.

The map on the right highlights the areas whose water supply sources have had problems with water quality. Data are based on the water quality reports of water districts (WDs) as consolidated by the LWUA. (Data on water supply sources not covered or owned by WDs are not reflected on this map.)

[17] *Water Quality Monitoring - A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programme, WHO*

[18] *Estimated number of Filipinos with no access to improved and basic sanitation facilities.*

[19] *The JICA Master Plan on Water Resources Management in the Philippines (1998) conducted water demand projections of the entire country up to the year 2025 taking into account the water demand the domestic, agricultural, industrial sectors. Water for hydropower use, although non-consumptive, was also considered.*



Water District-Areas with Water Quality Problems

LWUA, 2017

Waterborne Diseases

Waterborne diseases are conditions caused by pathogenic micro-organisms that are transmitted in water[20]. Disease can be spread while bathing, washing or drinking water, or by eating food prepared with unsafe and contaminated water.

The term 'waterborne disease' is reserved largely for infections that are predominantly transmitted through contact with or consumption of contaminated water. Many infections may be transmitted by microbes or parasites that accidentally, possibly as a result of exceptional circumstances, have entered the water. But the fact that there might be an occasional freak infection need not mean that it is useful to categorize the resulting disease as "waterborne".

Waterborne diseases account for an estimated 3.6% of the total disability-adjusted life year (DALY) global burden of disease, and cause about 1.5 million human deaths annually. The WHO estimates that 58% of that burden, or 842,000 deaths per year, is attributable to a lack of safe drinking water, sanitation and hygiene (WASH).

Various forms of waterborne diarrheal disease are the most prominent examples dramatically risking the lives of children in developing countries.

Effects of Open Defecation

Water pollution is the contamination of water bodies, usually as a result of human activities. Open defecation is a source of water pollution — rain flushes feces that are dispersed in the environment into surface water or unprotected wells.

In 2014, WHO found that **open defecation was a leading cause of diarrheal death.**

An average of 2,000 children under the age of five die every day from diarrhea.

Diarrhea and other water-related problems are associated with ingesting and being exposed to human waste (as a result of open defecation) found in waterways and rivers. In urban areas, human waste can find its way in drainage systems that are usually meant to convey rainwater into natural waterways.

Human waste is therefore carried into the water system. As a consequence, the contaminated water ends up in the main water source thus making people highly vulnerable to waterborne diseases such as cholera, typhoid, and trachoma.

Socio-economic Impact

Waterborne diseases have a significant impact on a nation's economy. People afflicted with a waterborne disease are usually confronted with related costs and not seldom with a huge financial burden. This is especially the case in less developed countries where most illnesses are caused by waterborne diseases. The financial losses are mostly caused by medical treatment and cost of medication cost, transportation expenses, special food, and by the loss of manpower.

Illnesses can cause short-term and long-term damage to a country's growth. Microeconomic damage may be due to the financial pressures for medical assistance and the physical deterioration of individuals. On the other hand, macroeconomic effects may be due to absenteeism and reduced or lost productivity. As it is also assumed that certain factors such as global warming, water shortage and the fast growth of population will lead to more new infections, it is worth investigating how these illnesses influence the socio-economic structures of affected regions.

National Status

The rainy season increases the risk of acquiring waterborne diseases such as typhoid fever, cholera, leptospirosis, and hepatitis A.

Typhoons and heavy rains may cause flooding which, in turn, can potentially increase the transmission of waterborne diseases, or diseases transmitted through water contaminated with human or animal waste.

Among the various waterborne diseases, DOH has identified the following as the most prevalent across the country:

- Diarrhea - is the frequent discharge of watery feces from the intestines, sometimes containing blood and mucus. This may last a few days, or several weeks, because of an infection as in persistent diarrhea. Persistent diarrhea may result in severe dehydration and shock. Severe diarrhea may be life-threatening due to fluid loss particularly in infants and young children, the malnourished and people with impaired immunity.
- Cholera - is an infectious disease that causes severe watery diarrhea, which can lead to dehydration and even death if untreated. It is caused by eating food or drinking water contaminated with a bacterium called *Vibrio cholera*.
- Typhoid - is an acute illness associated with fever caused by the *Salmonella enterica serotype Typhi* bacteria. It can also be caused by *Salmonella Paratyphi*, a related bacterium that usually causes a less severe illness. The bacteria are deposited in water or food by a human carrier and are then spread to other people in an area.
- Schistosomiasis - is a disease caused by parasitic flatworms called schistosomes. The urinary tract or the intestines may be infected. Its symptoms include abdominal pain, diarrhea, bloody stool, or blood in the urine. Those who have been infected for a long time may experience liver damage, kidney failure, infertility, or bladder cancer. The disease is contracted by people using or coming into contact with unclean water contaminated with the parasites. These parasites are released from infected freshwater snails.

The incidence of these waterborne diseases in 2015 are in Table 9.

Table 9: Number of Cases of Waterborne Diseases, 2015

Country / Region	Cholera	Acute Watery Diarrhea	Schistosomiasis	Typhoid and Paratyphoid
Philippines	86	129,544	1,843	11,366
Ilocos	-	22,147	-	2,550
Cagayan Valley	5	10,294	-	1,312
Central Luzon	1	1,969	-	35
CALABARZON	7	-	1	97
MIMAROPA	-	-	-	58
Bicol	2	822	10	93
Western Visayas	-	5,681	2	551
Central Visayas	-	-	-	-
Eastern Visayas	-	15,239	263	407
Zamboanga Peninsula	-	1,089	69	1,366
Northern Mindanao	-	2,818	227	323
Davao	-	-	125	193
SOCCSKSARGEN	70	22,019	-	4,054
Caraga	-	6,579	1,146	84
NCR	1	1,797	-	29
CAR	-	39,090	-	214
ARMM	-	-	-	-

Source: DOH, 2015 Field Health Services Information System (FHSIS)

[20] *Burden of disease and cost-effectiveness estimates, WHO*

5

WSS Infrastructure

Water Supply

The country's water supply needs are served by various water service providers (WSP) of different management types. Table 10 shows the number of WSPs in the country per management type as registered in NWRB's Listahang Tubig database. The data were also delineated according to the WSPs' levels of service (i.e., Levels I, II, and III). Table 11, on the other hand, gives a brief description of each WSP type.

While the WD data may be found in Listahang Tubig, more updated ones are found in the website and records of LWUA and Philippine Association of Water Districts (PAWD). As of 2017, there were a total of 748 WDs in the country, 517 (or 69%) of which were operational. The first map on the next page plots the existing water districts in the country (operational and non-operational). Some WSPs registered in the Listahang Tubig database provide water supply service coverage at the barangay level.

The second map shows the barangays with Level III water service. For municipalities/cities covered by WDs (but where relevant data are lacking), it is assumed that all barangays are being served by their respective WDs.

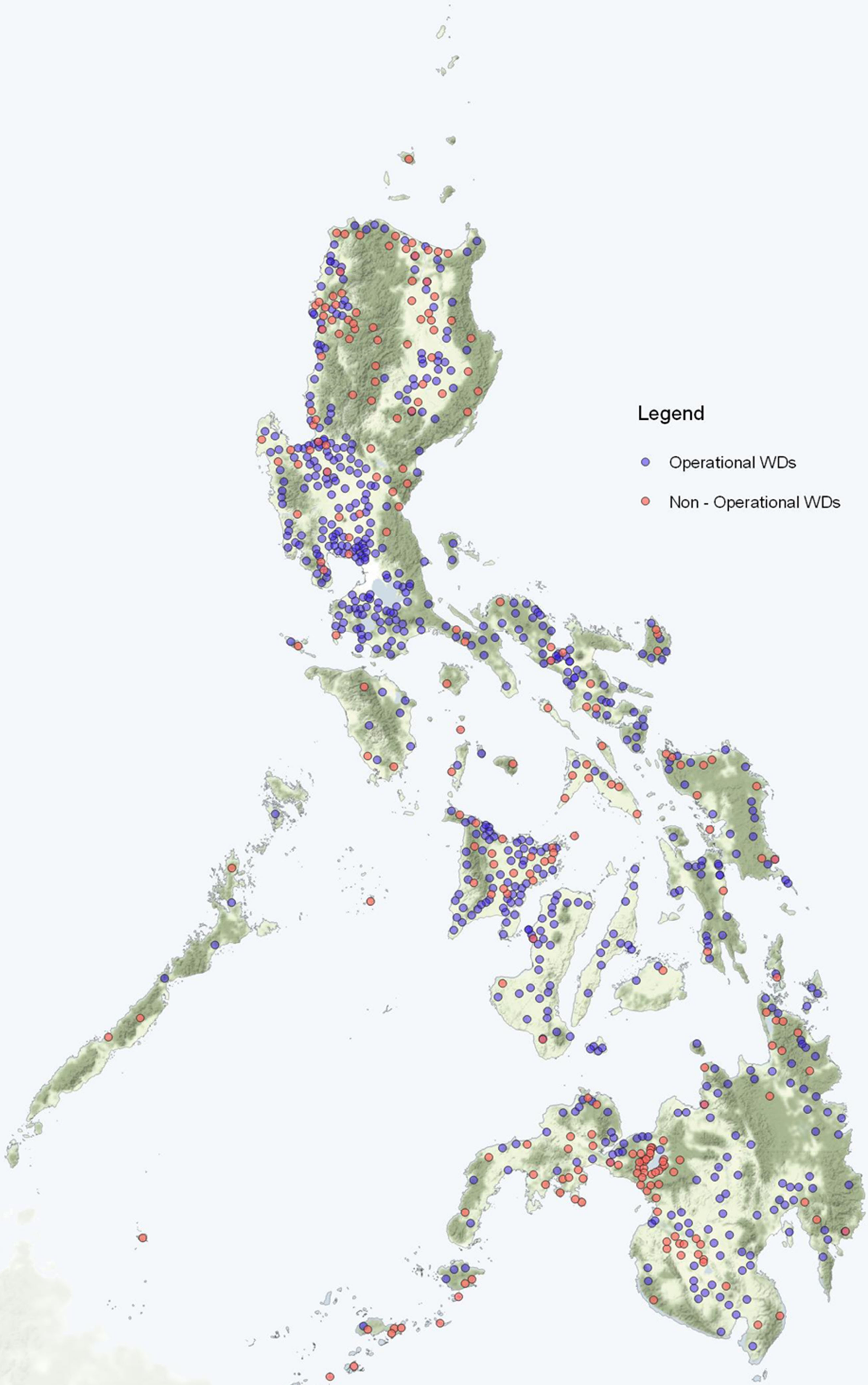
Table 10: Service Coverage of Water Service Providers by Management Type (Listahang Tubig Website)[21]

Management Type	No.	%	Level I	Level II	Level III
BWSA	6,621	27%	2,980	2,498	1,142
RWSA	1,418	6%	62	619	737
Cooperative	403	2%	46	90	267
Unnamed Water Service Provider	7,878	32%	7,486	303	89
LGU-Run Utility	4,184	17%	1,147	1,608	1,429
Water District	635	3%	19	4	611
Homeowners' Association	377	2%	168	77	132
Real Estate Developer	107	0%	8	8	91
Industrial Locator	45	0%	3	3	39
Peddler	211	1%	108	80	23
Ship Chandler	4	0%	1	2	1
Other Private Operators	1,779	7%	711	268	800
Refilling Stations	1,162	5%	1,122	24	15
Grand Total	24,824	100%	13,861	5,584	5,376

Table 11: Water Service Providers by Management Type

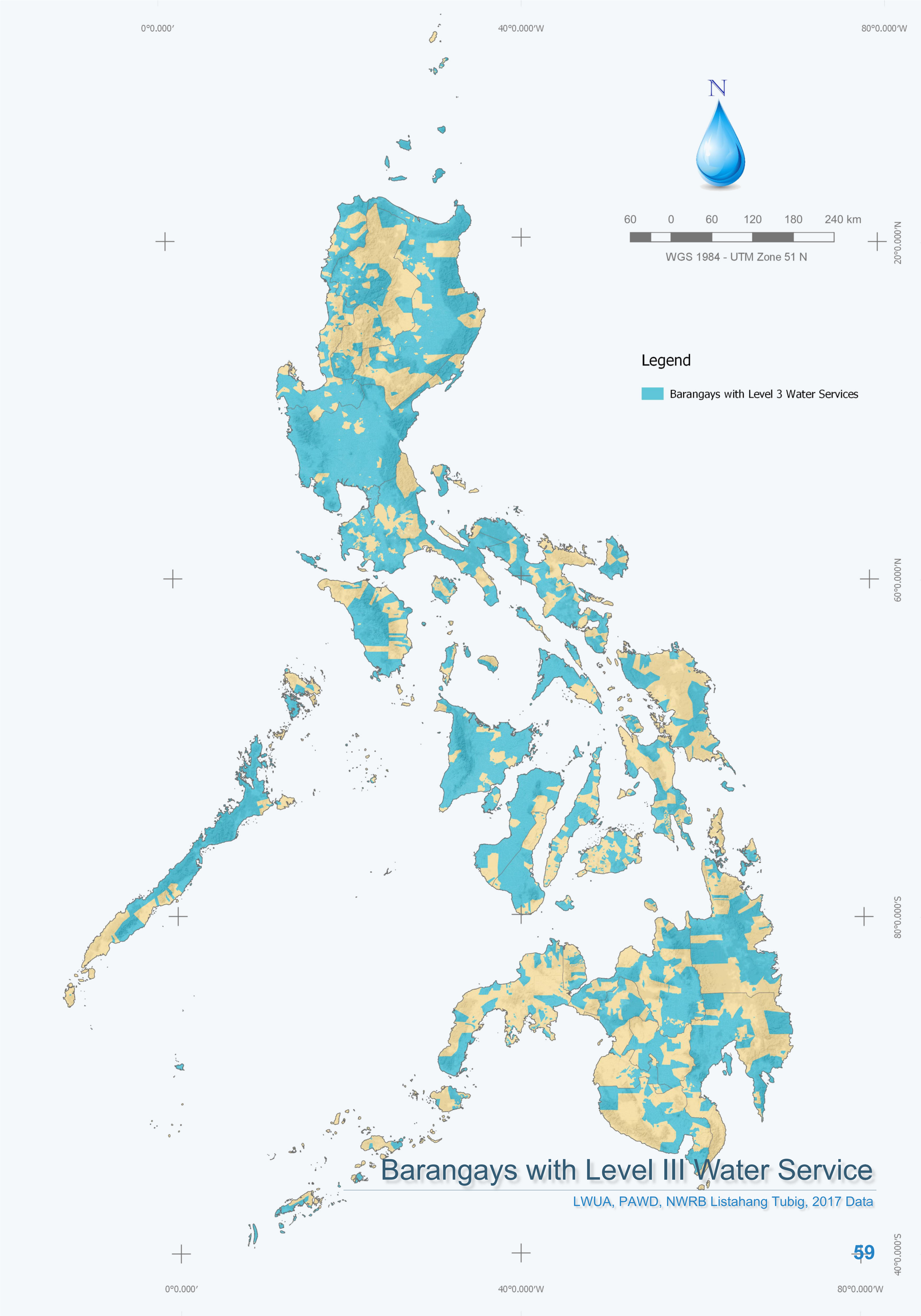
Major Groups	Management Type	Description
Water Districts	Water District	A quasi-public corporation formed by the local government unit under the Provincial Water Utilities Act for the operation and maintenance of water supply and wastewater management system, which has been issued a Certificate of Conditional Conformance by the Local Water Utilities Administration.
LGU-run Utilities	LGU-run Utilities	A water supply system owned and operated by the provincial, city or municipal government.
Community-based Organizations	Barangay Water and Sanitation Association (BWSA).	A non-stock, non-profit organization envisioned to operate and manage Level I water supply facilities.
	Rural Water Supply Association (RWSA)	A community-based water users' association formed to manage piped water supply systems either with house connections (Level III) or a network of public taps (Level II).
	Cooperative	An organization formed under the Cooperative Code of the Philippines to operate and maintain water supply systems and registered with the Cooperative Development Authority (CDA).
Private Utilities	Homeowners' Association	An organization that operates and maintains a water supply system and is registered with the Securities and Exchange Commission (SEC) or Housing and Land Use Regulatory Board (HLURB)
	Real Estate Developer	A real estate developer operating a water supply system that provides potable water to lot owners within its real estate development.
	Unnamed Water Service Provider	A water service provider serving at least 15 HHs and which is not registered formally with any government agency.
	Industrial Locator	An industrial estate operating the water supply system in an economic special zone to provide water to its locators.
	Peddler	A non-pipe water service provider or operator extracting water and supplying/delivering water by container.
	Ship Chandler	A water supply operator providing water to ships.
	Other Private Operators	Sole proprietorships, corporations and other private entities formed under the general business and corporation laws of the country for the operation and maintenance of water supply systems.

[21] Listahang Tubig Website (http://listahangtubig.cloudapp.net); accessed December 2018; based on data uploaded by water utilities in 1,470 participating cities/municipalities, out of a total of 1,634.



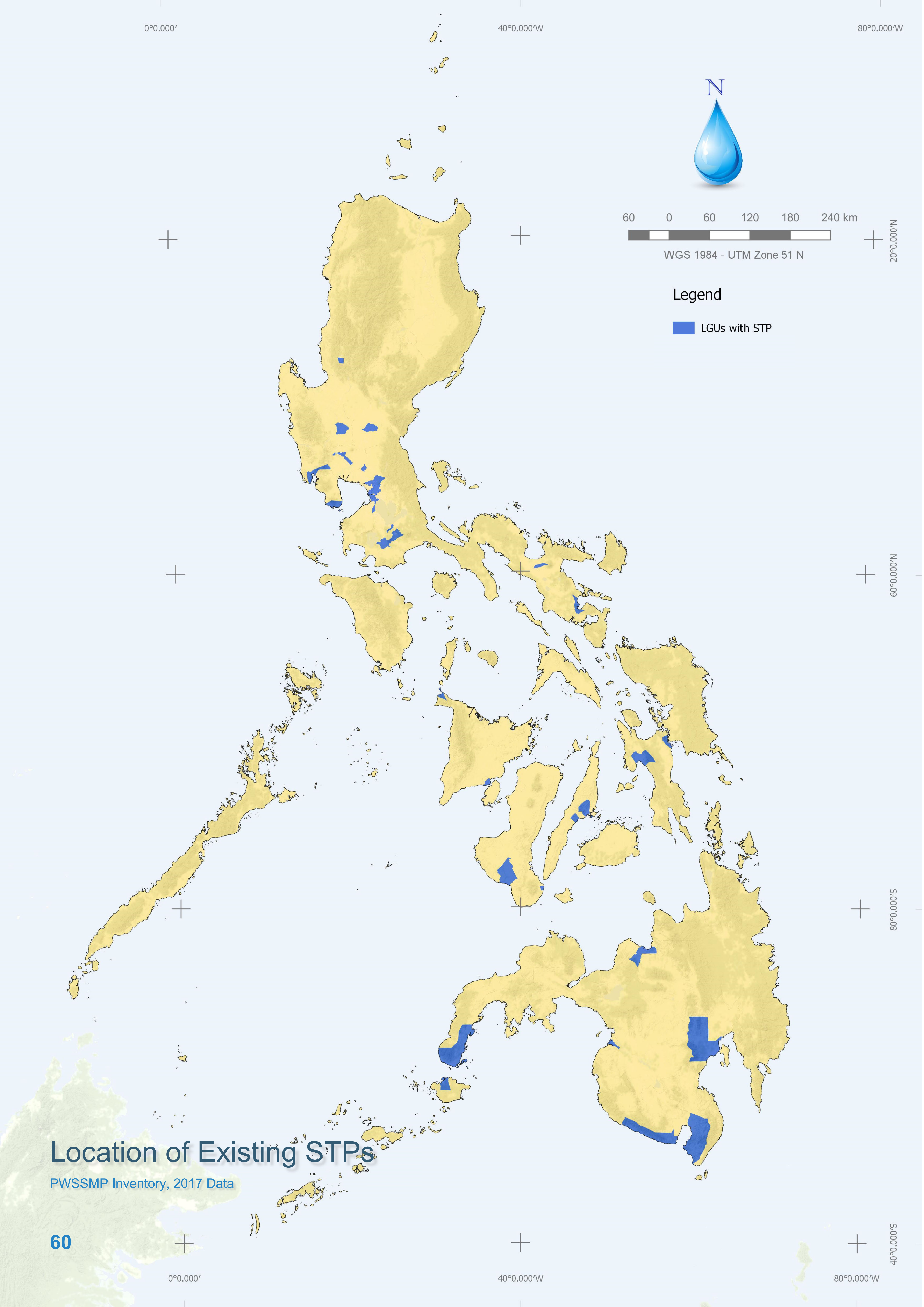
Existing Water Districts

LWUA, PAWD, 2017 Data



Barangays with Level III Water Service

LWUA, PAWD, NWRB Listahang Tubig, 2017 Data



Location of Existing STPs

PWSSMP Inventory, 2017 Data

Sanitation

For sanitary toilets and onsite treatment systems to be considered safely managed, wastewater and septage (sludge content of the septic tanks) coming from these systems should be treated and disposed of properly. It is the responsibility of households and communities that toilets and septic tanks be constructed in compliance with the National Building Code. These on-site systems need to be maintained and serviced by a service provider. Sanitation service then means desludging or emptying of septic tanks and provision of sewerage services, sometimes collectively referred to as wastewater management or fecal sludge management service. This service includes collection or conveyance, on-site or off-site treatment, and final disposal of wastewater, fecal sludge, or septage.

Sanitation service providers are principally comprised of WDs, LGU-run water utilities, private sector service providers, and cooperative-run service providers outside Mega Manila. Private service providers are popularly known as Malabanan Pozo Negro. Their services generally remain a private business activity and for-profit. New private players are emerging to provide sanitation services and comply with existing regulations set by DOH and EMB, and other ordinances of the LGUs.

Duly registered private service providers report their activities to the LGUs they serve and the Regional Health Offices of DOH to obtain and renew their Environmental Sanitation Clearance (ESC). By law, service providers can operate only in the areas that are stated and approved in their registration.

As of this writing, there are no known data or surveys of sanitation service providers outside Mega Manila. Unofficially, there are about 36 septage treatment facilities constructed all over the country at various stages of operation — some by LGUs, the rest by WD’s.

In Mega Manila, there are a total of 61 septage treatment plants (STP) spread throughout the service areas of two MWSS concessionaires (i.e., Maynilad Water Services Inc., 20, and Manila Water Company Inc., 41).

A rough estimation of performance of service delivery in the country is shown in Table 12 and Table 13.

Septage management is available to the equivalent of 3% of the population outside Mega Manila. With regard to sewerage systems, only 0.10% of the population outside Mega Manila is served.

Table 12: Coverage of Septage Management Program

Areas with Available Complete Septage Management Program			
Area Covered	2015 Covered Population	% of Philippine Population (2015)	Remarks
Mega Manila			76.48%
Total for Mega Manila	14,868,425	14.72%	
Outside Mega Manila			3.76%
Total for Outside Mega Manila	3,063,088	3.03%	

Table 13: Coverage of Sewerage System Services

Areas with Available Complete Sewerage System Services			
Area Covered	2015 Covered Population	% of Philippine Population (2015)	Remarks
Mega Manila			66.24%
Total for Mega Manila	12,877,253	12.75%	
Outside Mega Manila			0.12%
Total for Outside Mega Manila	101,883	0.10%	

6

WSS Gaps

Issues and Challenges

Issues and challenges confronting the WSS sector are summarized herein.

Table 14: Issues and Challenges in the Water Supply and Sanitation Sector

Elements of WSS Sector and its Objective Statements	Water Supply	Sanitation	Issues and Challenges
Natural Resources System Efficiently Managed Finite Water Resources and Water Ecosystem	■	■	▪ Some potential water sources are polluted or contaminated.
	■		▪ Water sources are insufficient in some areas. Other sources are drying up due to over-extraction or are sensitive to weather patterns and climate change.
	■		▪ Assuming it is business as usual, the country will experience high water stress owing to high total water withdrawal against projected renewable water resources by 2040.
	■		▪ Rainfall variability and extreme weather events (usually attributed to climate change) make water resource management more difficult.
	■		▪ Excessive groundwater extraction has led to saline intrusion and groundwater-related subsidence.
Socio-Economic System WSS Promoting Socio-Economic	■	■	▪ Increasing population and economic growth increase water demand and generation of waste and wastewater.
	■		▪ Increasing temperature (climate change) will increase water usage.
		■	▪ Climate change increases the risk of waterborne diseases and transmission of malaria.
Use of and Impact on Water Responsible Use and Balanced Demand and Supply	■	■	▪ The quality of water resources is deteriorating because of unmanaged wastewater entering the water ecosystem.
		■	▪ There is inadequate or a lack of awareness of and concern about the effects of unmanaged waste and wastewater on watersheds, water sources, and water ecosystems.
	■		▪ There is a lack of appropriate technologies, or application or use thereof, to optimize the use of water resources.
	■		▪ There is no clear policy promoting water demand management (WDM) in order to maximize available water supply. This includes water efficiency and water conservation for all users, using the right quality of water for its intended use, the use of economic instruments and other incentives/disincentives to effect behavioral change.
Administrative and Institutional System Enabling Administrative and Institutional Arrangements	■	■	▪ There is no single body focused on water supply and sanitation resulting in a fragmented sector with multiple water institutions and no clearly defined institutional roles to address sanitation issues.
	■	■	▪ There is no apex body to oversee the whole cycle with respect to the use of the country's water resources – from the source, to how much and in what manner water is used, to sanitation and treatment, and back to the source. Also, the inadequacy in numbers of river basin organizations makes it difficult to carry out a holistic planning approach.
	■		▪ NWRB does not have an appropriate institutional structure to complement its mandate as a policy-making body, water resource regulator, and economic regulator.
	■	■	▪ WSS data gathered by the PSA are limited.
	■	■	▪ LGUs lack the capacity and capability to perform their obligation of ensuring the reliability of WSS services as per the Local Government Code (LGC).
Policies, Regulations, and Management WSS-related Policies, Regulations, and Management	■	■	▪ The sector's economic regulatory framework is severely fragmented, poorly enforced, and has very limited coverage. Also, there is no regulatory oversight on JV arrangements.
	■	■	▪ Poor enforcement of and compliance with policies and laws (i.e., with the Clean Water Act, and other resource-, economic-, environment-related policies) can be observed.
	■	■	▪ The sector lacks an independent water agency with the power to grant and revoke licenses, as well as the authority to set standards and targets for private and public WSPs.
	■	■	▪ WSS data and information used in decision making are limited, scattered among the different government agencies/offices that have water-related functions, and poorly managed and monitored.
	■	■	▪ Implementation, monitoring, and management of WSS services and infrastructure are sorely lacking.
	■	■	▪ There have been no directives or strategies by which to translate PDP/SDG targets and commitments into local programs and projects.
	■	■	▪ Issuance of water rights is not regulated. In addition, speculators hoard water permits.
	■	■	▪ Sanitation interventions are very inadequate, not sustainable and unbalanced in terms of implementation.
	■		▪ Many WSPs have inadequate management and O&M capability.
	■		▪ Water rates are too low in some areas and yield no cost recovery.
	■	■	▪ Access to potential technologies is restrictive.
	■	■	▪ Water is being used as a political commodity. Some LGUs and WDs are caught up in political conflict or burdened by interference from politicians, thus affecting the interest of water consumers.
	■	■	▪ Investments in WSS sector are insufficient.
WSS Infrastructure and Services Resilient, Responsive, and Sustainable WSS Infrastructure and Services	■	■	▪ Water supply systems (or structures) are not properly designed, constructed, operated, and maintained.
	■		▪ There is a lack of water supply structures to optimize available resources, ensure good water quality and sanitation, or provide access to safe water.
	■	■	▪ Funds are inadequate and access to financing is difficult, yet there are programs and projects (NSSMP, LWUA WD Development Sector Project) with very few takers.
	■	■	▪ Some WSPs are not operational and sustainable.
	■		▪ Some WSPs, including WDs and LGU-run utilities, fail to serve barangays within their franchise area and meet set standards in water supply and service delivery.
	■	■	▪ Some WSPs are unfamiliar with new technologies and updated techniques.

Vision

"By 2030, all Filipinos will have access to sustainable and affordable safe water supply, and to adequate safely managed sanitation services."

Sector Goals and Outcomes: Benchmarks and Targets

Setting the direction towards the national targets and commitments (see Table 15), the PWSSMP's vision is set on the universal access of WSS services by 2030. Thus, it also aligns the direction towards achieving the WSS targets laid out in PDP by 2022.

The normative content of the human right to water supply and sanitation services must also be met in the achievement of the national targets. These normative content would include availability, physical accessibility, quality and safety, affordability, and acceptability. While it is important that the populace is given access to WSS facilities, it is equally essential to ensure that what they have is 'good access.' Moving forward, it is recommended that the proposed benchmarks and key performance indicators (shown in Tables 16 and 17) be monitored and targeted by government agencies and WSPs alike to achieve the WSS sector's goals.

WSS sector targets per region shall be discussed in detail in the regional subsections of this databook.

Table 16: Proposed Water Supply Sector Benchmarks

Key Performance Indicator (KPI)	Source of Data	2015 Baseline	2022 Target	2030 Target
Percentage of households with no access to safe water	PSA	12.8%	6.6%	0.0%
Percentage of households with access to Level III systems	PSA, Regional Consultations	43.6%	58.3%	77.1%
Percentage of households with access to Level II systems	PSA, Regional Consultations	11.2%	15.0%	14.0%
Percentage of households with access to Level I systems	PSA, Regional Consultations	32.4%	20.1%	8.9%
Percentage of WSPs providing water that meets the PNSDW requirements	No data available			
Percentage of WSPs with at least 19 hours per day of water supply service	Listahang Tubig	19 hours per day		
Percentage of Level III WSPs achieving 7 m minimum water pressure	No data available			
Percentage of WSPs that have sufficient water sources to serve franchise beneficiaries	No data available			
Percentage of Level III WSPs with an average per capita consumption equal to or less than 120 lpcd	No data available			

Table 15: Sector Goals, Benchmarks

Hierarchy of Objectives	National Targets and Commitments	Benchmark	Source of Data
Goal	Universal (100%) and equitable access to safe and affordable drinking water by 2030	91.67%	NDHS, 2017
	Universal access to adequate and equitable sanitation by 2030	69%	NDHS, 2017
Outcomes	Increase in the percentage of households with access to safe water supply to 95% by 2022	87.70%	FIES, 2015
	Increase in the percentage of households with access to basic sanitation to 97% by 2022	73.80%	FIES, 2015
	By 2020, all LGUs (1,634) will have developed septage management systems.	3.18% (52 of 1,634)	PWSSMP Inventory
	By 2020, the 17 highly urbanized cities (HUCs) will have developed sewerage systems.	6% (1 of 17)	PWSSMP Inventory
	By 2020, approximately 43.6 million people will have had access to septage treatment facilities.	41.12% (17.93 M of 43.6 M)	PWSSMP Inventory
	By 2020, approximately 3.2 million people will have had access to sewerage treatment facilities.	405% (12.98 M of 3.2M)	PWSSMP Inventory
	By 2020, ₱26.3 billion will have been invested in sanitation improvement projects.	No data available	
	By 2020, approximately 346 million kilograms of BOD will have been diverted from the environment per year as a result of the sewerage and septage management projects.	No data available	

Legend: SDG 2030 PDP 2017-2022 Clean Water Act 2004

Table 17: Proposed Sanitation Sector Benchmarks

Key Performance Indicator (KPI)	Source of Data	2015 Baseline	2022 Target	2030 Target
Percentage of households with access to improved facilities	DOH/PSA	94%	100%	100%
Percentage of households practicing open defecation;	DOH/PSA	4%	0%	0%
Percentage of households with septic tanks (on-site system)	DOH/PSA	74%	97%	100%
Percentage of households with access to septage collection services	DOH/PSA	17%	69%	100%
Percentage of households with access to a sewerage system	DOH/PSA	12%	23%	60%
Percentage of households connected to a sewerage system	DOH/PSA	3%	20%	50%
Percentage of HUCs with sewerage service provision	DOH/PSA	53%	94.12%	100%
Percentage of non-HUCs with septage service provision	DOH/PSA	0.73%	61.20%	100%
Rate of morbidity caused by water-related illnesses and disease	DOH/PSA	12,833	An annual drop of 10% to 20% is ideal with improvement of water quality.	21.00%
Volume of Biochemical Oxygen Demand removed from the ecosystem	LGU/DENR-EMB/DOH	65.4 Tons (T)	233.2 T	514.1 T
Volume of wastewater collected and treated (m^3)	LGU/DENR-EMB/DOH	2.95 T	3.32 T	3.81 T
Percentage of treatment plant capacity utilization	LGU/DENR-EMB/DOH	For septage and sewerage treatment facilities, % utilization starts high after the first year and reaches full capacity toward the end of the 3-5 year cycle.		
Percentage of WSPs complying with national standards for sanitation (e.g., DENR, DOH, and local government)	LGU/DENR-EMB/DOH	17%	67%	100%

7

Addressing the Gaps

Proposed Projects and Investments

Based on the WSS Issues and Challenges, eight (8) reform agenda were identified thus setting the focus on prioritizing project interventions for the sector. Figure 21 illustrates the PWSSMP Results Framework with the 8 reform agenda. These are discussed in detail in the Master Plan (Volume 1).

Complementing the Reform Agenda (soft components) are the Priority Programs (hard components) consisting of (1) WSS Potential Projects and (2) Identified Projects.

WSS Potential Projects

WSS potential projects shall be based on the total infrastructure investments needed towards achieving the 2022 and 2030 sector targets and commitments. Table 18 shows in detail the sector's total budget requirements. Derivations of these costs are shown in the Master Plan. Breakdown per region, on the other hand, shall be discussed in the regional subsections of this databook.

Identified Projects

In the course of the study, lists of potential and pipeline WSS projects from various agencies and LGUs were collected. These are summarized by agency, major

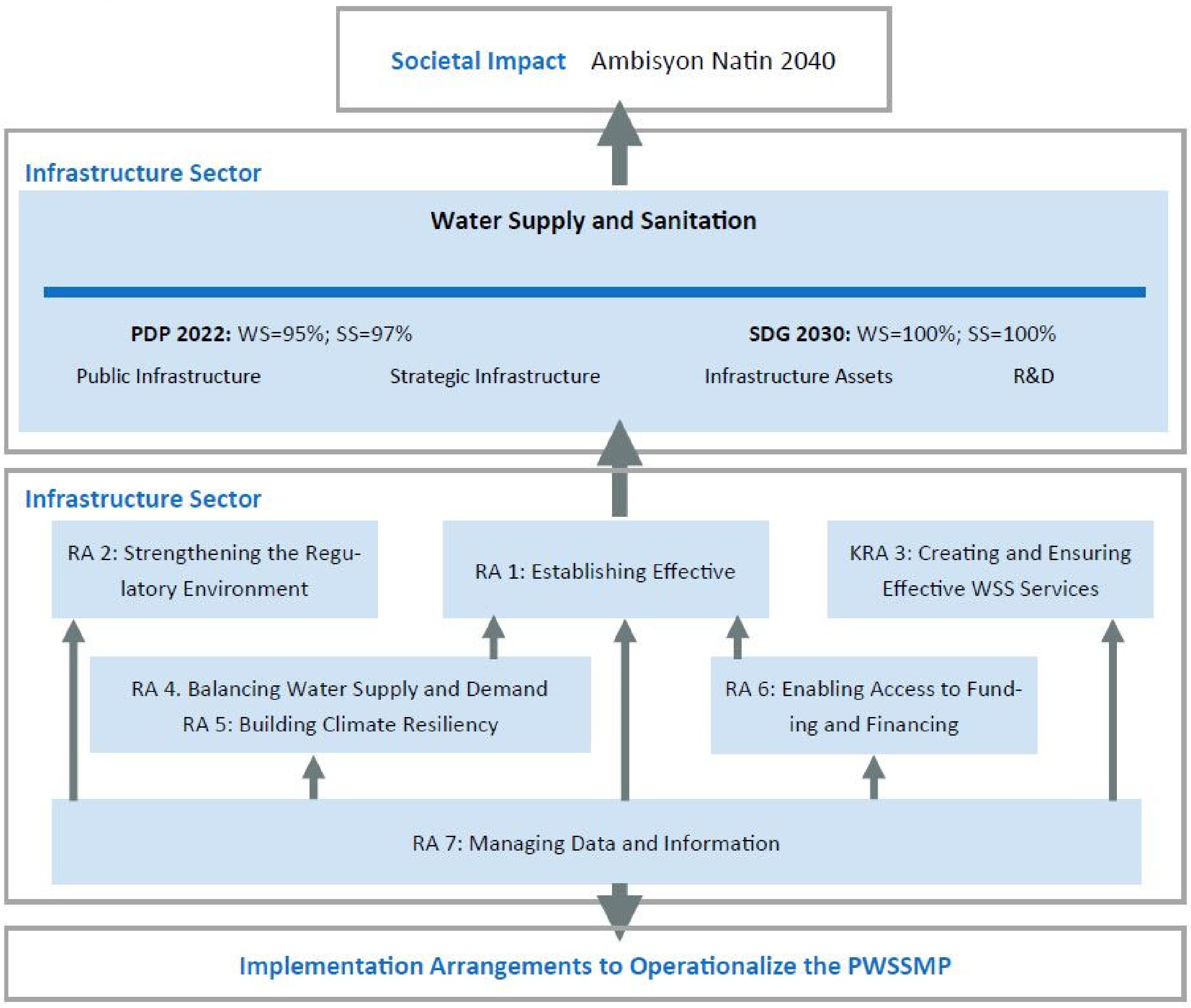


Figure 21: PWSSMP Results Framework Diagram

Table 18: Investment Requirements for Potential Projects

Region	Population	Access WS Gap	Access Sanitation Gap	Total Budget Requirement (In PhP Million)	Budget Requirements for 2022 (In PhP Million)	Budget Requirements for 2030 (In PhP Million)
CAR	1,722,006	137,516	523,458	20,418	12,415	8,003
Region 1	5,026,128	210,460	271,458	57,674	37,363	20,311
Region 2	3,451,410	-	92,934	38,446	27,389	11,057
Region 3	11,218,177	201,026	756,951	106,659	76,431	30,228
Region 4A	14,414,774	1,659,631	926,875	213,918	148,721	65,197
Region 4B	2,963,360	674,207	520,886	33,410	22,733	10,677
Region 5	5,796,989	1,407,084	672,902	51,574	33,026	18,549
Region 6	7,536,383	1,457,642	1,186,720	81,691	57,366	24,325
Region 7	7,396,898	2,609,319	1,229,842	101,637	75,299	26,339
Region 8	4,440,150	594,882	1,314,215	54,415	36,681	17,734
Region 9	3,629,783	832,841	245,591	42,683	27,156	15,527
Region 10	4,689,302	545,846	260,214	59,744	40,318	19,426
Region 11	4,893,318	679,003	396,798	55,758	35,705	20,053
Region 12	4,545,276	265,247	610,714	66,251	45,842	20,409
Region 13	2,596,709	214,780	431,633	31,364	22,711	8,653
ARMM	3,781,387	1,760,648	1,310,520	52,539	34,493	18,046
Total	88,102,050	13,250,132	10,751,711	1,068,186	733,657	334,529

infrastructure type (i.e., water supply, sanitation), year of commencement, and total budget in Table 19. A breakdown of these projects, on the other hand, is shown in the regional subsections.

Priority Projects

To ensure that funded infrastructure projects shall contribute to the timely achievement of national targets, the prioritizing framework is as follows:

- Higher priority is given to WSS infrastructure where 100% of target beneficiaries belong to: (1) households without access to safe water supply; and (2) households without access to basic sanitation.
- Higher priority is given to WSS infrastructure deemed feasible and ready for implementation.

PWSSMP has identified priority and pipeline projects that shall be funded in different stages of development for 2019 to 2020. Data on these projects included in the Priority Investment Program (PIP) were gathered from LWUA and DILG, among other government agencies.

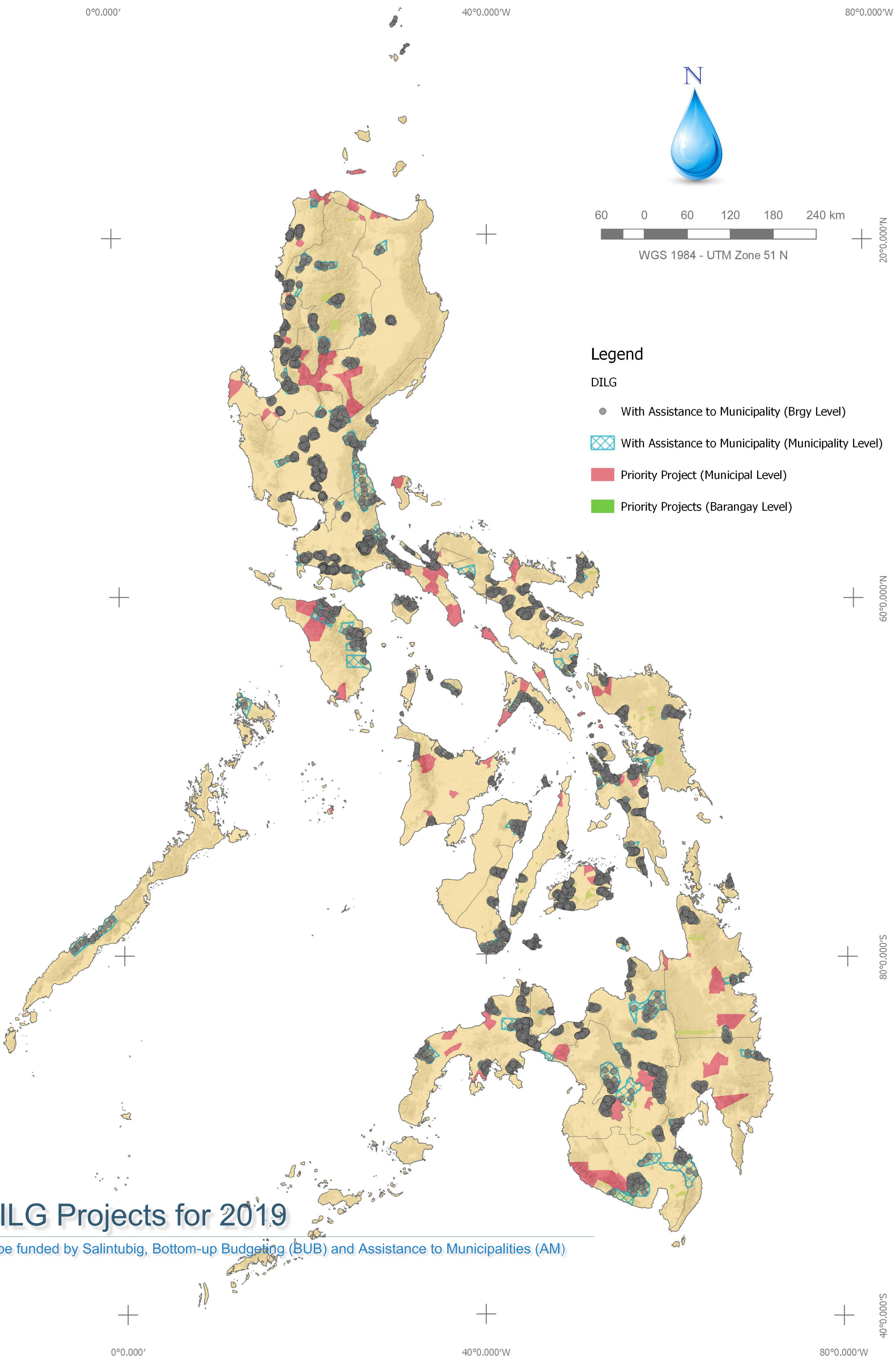
DILG's pipeline projects under Salintubig, Bottom-up Budgeting (BUB) and Assistance to Municipalities (AM) for 2019 were also considered.

As of 2018, NEDA has bid feasibility studies for Mandamus, non-Mandamus, high NRW, and non-operating WDs. The WDs with expected complete concept design and feasibility studies by 2019 are included in the pipeline projects for 2020 (mobilization). Also included in NEDA's Project Development and Other Related Studies (PDRS) Fund is the conduct of feasibility studies and/or concept designs for bulk water supply in selected provinces in the country. DILG will execute the project as its implementing agency (IA).

The maps on the next pages show the municipalities covered by these projects.

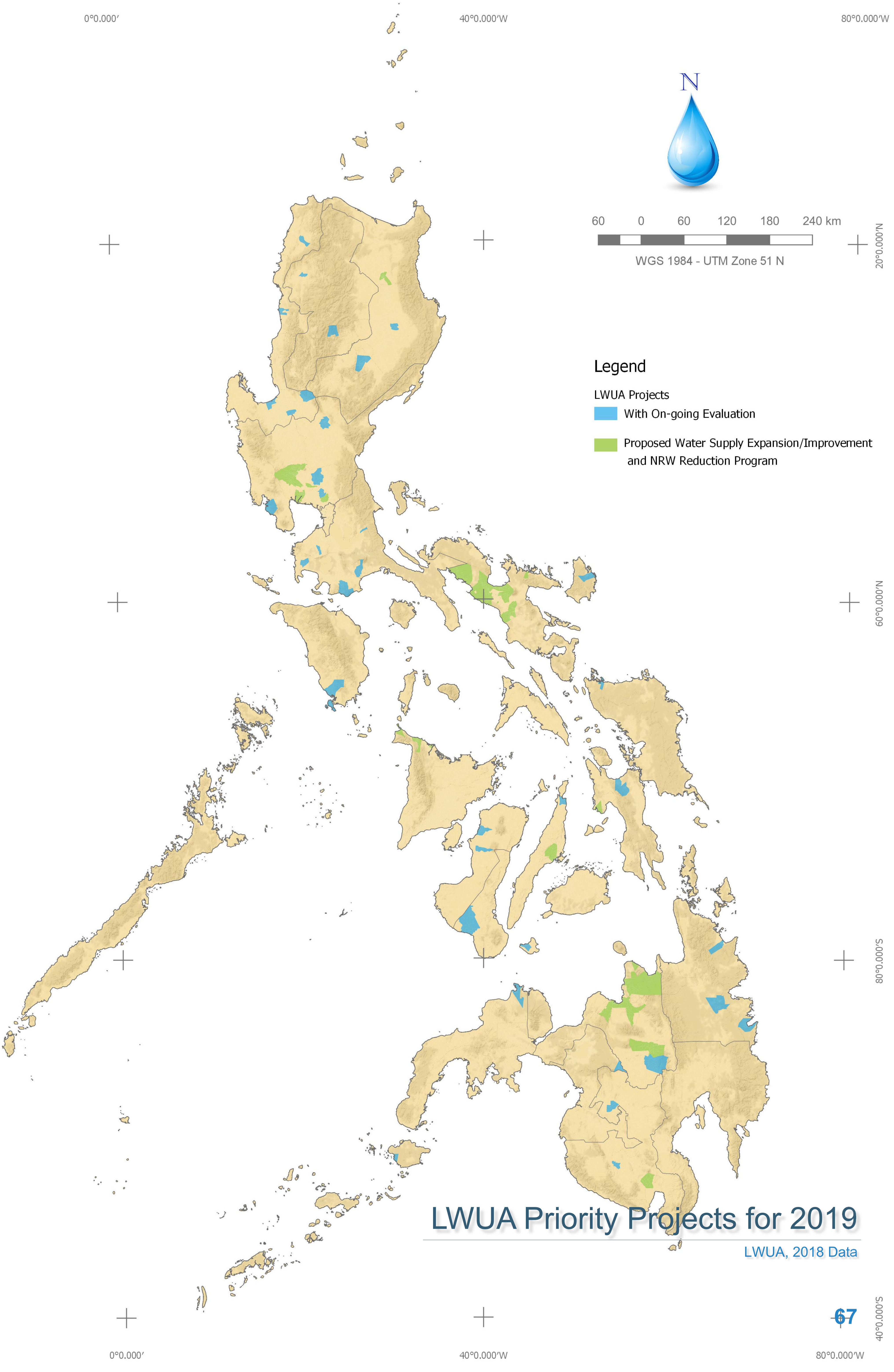
Table 19: Investment Requirements for Identified Projects

Agency/Region	Infrastructure Type	Project Cost Implemented in 2019-2023	Project Cost Implemented in 2024-2030	HH Beneficiaries	Percent Population Covered
DILG	WS	1,045,348,178.00	-	1,667,138	8%
	S	188,120,000.00	-	322,049	2%
DILG Salintubig	WS	1,549,641,000.00	-	863,992	4%
LWUA	WS	10,740,560,000.00	-	4,748,123	24%
CAR	WS	2,446,676,640.00	26,795,000.00	448,430	100%
	S	1,705,802,100.00	3,691,462,000.00		
	WSS	2,000,000.00	-		
Region 1	WS	7,328,294,801.35	1,003,845,900.80	1,241,079	100%
	S	100,000,000.00	8,950,884,500.50		
	WSS	3,000,000.00	-		
Region 2	WS	3,014,049,000.00	13,944,709,000.00	845,036	96%
	S	1,508,000,000.00	1,263,120,000.00		
Region 3	WS	34,342,093,000.00	1,935,100,000.00	2,174,945	72%
	S	210,000,000.00	57,625,816,000.00		
	WSS	2,502,000.00	67,000,000.00		
Region 4A	WS	2,052,010.00	-	1,547,066	39%
Region 4B	WS	4,104,450,000.00	1,916,950,000.00	765,497	100%
	S	6,182,000,000.00	383,980,730.00		
	WSS	8,000,000.00	-		
Region 5	WS	3,505,270,000.00	3,878,586,000.00	1,341,295	100%
	S	51,100,000.00	7,368,140,000.00		
	WSS	80,050,000.00	200,000.00		
Region 6	WS	-	10,000,000.00	474,538	25%
	S	-	80,000,000.00		
Region 7	WS	1,261,910,000.00	2,562,899,000.00	1,412,468	74%
	WSS	35,000,000.00	-		
Region 8	WS	730,500,000.00	1,401,677,420.45	999,767	82%
	S	-	338,000,000.00		
	WSS	1,000,000.00	-		
Region 9	WS	370,900,000.00	21,876,771,600.00	870,600	97%
	S	2,000,000.00	905,971,520.00		
	WSS	155,835,000.00	-		
Region 10	WS	8,556,430,000.00	8,892,800,000.00	828,170	70%
	S	4,392,481,420.00	2,299,036,910.00		
	WSS	257,100,100.00	15,000,000.00		
Region 11	WS	5,172,767,764.00	792,794,028.00	1,154,438	87%
	S	5,273,572,000.00	541,992,000.00		
Region 12	WS	32,160,000.00	474,946,000.00	1,000,291	82%
	S	170,000.00	91,420,000.00		
	WSS	790,280,000.00	64,000,000.00		
Region 13	WS	24,900,000.00	8,512,441,000.00	548,645	87%
	S	-	3,104,550,000.00		
ARMM	WS	4,331,952,110.00	10,691,005,026.67	725,449	100%
	S	11,742,740,000.00	8,060,535,614.00		
	WSS	12,800,000.00	41,600,000.00		
Subtotal	WS	75,224,405,325.35	77,921,319,975.91		
	S	31,167,865,520.00	94,704,909,274.50		
	WSS	1,347,567,100.00	187,800,000.00		
Total		107,739,837,945.35	172,814,029,250.42	16,377,714	72%



DILG Projects for 2019

To be funded by Salintubig, Bottom-up Budgeting (BUB) and Assistance to Municipalities (AM)



LWUA Priority Projects for 2019

LWUA, 2018 Data

Strategic Interventions

Apart from the activities and reforms proposed in the eight key agenda (discussed in detail in the Master Plan), a number of other strategic interventions to achieve the WSS sector targets in 2022 and 2030 are discussed below. These shall help ensure that the proposed infrastructure projects are realized and are readily applicable and adoptable at the local level.

These interventions shall also be discussed in detail and shall be region-specific in the subsequent regional roadmaps included in this Volume.

Water Supply

The proposed strategic interventions for the water supply sector are presented in Table 20.

To meet the targets for access and coverage as well as the normative content of water (service standards), the capital investments needed in 2022 and 2030 are listed in Table 21.

Table 20: Proposed Strategic Interventions for Water Supply

Access to Safe Water	Planning and Development	Service Provision	Regulation	Promotion
95% Access to Safe Water by 2022 Universal Access by 2030	▪ Planning, program or project design ▪ Establishing labs and water quality testing centers ▪ Lobbying for the Regional WSS Masterplan	▪ M&E expansion ▪ Rehabilitation/Non-revenue water (NRW) reduction maintained at 20% of total production ▪ Integration/ Amalgamation ▪ Automation ▪ Residuals management ▪ Mitigation ▪ Water potability maintained at all times ▪ Providing 24/7 water supply service ▪ Achieving 100% coverage ▪ Residuals management	▪ Water resources protection ▪ Arbitration ▪ Environmental and social safeguards ▪ Compliance with PNSDW 2017 ▪ Close monitoring of Joint Agreement ▪ Compliance training from DOH ▪ Resource studies	▪ Willingness to connect and pay ▪ Demand creation

Table 21: Capital Investments Required for the Water Supply Targets

Service Level	2022	2030
Level III	▪ Water source assessment and development ▪ Construction of water treatment facilities ▪ Distribution network expansion ▪ Provision of service connections ▪ NRW reduction program ▪ Watershed and water resources protection, management and development ▪ Development of a Water Safety Program ▪ Adoption of a rainwater harvesting program ▪ Establishment of adequately equipped laboratory testing centers in strategic areas to serve all service levels clientele	▪ Water source assessment and development ▪ Construction of water treatment facilities ▪ Distribution network expansion ▪ Provision of service connections ▪ NRW reduction program ▪ Watershed and water resources protection, management and development ▪ Development of a Water Safety Program ▪ Adoption of a rain water harvesting program ▪ Automation of operations and major services
Level II	▪ Rehabilitation of existing water supply system to upgrade it to Level III	▪ Rehabilitation of water supply system to upgrade it to Level III
Level I	▪ Upgrading to "safe level" those water sources found "unsafe"	▪ Adoption of a rain water harvesting program in areas not reached by Levels II and III services

Sanitation

Table 22 presents specific strategic interventions for varying levels of access coverage for improved sanitation. This indicates that proposed interventions are specific and tailor-fitted to actual local conditions.

Capital investments for the sanitation targets will include programs in basic sanitation, septage management, and sewerage management.

For basic sanitation, it is recommended that DOH prescribe a national basic sanitation program for the entire country – looking into a combination of micro-financing and behavior change communication. A Department Administrative Order on standard septic tank use and design will also be released by DOH soon after the planned consultation activities are rolled out in the country's three major island groups (Luzon, Visayas, and Mindanao).

For septage management, a clustering approach will be recommended to reduce capital costs and attain economies of scale. Clustering of municipalities to be served by their dedicated proposed STP had been accomplished by the provinces' representatives in the regional consultations. Clusters shall be discussed in detail in the succeeding regional roadmaps.

Table 22: Proposed Strategic Interventions for Sanitation

Access to Improved Sanitation	Planning & Development *Planning* *Program or Project Design* *Institution Building* *Training* *Financing* *Climate/Disaster Resiliency* *Policy*	Service Provision *Operations* *M&E* *Expansion* *Amalgamation* *Automation*	Regulation *Tariff/Pricing* *Resource* *Arbitration* *Registration, Permits, Rights*	Promotions *Social Preparation* *Advocacy* *Demand Creation* *Behavior Change*
High Access Areas with 60% to 100% Improved Sanitation Coverage	▪ Local Sustainable Sanitation Plan (LSSP) should be incorporated into the WSS Sector Plan, local development plan (LDP), annual investment program (AIP), and local health plan. ▪ A sewerage system program should be developed to provide service in the urban core coordinating with those in charge of the septage management program; project urban sprawl ▪ A National Sewerage and Septage Management Program (NSSMP) subsidy grant for sewerage and septage management programs (SMP) should be in place. ▪ Capacity development in regard to sewerage systems should be planned and integrated with other infrastructure. ▪ A sanitation ordinance covering sewerage system and septage management services should be passed, possibly integrating it into the environment code and Water Quality Management Areas (WQMA)	▪ Sanitation programs should focus on implementing sewerage systems and completing septage management programs. ▪ Expansion of urbanized and urbanizing barangays should be pursued. ▪ M&E system should conform to PSA/Census (covered by sewerage system, households desludged, and on-site systems).	▪ Tariff should be computed using full cost recovery with infusion of capex subsidy for sewerage projects. ▪ LGU implementers have undergone compliance training given by DOH and DENR (particularly in sewerage systems), and the Dept. of Agriculture (DA) with respect to regulations/guidelines governing disposal of by-products. ▪ Penalties should be strictly imposed on those not complying with certain requirements, including LGUs/WDs by filing cases with the environmental ombudsman.	▪ Promotions should focus on enjoining the public to connect to the sewerage system when made available stressing the importance of compliance and the benefits therefrom. ▪ Promotional efforts regarding water demand management should be supported to minimize wastage and unnecessary use of water. ▪ Building buy-in for paying for sanitation services should be promoted.
Medium Access Areas with 30% to 59% Improved Sanitation Coverage	▪ Local Sustainable Sanitation Plan (LSSP) should be incorporated into the WSS Sector Plan, LDP, AIP, and local health plan. ▪ A septage management program should be developed to provide service to the entire population using a customized approach in rural areas. ▪ The NSSMP subsidy grant should be included in septage management programs. ▪ A sanitation ordinance covering septage management services should be passed, possibly integrating it with the environment code and WQMA action plan.	▪ Sanitation programs should focus on implementing septage management programs and completing projects on basic sanitation and zero open defecation. ▪ Systems should be expanded to cover increase in population and additional buildings. ▪ M&E system should conform to PSA/Census (covered by households desludged and on-site systems). ▪ Sewerage system programs should be introduced.	▪ Tariff should be computed using full cost recovery with possible infusion of capex subsidy for septage management projects (with possible clustering of LGUs). ▪ LGU/WD implementers have undergone compliance training given by DOH and DENR (particularly in septage management systems), and by DA regarding regulations/guidelines on disposal of by-products. ▪ Strict penalties should be imposed on those not complying with certain procedures, including LGUs/WDs, by filing cases with the environmental ombudsman.	▪ Promotions should focus on enjoining households to have their septic tanks desludged once SMP is in place; the importance of building the right septic tanks and the benefits of good sanitation should likewise be promoted. ▪ Building buy-in for paying for sanitation services should be promoted.
Low Access Areas with 0% to 29% Improved Sanitation Coverage	▪ Local Sustainable Sanitation Plan (LSSP) should be incorporated into the WSS Sector Plan, LDP, AIP, and local health plan. ▪ A basic sanitation program should be developed and an ordinance thereon passed to make sure that every household/building has a toilet and septic tank and access to on-site treatment. ▪ Financial support should be pursued for basic sanitation programs – a combination of micro-finance and behavior change communication. possibly integrating output-based aid (OBA), sweat equity, and sanitation vouchers. ▪ Interventions should be planned for rural and inaccessible areas; alternative on-site systems should be developed.	▪ Sanitation programs should focus on implementing projects in basic sanitation and zero open defecation. ▪ M&E system should conform to PSA/Census in place (covered by on-site systems). ▪ Septage management programs should be initiated.	▪ LGU/WD implementers have undergone compliance training initiated by DOH and DENR (particularly in basic sanitation systems). ▪ Compliance with Office of the Building Officials and Sanitary Inspectors regulations and guidelines should be required. ▪ Strict penalties should be imposed on those not complying with building regulations and laws on open defecation.	▪ Promotions should focus on enjoining the public, households and building administrators to have their toilets and septic tanks properly installed; the level of public awareness of the benefits of good sanitation should be raised. ▪ Public awareness of the health and environmental hazards of open defecation should be generated.

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