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Review of Urban Wastewater Management and Clean Water Act

Sonny N. Domingo and Arvie Joy A. Manejar



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Review of Urban Wastewater Management and Clean Water Act

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Abstract

Wastewater and pollution management issues are usual negative externalities in the pursuit of economic development. This is true in the Philippines where industrial and domestic refuse often end up in tributaries and major water ways, sometimes even contaminating ground water due to improper septage and sewerage design. The passage of the Clean Water Act (Republic Act No. 9275), and the subsequent launching of the National Sewerage and Septage Management Plan (NSSMP) were expected to facilitate the accomplishment of water sectoral targets. While acknowledged to be an integral component of the country's development agenda, wastewater management's requirements for large scale investments and resources were often overlooked and underfunded, adding to target shortfalls. The sector also remained plagued with institutional fragmentation and disjointed efforts in the absence of an overarching framework and master plan. In view of these challenges, the study echoes the call to rationalize the sector's institutional governance, and development direction. Improved septage coverage and standardization guidelines are viable short run intervention, while the national government orchestrates and the local government units muster interest in investing on sewerage facilities.

Keywords: clean water act, wastewater management, sewage, septage, sanitation, effluent

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1. Introduction

1.1. Background of the Study

Sanitation and waste-water management are often correlated with issues on public health, economic progression, environmental integrity, and climate change. Such makes this discourse critically relevant to the country's evolving development agenda.

OECD's observation and projection of increasing water stress, including the complications from climate change, raise the stakes for at-risk and disadvantaged communities². In Metro Manila alone, approximately 2,000 cubic meters of solvent wastes, 22,000 tons of heavy metals, infectious wastes, biological sludge, lubricants, intractable wastes, as well as 25 million cubic meters of acid/alkaline liquid wastes are improperly disposed of annually. However, only five percent³ of the population is connected to sewerage networks and treatment facilities, equivalent to only around 440,000 households being serviced.

The compounding problems of open defecation, inadequate sanitation facilities, and unmanaged discharge of wastewater into water bodies subject communities to health hazards and contribute to unmitigated environmental damage (Agcaoili et al. 2015; Buonocore et al. 2018). Annual losses are conservatively estimated at about PHP 67 billion, the biggest for tourism at PHP 47 billion, and fisheries at PHP 3 billion (Bergkamp & Lim 2018).

The passage of Philippine Clean Water Act of 2004 (Republic Act No. 9275) and the eventual rollout of the National Sewerage and Septage Management Program (NSSMP) both aimed to address the above situational concerns and emerging threats. The study looked into relevant policy provisions and grounding, while bringing to light the current priorities and concerns of select case study sites, including insights from the biggest water concessionaires in the National Capital Region, and the local government initiatives of the City of Baguio in the northern Philippines.

1.2. Objectives

The study generally reviewed waste-water related policy and implementation, particularly in select urban case study sites. Specifically, the study (a) assessed the National Sewerage and Septage Management Program (NSSMP) vis-à-vis policy declarations under the Clean Water Act; (b) identified existing wastewater management arrangements and corresponding sewerage and treatment coverage in both national and subnational levels; (c) Reviewed institutional structures and financing mechanisms vital to implementation of the policy; and, (d) mapped persistent and emerging concerns across case studies and the bigger literature landscape and identification of areas for intervention.

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² "At least 1.8 million children under 5 years old die every year or one every 20 seconds because of water and sanitation-related diseases" (Pham & Kuyama 2013; OECD 2012).

³ Philippine Development Plan 2017-2022

1.3. Policy questions

Wastewater management in the Philippines started way back in the 1970s, but the problem remained unabated, and the quality of water bodies and watersheds continued to degrade over the years. The passage of Clean Water Act sought to jointly address the problem of water pollution and sewerage provision, protecting natural resources and human health.

The study sought to answer the following policy questions:

- What is the status of implementation of policy provisions on wastewater management?
- How has the NSSMP bridged compliance to the provisions of the Clean Water Act?
- What policy augmentations can be made to facilitate the implementation of NSSMP and RA 9275?

1.4. Methodology

1.4.1. Conceptual framework

The Clean Water Act and NSSMP were assessed within the process evaluation framework; the concept allowed to pinpoint the services provided, the recipients, and the extent given. Through this method, one could identify strengths and weaknesses of the program during the implementation process and where improvements could come in.

The following table was adapted from the studies of Capodaglio (2017) in assessing decentralized water management systems and Robinson (2003) using Methodology for Participatory Assessments (MPA) on sanitation services.

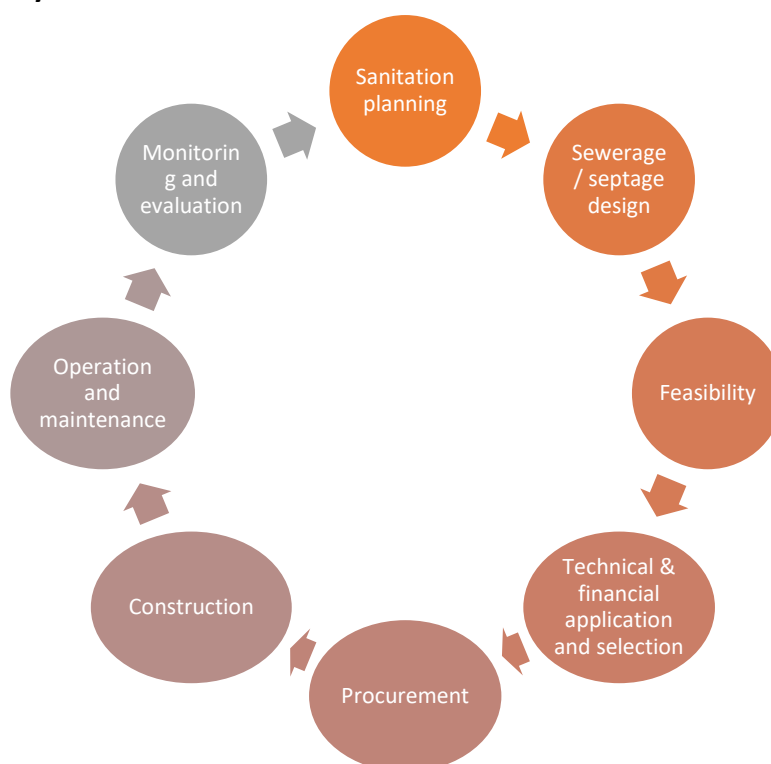
Table 1. Process evaluation indicators

Activities	Sub-activities	Immediate Outcomes	Indicators
Streamline procedures in water pollution abatement	Domestic sewage collection, treatment, and disposal	Increased sewerage access and coverage	Number of households with access
	Industrial sewage systems within PEZA		Number of economic zones with water management systems
Promote environmental strategies	Establishment of wastewater treatment plants	Increased service coverage of WWTPs	Number of treatment plants
	Use of technology for reuse	Available by-products for reuse	Number of septic tanks connected to treatment plants
			Valuation of reused by-products (energy, biosolids)
			BOD diverted, amount of sludge reused and effluents treated

Formulate national program of water management	holistic quality	Clear delineations among institutions and entities	functional among and	Increased coordination among institutions and entities	No overlaps and conflicts in functions and policy objectives
					Data on water-related diseases
					Accrued and mitigated loss from water bodies (fishing income, other ecosystem services, flood and typhoon damage)
Enforce accountability systems on adverse impacts	Functional appropriate systems	Functional and charge	and liability	Commensurate to cover costs of water management	Cost of infrastructure related to wastewater management
	Functional mechanisms	Functional liability	liability	Fines and penalties go to national and area funds	Cost effectiveness on discharge fees
	Available incentives and rewards	Available incentives and rewards	incentives	Incentive mechanisms are accessed	Expenditure list of fines and penalties vis-à-vis existing funds
					Amount of cash incentives availed; number of entities included in the priority list since 2004

Indicators followed the project cycle detailed in the NSSMP, allowing for triangulation of results from literature and policy, data outputs, and case studies.

Figure 1. Project cycle in NSSMP



1.4.2. Data collection and analysis

The data gathering followed the case study approach of Gamaralalage, Gilby, & Lee (2015). Primary data were collected through key informant interviews (KII) and focus group discussions (FGD) with key implementers and concessionaires while secondary data were generated from various databases.

Table 2. List of data sources

Primary data	Secondary data
Maynilad	OpenStat
Manila Water	Listahang Tubig
Baguio City	NEDA PH Water Supply and Sanitation Master Plan
DENR – Water Quality Management Division	Annual Poverty Indicators Survey
	National Demographics and Health Survey

2. National landscape

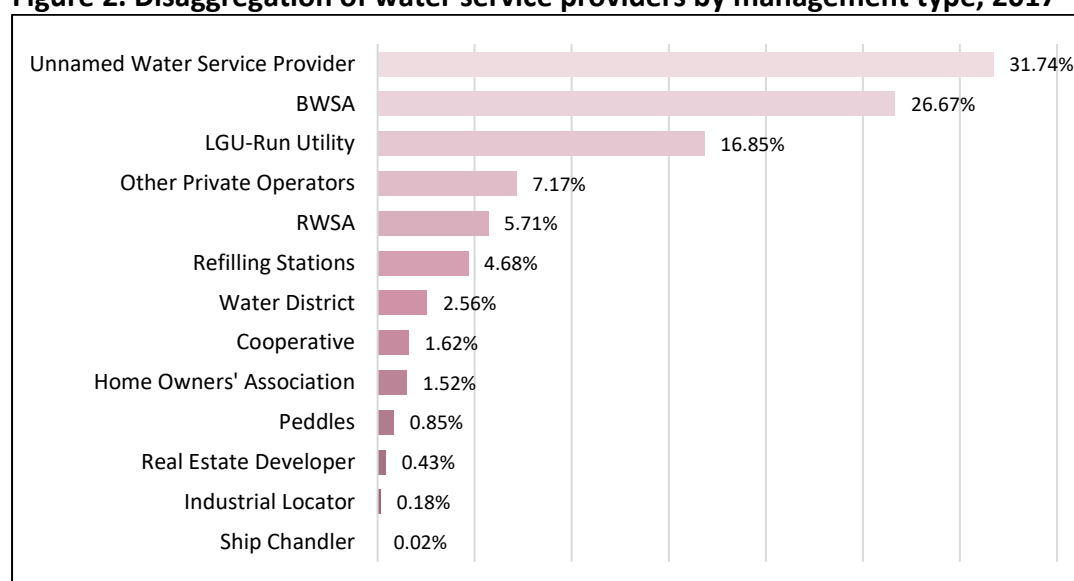
2.1. Water supply

Unnamed water service providers⁴ dominated the number of suppliers with 31.74 percent share in composition. Following next were Barangay Waterworks and Sanitation Association

⁴ They serve a minimum of 15 households but do not have formal registration with the government. Definition from Philippine Water Supply and Sanitation Master Plan 2019-2030

(BWSA), LGU-run utilities, private operators, and Rural Waterworks and Sanitation Association (RWSA).

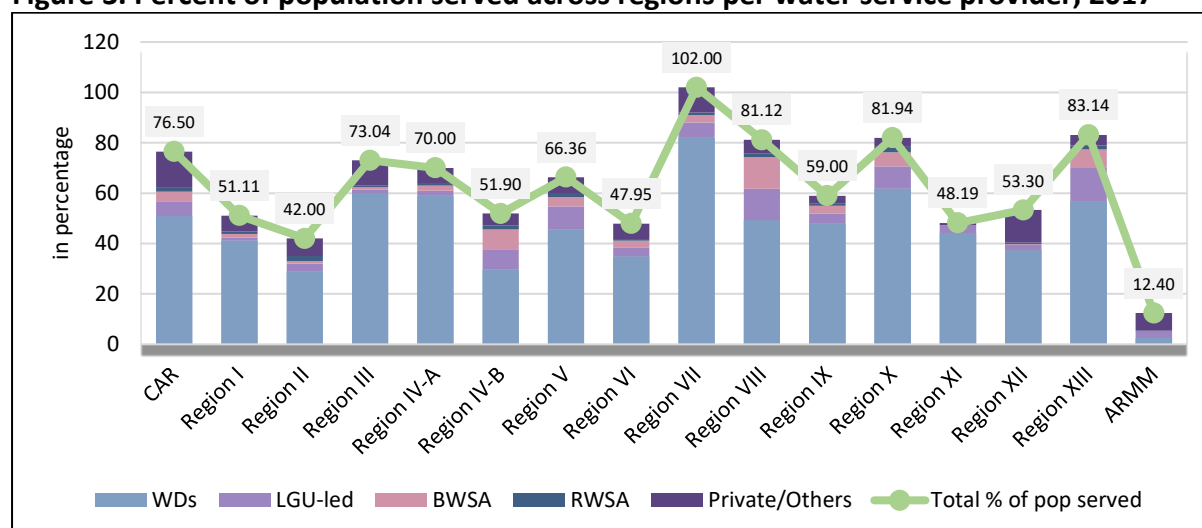
Figure 2. Disaggregation of water service providers by management type, 2017



Source: Listahang Tubig 2017

In terms of percent of population served however, water districts dominated the landscape in all regions, followed by private/others and LGU-led utilities. Region VII had 102 percent of its population served with various providers while ARMM had a concerning figure of only 12.40 percent.

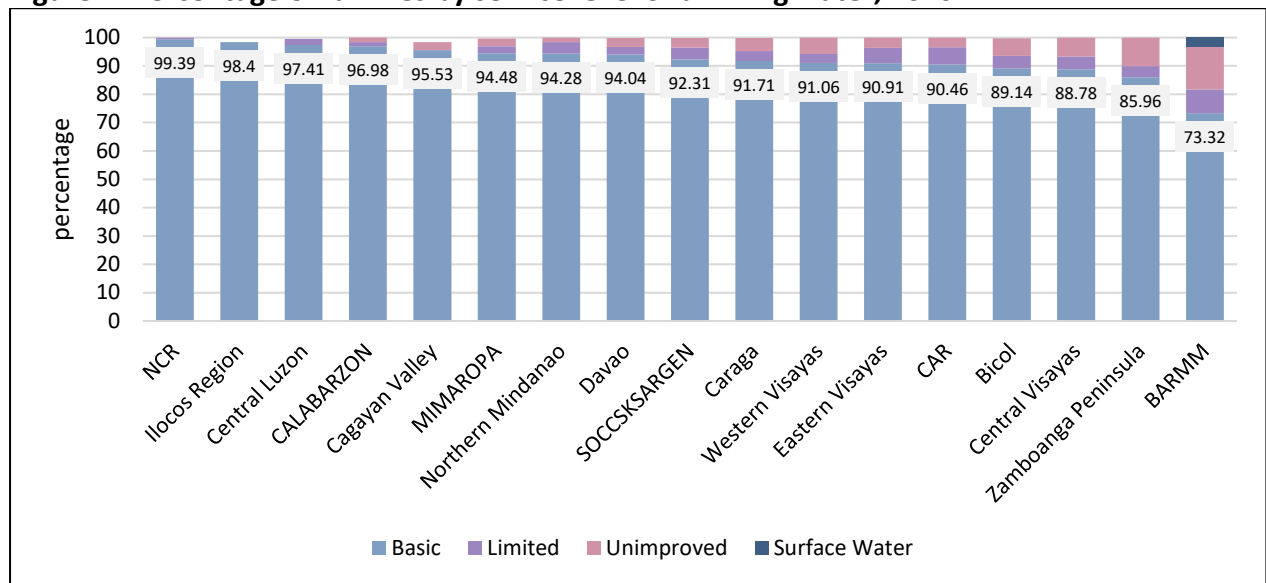
Figure 3. Percent of population served across regions per water service provider, 2017



Source: Listahang Tubig, 2017

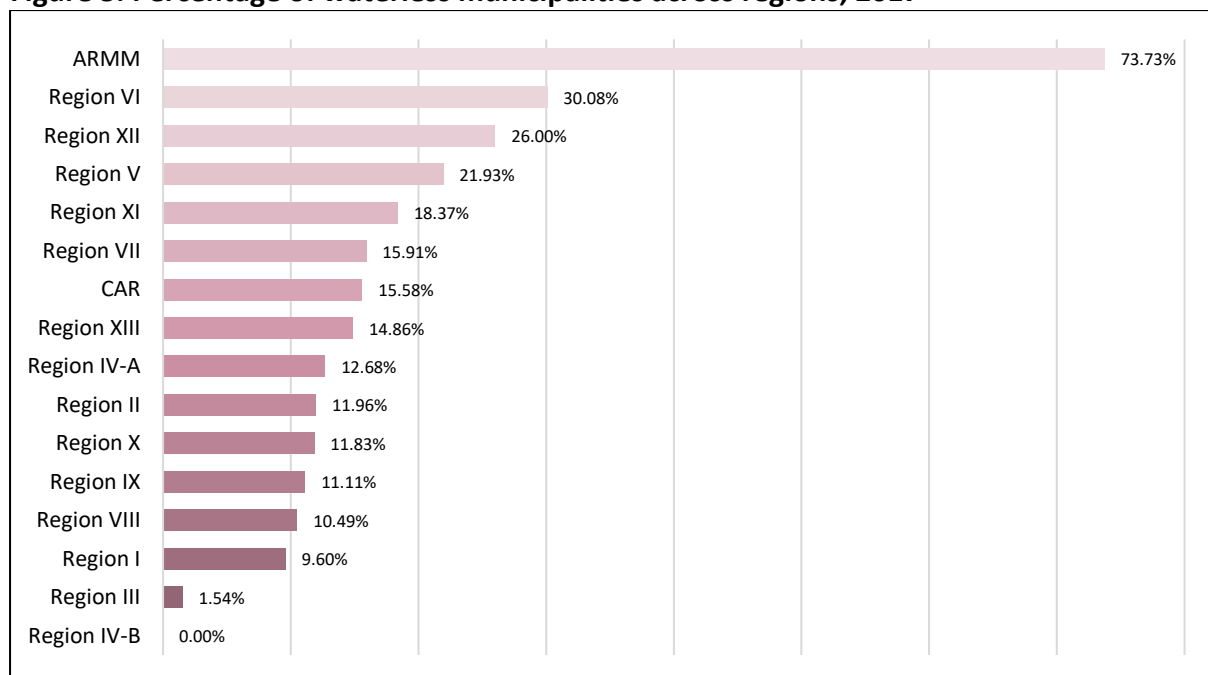
Figures for basic service level in terms of drinking water were relatively high. NCR was highest in coverage with 99.39 percent, followed by Ilocos Region, Central Luzon, and CALABARZON. BARMM, aside from being the only region below 80 percent, also had 8.34 percent limited service, 15.18 percentage unimproved, and 3.16 percent surface water.

Figure 4. Percentage of families by service level of drinking water, 2020



Consistent with the observations above, ARMM had the highest waterless municipalities. This strongly indicated the need to catch up with the other regions' water service coverage and access.

Figure 5. Percentage of waterless municipalities across regions, 2017



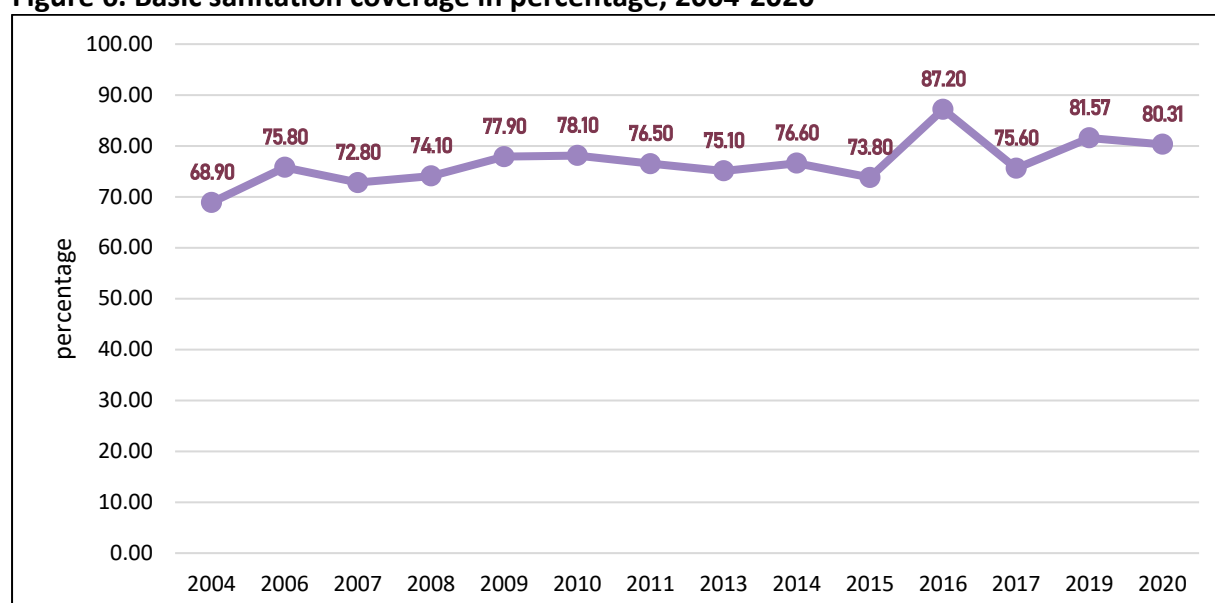
Source: Listahang Tubig 2017

2.2. Wastewater management

National coverage of toilet facilities showed slight fluctuations across the years, suggesting household movements from improved to unimproved sanitation. PSA defined basic sanitation services as presence of non-shared, improved sanitation facility with hygienic separation of human excreta from human contact.

In Figure 6, the highest coverage was recorded in 2016 followed by an immediate fluctuation to 75.60 in 2017. Most recent figure pegged the percentage at 80.31 in 2020.

Figure 6. Basic sanitation coverage in percentage, 2004-2020



Source: Compiled from various sources (APIS, FIES, Philippine Water Supply and Sanitation Master Plan 2021)

More than three fourths of the population have access to improved and not shared sanitation facilities, but open defecation persisted in three to four percent of the population (Table 3). The latter condition was aimed to be eradicated in several commitments and development goals.

Table 3. Breakdown of sanitation facilities in the Philippines, 2016-2020

Type of sanitation facilities	2020	2019	2018	2017	2016
Improved, not shared facility⁵	80.39	81.57		75.60	87.20
Flush to piped sewer system	7.44	9.93		5.90	
Flush to septic tank	61.04	55.18		67.10	84.50
Flush to pit latrine	9.97	14.30		2.30	
Ventilated improved pit latrine	0.92	0.96		0.00	
Pit latrine with slab	0.98	1.11		0.20	2.70
Composting toilet	*	0.10		0.00	
Unimproved sanitation	16.09	14.68		24.40	
<i>Shared facility</i>	<i>13.49</i>	<i>10.93</i>		<i>19.60</i>	
Flush to piped sewer system	1.06	1.05		1.10	
Flush to septic tank	10.31	7.57		17.50	
Flush to pit latrine	1.56	1.94		0.70	

⁵ "Improved sanitation facilities are designed to hygienically separate excreta from human contact. These include wet sanitation technologies (flush and pour flush toilets connecting to sewers, septic tanks or pit latrines) and dry sanitation technologies (ventilated improved pit latrines; pit latrines with slabs; or composting toilets)" (PSA 2019, p.17).

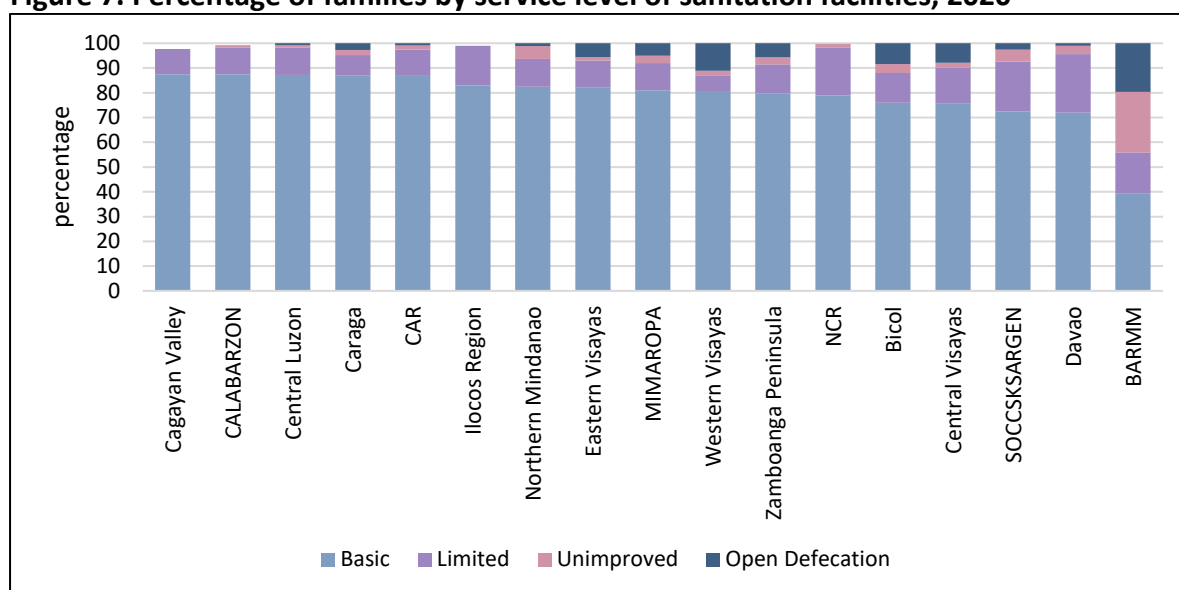
Ventilated improved pit latrine	0.17	0.10	0.00	
Pit latrine with slab	0.32	0.23	0.10	
Composting toilet	*	-	0.00	
<i>Unimproved facility</i>	<i>2.60</i>	<i>3.75</i>	<i>1.90</i>	
Flush to open drain	1.14	1.29	0.90	
Flush to don't know where	0.26	0.55		
Pit latrine without slab/open pit	0.24	0.44	0.50	2.70
Bucket	*	*	0.10	0.30
Hanging toilet/hanging latrine	0.49	0.68	0.30	0.80
Public Toilet	0.40	0.51	0.10	
Other	*	0.15	0.10	4.20
No facility/bush/field	3.53	3.75	3.00	

Source: NDHS 2017, APIS 2016, 2019 and 2020

Notes: (1) Classifications based on WHO/UNICEF JMP Report 2017; (2) An asterisk indicates that a figure is based on fewer than 25 unweighted cases and has been suppressed.

BARMM (formerly ARMM) also exhibited low figures for the sanitation sector; it only recorded 39.26 percent coverage, but the region has high percentage of open defecation and unimproved sanitation. The highest coverage figures were recorded in Region II, Region IV-A, and Region III while the capital region with most HUCs, NCR, ranked only 12th.

Figure 7. Percentage of families by service level of sanitation facilities, 2020



Source: APIS 2020

Urban areas have higher basic service level coverage than rural areas, the latter having higher open defecation incidence. Communal facilities with septic tanks were commonly set in these areas, but desludging and transport costs to remote places have been noted to be expensive for lower quintile users.

Basic coverage decreased in both urban and rural areas compared to 2019 figures, but limited coverage grew. This supported the observation of movements in sanitation access which can

be attributed to several things: population growth, migration, and economic performances, among others.

Table 4. Comparison of sanitation facilities between urban and rural, 2019-2020

Service level	2019		2020	
	Urban	Rural	Urban	Rural
<i>No. of families (in '000)</i>	13,041	12,269	13,332	12,516
Basic ⁶	82.8	80.2	80.9	79.9
Limited ⁷	12.2	9.6	15.7	11.2
Unimproved ⁸	2.9	4.6	1.8	3.4
Open defecation ⁹	2.1	5.5	1.6	5.6

Source: APIS 2019 and 2020s

2.3. Prevailing policies

Clean Water Act (RA 9275, 2004)¹⁰ informed subsequent policies and regulations in the sector. It had the primary goal of protecting water bodies from domestic, commercial, and industrial discharges, all land-based sources of pollution. The policy, at the moment of its inception and during its first years of implementation, did not consider uncontrolled and unmitigated sewage as a contributing factor yet but focused instead on ensuring the connectivity of all sewage lines to sewerage systems five years within its passage.

To achieve this, the IRR spotlighted key actions: designation of the water quality management areas (WQMAs), development of the National Sewerage and Septage Management Plan (NSSMP), provision of water supply and sewerage to highly urbanized cities, and prescription of wastewater discharge fees. The preparation of NSSMP, in particular, was aligned with the frameworks of the National Sustainable Sanitation Plan (NSSP) and the Philippine Sustainable Sanitation Roadmap in addressing the full spectrum of sanitation challenges (DPWH 2013).

NEDA and DPWH¹¹ jointly headed the Technical Working Group (TWG) and Inter-agency Steering Committee in charge of the implementation of NSSMP. The general goal of NSSMP to improve water quality and public health in urban centers by 2020 fit well with the combined perspective of economic development and infrastructure. This was further supplemented with the more specific objectives namely, to enhance the capacity of local implementers to construct, maintain, and operate wastewater treatment systems; foster an enabling environment for effective and sustainable systems, and encourage bottom-up relationships by providing national support in resources and incentives (DPWH 2013).

Launched in 2010, the program's initial coverage was intended only for highly urbanized cities and first-class municipalities. It offered a 40 percent national government subsidy for sewerage projects with the following partnership options: (a) LGU and water district, (b) LGU only, (c) LGU and private partners, and (d) tripartite agreement among LGU, WD, and private partners.

⁶ Use of improved facilities not shared with neighbors or other households

⁷ Use of improved facilities shared between two or more households

⁸ Includes pit latrines without a slab or platform, hanging latrines or bucket latrines

⁹ Disposal of human feces in the surrounding environment, any open space, or with solid waste

¹⁰ Its IRR was released in 2005 through DENR Administrative Order 2005-10

¹¹ Local Water Utilities Authority, DENR, DOH, and MWSS and its concessionaires are also active members of the steering committee and TWG.

An influx of interest and inclusion concerns led to amendments¹² in 2017, including the extension of coverage to non-HUCs and an increase of assistance to 50 percent across sewerage, septage, and combined sewerage and septage projects.

Related policies on wastewater management, sanitation, and natural resource protection listed in the table below showed rough priority evolution and mandate distribution. Policies passed after Clean Water Act were expected to ensure availability and sustainable management of water and sanitation (SDG 6, Clean Water and Sanitation).

Table 5. Related laws and policies on sanitation

Policy	Description
PD 856, Code on sanitation of the Philippines	Septic tanks must be water-tight, inspected once a year, must be cleaned and treated when sludge reduced liquid capacity by 50 percent
Operations manual on rules and regulations governing domestic sludge and septage	Haulers and treatment entities must secure an Environmental Sanitation Clearance (ESC) from the Center for Health Development of DOH
Plumbing Code of the Philippines	Illegal to deposit oil, grease, or other things which could damage plumbing fixtures connected to excreta and storm drainage
Commonwealth Act 383, Anti-Dumping Law in 1938	Prohibition on dumping of waste matter and other substances into rivers
PD 198	Water district may require, construct, operate, and furnish facilities and services for collection, treatment, and disposal. They have discretion to require all buildings to connect to sewer system and prescribe rates and charges. Failure to comply may result to denial of water services
PD 984	Pollution Control Law in 1976; regulation of water pollution from industrial sources, set penalties and permit requirements
DENR AO 90-34	Revised Water Usage and Classification/Water Quality Criteria; categorized water bodies according to usage and provided parameters and criteria for the quality each classification
DENR AO 90-35	Revised Effluent Regulations of 1990; provided standards of effluents for each water body
Local Government Code in 1991	There are levels of responsibilities per institution – barangays for general hygiene and sanitation services; provinces, municipalities, and cities for drainage and sewerage infrastructure. LGUs may also impose special levy on lands but shall not exceed 60 percent of actual project costs
DENR AO 94-26A	Philippine National Standards for Drinking Water; identified parameters for safe, drinking water
Department of Health Sanitation Code	1995 Rules and Regulations of Chapter 17, provided sewage collection and disposal, excreta disposal and drainage
DENR AO 97-39	Chemical Control Order for Mercury and Mercury Compounds
DENR 98-58	Priority Chemical List; listed chemicals with large risk and hazard to public health, workplace, and environment
DENR AO 2000-18	Chemical Control Order for Cyanide and Cyanide Compound
Ecological Solid Waste Management Act in 2001	Landfill leachate should not seep in reservoirs and groundwater.

¹² Per NEDA Board Resolution No. 6 s. 2017

DA AO 2007-26	Guidelines on the Procedures and Technical Requirements for the Issuance of a Certification, Allowing the Safe Re-Use of Wastewater for Purposes of Irrigation and other Agricultural Uses.
PEZA 2009-19	Guidelines on Wastewater Management; requires all economic zones to have a centralized wastewater treatment facility. Monitoring will be done by an accredited pollution control officer or environmental management officer.
PNS/BAFS 183:2016	Philippine National Standard on Organic Soil Amendments; regulation of sludge, biosolids, and biochar sold to the market
DENR AO 2016-08	Water Quality Guidelines and General Effluent Standards (GES); provides additional 16 parameters to monitor the industry with. Industries were given a grace period of five years to comply.

Source: DPWH 2013; Bergkamp & Lim 2018

2.4. Sector goals and commitments

Despite the initial high interest, uptake for NSSMP eventually dwindled down due to preference for sewerage systems. These entailed capital expenses, and costs of operating and maintenance were considered heavy¹³ for a non-HUC and non-first class LGU. Since the subsidy was capped at 50 percent, an alternative route offered by DPWH was assistance in feasibility studies. Only Zamboanga City availed of the program as of October 2021 with a subsidy worth PHP 79.3 million, seconded by Cotabato City's application under review¹⁴.

Table 6. Status of NSSMP applications, 2012-2020

Fiscal year	LGU	Status
2012	Puerto Galera (non-HUC)	Letter of intent
2013	Baguio City	Requested for other documents
2013	Isabela City Water District (non-HUC)	Requested for other documents
2013	Metropolitan Naga WD	Awaiting other documents
2013	Zamboanga City	Approved as of 2020
2014	Roxas, Palawan	Awaiting other documents
2014	General Santos City WD	Requested grant for feasibility study
2014	Olongapo City	Requested for 100% subsidy; does not conform to 40% NG Cost Share
2014	Cotabato City (non-HUC)	Pending amendments to NSSMP scope
2016	Butuan City	Submitted final FS reports on October 2018
	Cagayan de Oro City	
2018	Bacolod City	Awaiting submission of final reports
	Iloilo City	
2019	General Santos City	Ongoing
	Puerto Princesa City	
2020	Iligan City	Ongoing
	Olongapo City	

Source: PPP for 2012-2014; DPWH for 2016-2020

The maximum targets set by pertinent policies reflected the importance of sanitation in international development agenda. While a noble effort, the progress remained non-

¹³ Per Baguio City, the subsidy does not cover maintenance costs which may not be feasible for low income LGUs.

¹⁴ From DPWH's email response to data request dated October 25

commensurate to the expectations. All numbers fell short for 2020 except for access coverage for sewerage treatment facilities. The combined serviced population from the concessionaires exceeded the target of 3.20 million people. Septage had a lower accomplishment due to its five-year cycle and dependence on household request for treatment assistance.

Table 7. Status and accomplishments of Clean Water Act and NSSMP on sanitation

TARGET	BASELINE	YEAR	SOURCE	LATEST DATA	YEAR	SOURCE	2020 TARGET
By 2020, all LGUs (1,634) will have developed septage management systems	3 percent (52 of 1,634)	2015	PWSSMP Inventory	71.35% households have on-site septic tanks	2020	APIS	100 percent
By 2020, all 17 HUCs have sewerage systems	6 percent (1 of 17)	2015	PWSSMP Inventory	8.5% households have access to sewerage (national) 5% population connected to sewer network	2020 2019	APIS DENR	100 percent
By 2020, approximately 43.60 million people will have had access to septage treatment facilities	41 percent	2015	PWSSMP Inventory	Only 10% of wastewater is treated (national) 454,806 cubic meters treated, 9,398,944 people	2019 2020	DENR MWSS	43.60 million
By 2020, approximately 3.20 million people will have had access to sewerage treatment facilities	24.7 percent	2015	PWSSMP Inventory	127,838,190 cubic meters treated 4,227,274 people	2020	MWSS	3.20 million

Source: Authors' compilation from various sources

Table 8 focused on environmental indicators of the policies. An overview of the progress identified room for improvement for industry compliance to wastewater discharge. The extent of oversight agencies ranged from cease-and-desist orders to administrative cases with the pollution adjudication board. However, no establishment has been convicted yet.

Table 8. Status and accomplishments on environment

COMMITMENT	TARGET	STATUS	SOURCE
Water quality of rivers preserved	421 rivers	180 rivers polluted	DENR Report to WEPA
Improvement of priority rivers' water quality	42 rivers (only 37 monitored)	30 (81%) passed BOD 31 (84%) passed DO	EMB 2018
Industries comply with DENR Standards and have wastewater discharge permit	100%	45.41% (Manila Bay) 50% (national level)	DENR Report to WEPA

Volume of BOD diverted	346 million kgs (against 7,465 million cubic meters of annual wastewater)	37.6 million kgs removed (Metro Manila)	2016-2020 DENR Report to WEPA
Investment for sanitation improvement	PHP 26.3 billion	PHP 3.16 billion (programmed spending)	2020 ADB WDDSP, LWUA

Notes: Biological Oxygen Demand (BOD) is a measure of oxygen needed to remove waste organic matter from water in the process of decomposition. It indicates the degree of organic pollution in the water body. Dissolved oxygen (DO), on the other hand, is the amount of oxygen found in the water body which decreases as organic materials increase.

Source: Authors' compilation from various sources.

2.5. *Institutional arrangements*

The Clean Water Act designated the Department of Environment and Natural Resources (DENR) as the oversight agency for the implementation on water quality guidelines, effluent standards, and environmental regulatory compliance, but this did not consolidate mandates of institutions across specific aspects on sanitation.

On establishment compliance alone, supplemental efforts came from Laguna Lake Development Authority (LLDA) as its water body jurisdiction spanned local governments and livelihood sectors¹⁵; Philippine Economic Zone Authority (PEZA) for industry sector; and Bureau of Agriculture and Fisheries Standards for agricultural reuse guidelines (Bergkamp & Lim 2018).

Metropolitan Waterworks and Sewerage System (MWSS) and Local Water Utilities Authority (LWUA) regulated the concessionaires while the Department of Health (DOH) provided the standards for drinking water as well as health guidelines for collection, treatment, and disposal of sewage (Claudio 2013). The latter has a separate Sanitation and Wastewater Management Division focused on disposal of hospital wastes as a mandate from PD 856.

In the subnational level, Local Government Code (RA 7160) required local governments to establish sanitation systems however, few have managed to comply due to limited capacity and weak incentives. These services were typically carried by water districts and/or private service providers.

2.6. *Infrastructure Financing and Tariffs*

Fines, permit fees, endowments, donations, and grants mainly comprised national water quality management fund while discharge fees¹⁶ financed some subnational level activities which include maintenance of wastewater facilities and water body upkeep, among others (Claudio 2013). Fines for non-compliance of any provision in the Clean Water Act ranged from Php 10,000 to 200,000 per day of violation, and contamination of coastal and marine waters were higher at Php 500,000. As cushion, program and projects related to the policy were required

¹⁵ Existing lake uses included fisheries (capture, aquaculture), flood reservoir, power generation, recreation, irrigation, industrial cooling, waste sink, source of potable water (<https://ilda.gov.ph/existing-lake-uses/>).

¹⁶ This should reflect level of cost for polluters to modify production or management process; should also cover water quality programs, rehabilitation, type of pollutant, classification and attributes of water body.

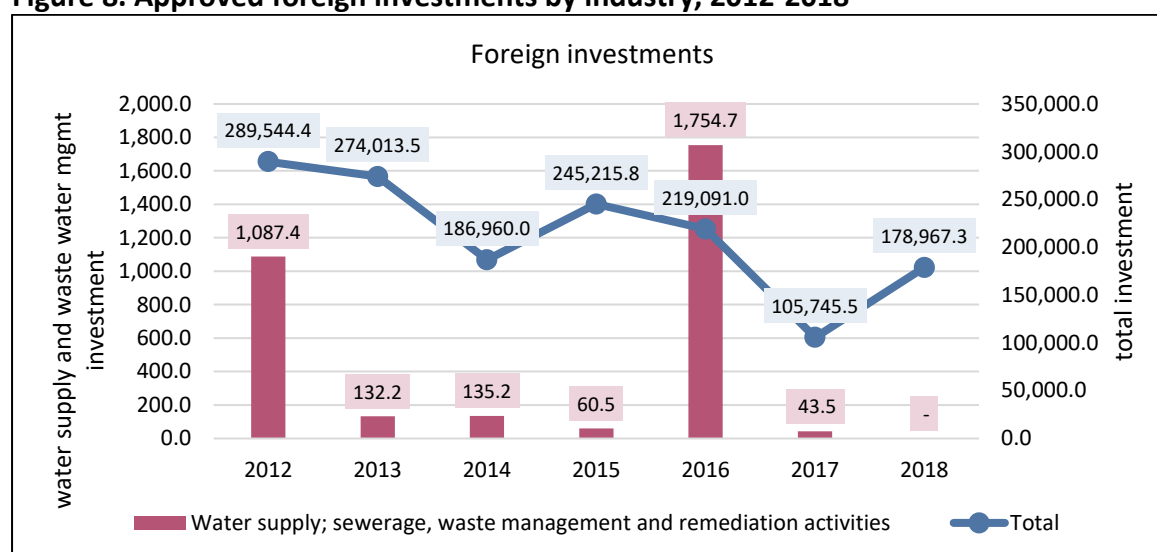
by DENR to have environmental guarantee fund (EGF) for the conservation of watersheds and aquifers and a conduct of programmatic environmental impact assessment (EIA).

On the other hand, the National Water Regulatory Board (NWRB) regulated the tariff for small water and wastewater utilities in the Philippines in which local water service operators were allowed a maximum rate of return of 12 percent. Costs of wastewater treatment, divided into personnel, chemical treatment, sludge disposal, and maintenance fees, were already lodged in the national average tariff of USD 0.36 per cubic meter (Bergkamp & Lim 2018).

As the landscape leaned more towards more sustainable forms of wastewater reuse, monetary institutions picked up green financing mechanisms. Several of these were DBP's Green Financing Program¹⁷; LBP and World Bank Group – International Bank of Reconstruction and Development (IBRD)'s lending stream called CLEECF Program¹⁸; Sustainable Energy Finance of BPI, BDO, China Banking Corporation, and International Finance Corporation¹⁹.

Foreign infusion for similar mechanisms on water supply, sewerage and waste management was provided by Asian Development Bank, Japan International Cooperation Agency (JICA), Japan Bank of International Cooperation (JBIC), and USAID, but these were comparatively lower than other sectors and have since declined from 2012. Investments for the sector last peaked in 2016 when investments reached PHP 1.75 billion and immediately fell to PHP 43 million the next year.

Figure 8. Approved foreign investments by industry, 2012-2018



Source: ASPBI

The national government hoped NSSMP would address the limitations in fiscal resource, given the instrumental role of infrastructure requirements in achieving sanitation targets. An urban focus explored how city LGUs navigated the narrow room of implementation.

¹⁷ Can be availed by both private corporations and local governments with loan rates up to 80-90 percent of total project capital outlay and can be repaid up to 15 years inclusive of grace period.

¹⁸ Institutions/groups can ask for assistance in establishing renewable energy. As of mid-2017, LBP was able to finance 17 biogas projects worth PHP 264 million.

¹⁹ Loans targeted to serve small- and medium-sized firms

3. Urban focus: Metro Manila

3.1. *Background and caveats*

The private sector was actively involved in urban sanitation as early as the 1970s; the National Water Crisis Act of 1995 (RA 8041) triggered the case of privatization in Metro Manila under the management of MWSS. The service area was divided into East²⁰ and West²¹ Zones, the former under Manila Water Company, Inc. (MWCI) and the latter under Maynilad Water Services, Inc.

While Manila Water has gained a headstart in its operations, Maynilad experienced a standstill in its earlier years, primarily due to the effects of the Asian Crisis. Ninety percent (90%) of MWSS loans were allocated to Maynilad, most of which were foreign-exchange dominated, and used to service higher concession fees. As a result, no capex was spent in Maynilad from 1997 to 2006. When the West Zone concessionaire was reprivatized, water supply was given prioritization for the first 10 years and wastewater only in the last seven years. This led up to big adjustments in contract service obligations. As of writing, both concessionaires have been granted renewal of their franchise contract until 2037.

Meanwhile, the Baguio City case study implied institutional fragmentation on water supply and sanitation; the water district was responsible for the former and LGU for the latter, but neither agreed on an overarching framework to inform a harmonized and streamlined approach. The case aimed to present a particular arrangement on upland areas as watersheds and major water reservoirs were in Cordillera Administrative Region (CAR).

Environmental protection and conservation of water sources were supported by concessionaire programs; a close example of which was their inclusion in Manila Bay rehabilitation. Major efforts addressed reduction of untreated discharges through increasing treatment facilities. Complementing these were partnership programs with LGUs, private sector, and international organizations.

3.1.1. Supply and demand

Bulk of water supply for Metro Manila and some parts of Bulacan came from Angat Dam, augmented by La Mesa Dam during summer season (only for Manila Water). However, due to the latter's small size and unsustainable water precipitation levels, the latter was considered more as a storage facility or reservoir rather than a primary source. Treatment of water supply followed parameters and guidelines set by various agencies like MWSS, DOH, and DENR prior to customer distribution.

All 46 cubic meters of water from Angat Dam were shared between the concessionaires, and Laguna Lake eventually supplemented the supply in light of increasing water demand. The move to tap the latter as an immediate water source started around 2009 from Maynilad and more recently in 2020 for Manila Water. Treatment costs rose ten times higher due to a higher concentration of feed residue and industrial wastes, but it relatively reduced reliance on Angat by 90 percent.

²⁰ Covers Mandaluyong, Marikina, Pasig, Pateros, San Juan, Taguig, Makati and parts of Quezon City and Manila. Also provides services to Antipolo City and some Rizal towns which are part of the coverage expansion once renewed.

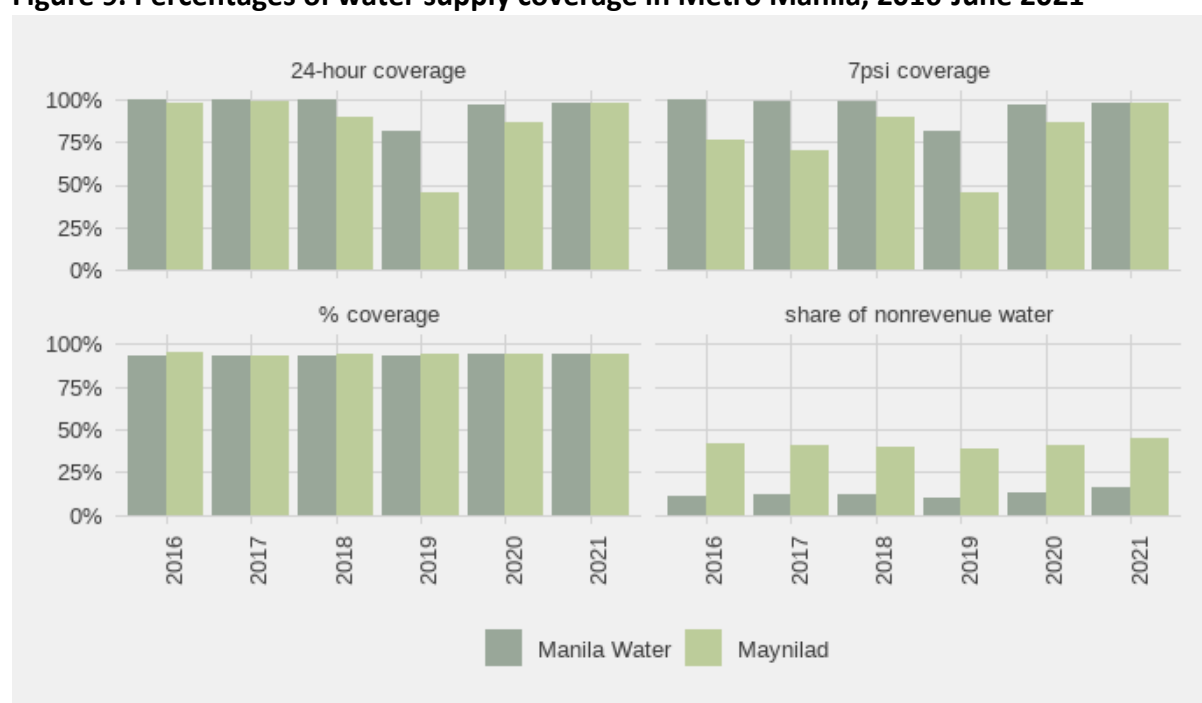
²¹ Includes Caloocan, Malabon, Navotas, Valenzuela, parts of Quezon City, parts of Manila, parts of Makati, and South areas - Pasay, Parañaque, Las Piñas, Muntinlupa, Bacoar, Imus, Kawit, Rosario, Noveleta, Cavite City.

Manila Water's service connections numbered around one million connections²² and seven million accounts²³ in both commercial and residential types with an average household consumption of 30 cubic meters per month. Water access coverage for the East Zone was at 93.65 percent with whole NCR looped within the Central Distribution System.

The concessionaire's next targets were identified as Antipolo, San Mateo, and Montalban, Rizal, resettlement near landfills, and areas adjacent to Laguna Lake. Growth was projected to increase by 100,000 connections annually, particularly among vertical structures (e.g. condominiums).

Both concessionaires were mostly successful in meeting their contract obligations, reaching almost 100 percent for the coverage. In the 24-hour coverage and 7psi²⁴ coverage, a decrease in figures were noted for 2019, particularly for Maynilad. Taking in the caveats mentioned earlier and the condition of pipe networks, the same concessionaire has a greater share of nonrevenue water losses or leaks in connection.

Figure 9. Percentages of water supply coverage in Metro Manila, 2016-June 2021



Source: MWSS 2021

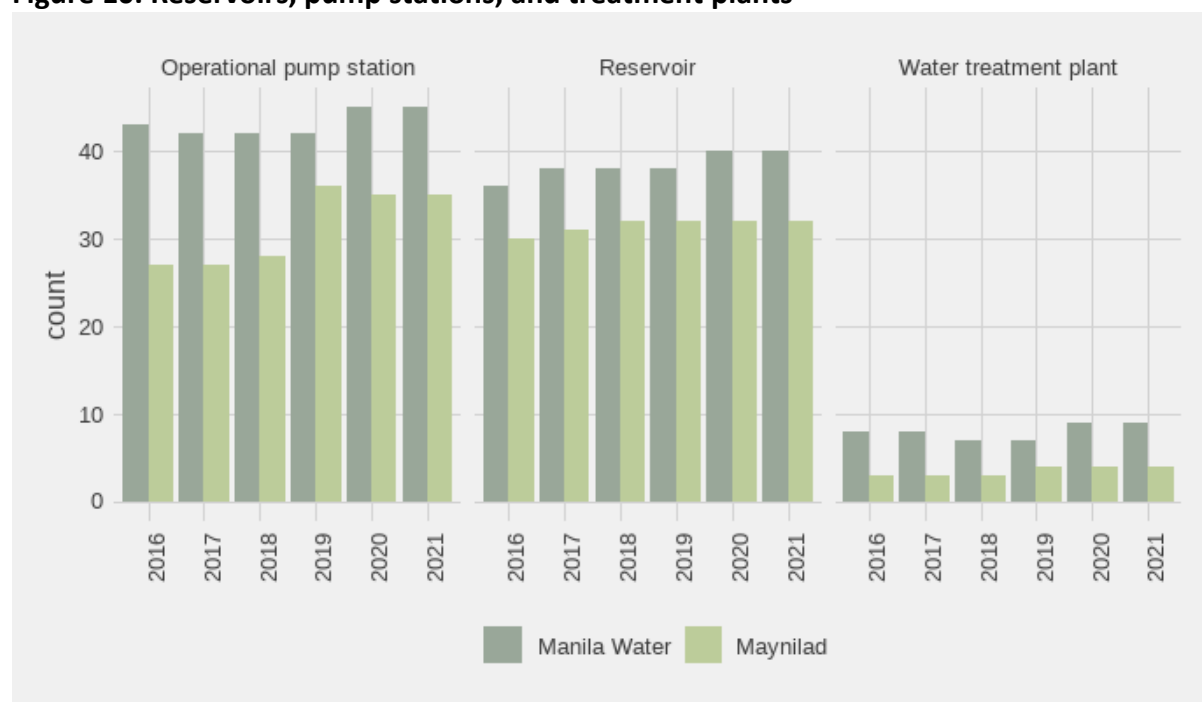
The higher number of reservoirs and facilities in Manila Water contributed to bigger and faster reach. It almost reached the saturation level in terms of reservoir capacities vis-à-vis billed volume. On the other hand, Laguna Lake's augmentation increased Maynilad's share.

²² One connection may cover multiple households, depending on area and building. Standard arrangement limited one title to one account until the launching of Tubig Para sa Barangay program where a meter is placed on a barangay street to service multiple households.

²³ Estimates of individuals covered, KII

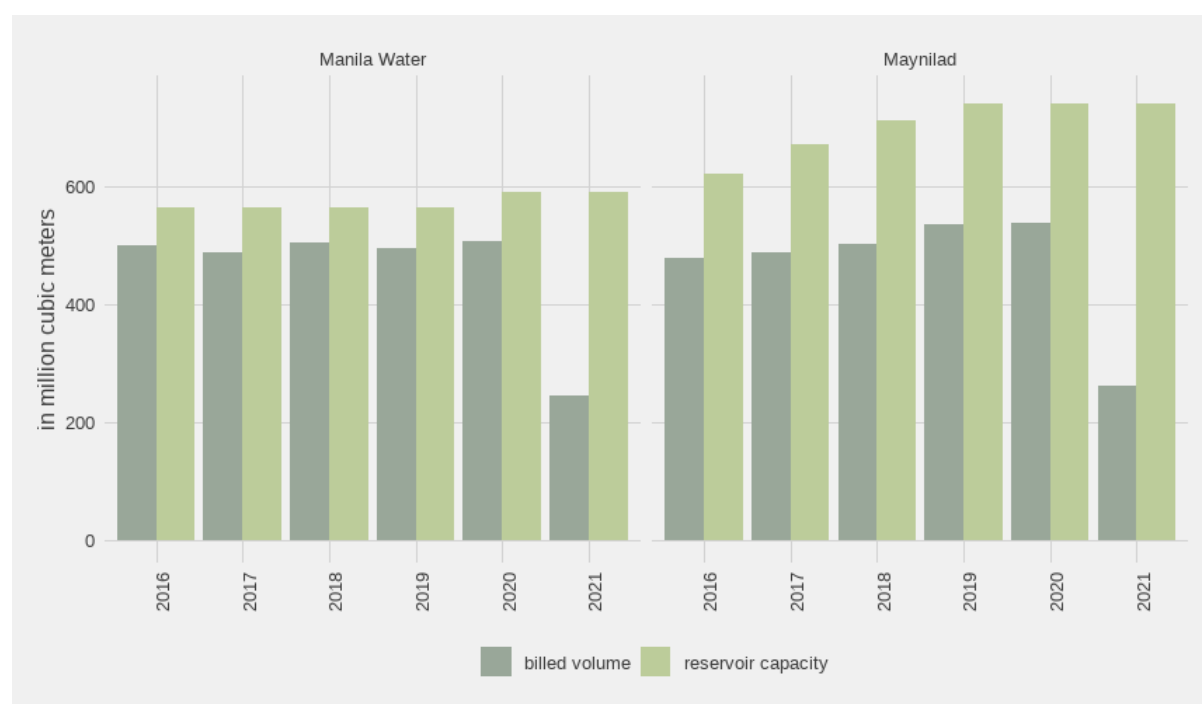
²⁴ 7psi=7 pounds per square inch. Average pressure required for the water to reach the second floor.

Figure 10. Reservoirs, pump stations, and treatment plants



Source: MWSS 2021

Figure 11. Billed volume versus reservoir capacity (in million cubic meters)



3.1.2. Pandemic shifts

Use patterns changed at the onset of the pandemic. Residential accounts increased and took over commercial ones, which had the bigger share prior, and consumption was evidently higher during daytime, the last observation a side effect of lockdowns. Overall, the demand dampened

because of low usage from commercial, manufacturing, and industrial sectors, and slower economic activities.

The crisis and resulting shifts also exposed emerging concerns such as varying consumption, overloading of north to south pipes, increasing demand due to population growth and growing export processing zones. To address these, Maynilad planned to establish local reservoirs in south area (e.g. Cavite) and to utilize excess water from NIA's smaller dams. Kaliwa Dam will also augment the supply with its initial allocation by 2025.

3.2. Wastewater management

3.2.1. Current arrangements

The concessionaires both used the separate and combined sewage systems. The former separated domestic and storm water in two pipes. The sanitary sewer system would collect wastewater from household sewer line and transport the load to treatment plants while the latter placed domestic and storm water in the same pipe. Combined system, the prevailing setup in Metro Manila, tended to overflow into water bodies during heavy rains.

As for sanitation, both sewerage network and non-sewer activities (i.e. desludging) were conducted. The service obligation of the concessionaires is only limited to domestic coverage, but the use of combined systems over drainages and sewer networks allowed extension to commercial areas. Septage coverage remained greater than sewerage, hastened by the convenience and feasibility of vacuum truck units and capital costs.

Table 9. Comparison of coverage and facilities between the concessionaires

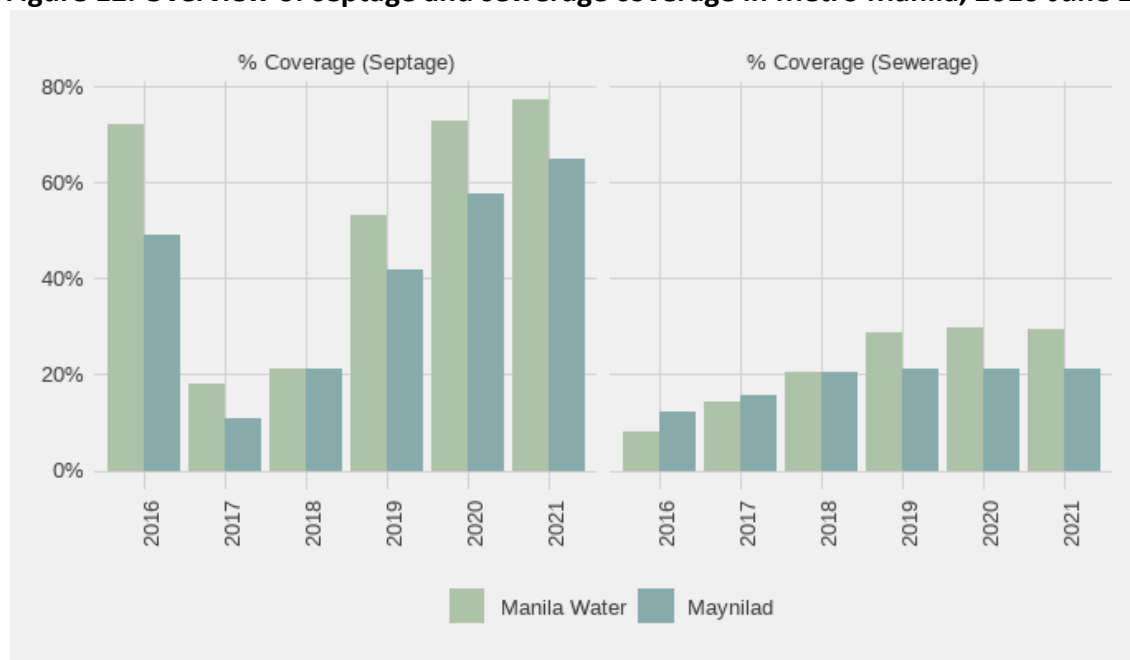
Concessionaire	Sewerage			Septage		Investment
	System	Coverage	Facilities	Coverage	Facilities	
Manila Water	Combined	31%	41 facilities 400 km of sewer network	63%		+ 15 WWTPs and 600 km of network
Maynilad	Combined	21.3%	22 treatment plants 203 lift stations	992,000 septic tanks cleaned	110 vacuum truck units ²⁵	PHP 37 billion for 100% coverage by 2037 PHP 1 billion /WWTP

Source: Authors' compilation from KII

Sewerage and septage figures exhibited increasing trends, but the former's coverage values dwarfed in comparison to the latter. Sewerage barely reached a 40-percent mark for both concessionaires, highlighting the gap in this kind of arrangement. A focus on full septage access and treatment coverage can work in the short term to allow key players on how to best meet the commitments for full sewerage systems.

²⁵ Offers both sanitation and desludging services. Initially started with 32 units.

Figure 12. Overview of septage and sewerage coverage in Metro Manila, 2016-June 2021



Note: The septage coverage follows a five-year cycle²⁶; upon reaching the fifth year, the coverage will revert to zero.

Source: MWSS 2021

Volume of treated water were also higher for septage than sewerage. Interestingly, Maynilad has a higher treated volume for sewerage compared to Manila Water while the opposite was observed for septage. This can be attributed to Maynilad's longer pipeline distance of 607 km (Manila Water only has 432.91 km of laid pipelines). However, in terms of number of treatment plants, the latter has double the count. The numbers have not changed more or less in the last five years; construction of another treatment plant would need an additional PHP 1 billion investment.

Table 10. Relevant variables on wastewater management

Year	Maynilad				Manila Water			
	Treated sewage (m ³)	Treated septage (m ³)	No. of WWTP	Pipelines (km)	Treated sewage (m ³)	Treated septage (m ³)	No. of WWTP	Pipelines (km)
2016	57,981,304		20	586	36,994,838	222,737	40	359.47
2017	59,490,425		20	588	40,419,040	310,668	40	369.53
2018	63,420,692	170,684	22	633	44,390,251	329,325	40	392.79
2019	74,470,149	283,402	22	637	44,592,574	321,026	40	396.81
2020	71,919,760	214,910	22	638	55,918,430	239,896	40	428.73
June 2021	35,545,438	109,703	22	607	25,452,699	149,762	41	432.91

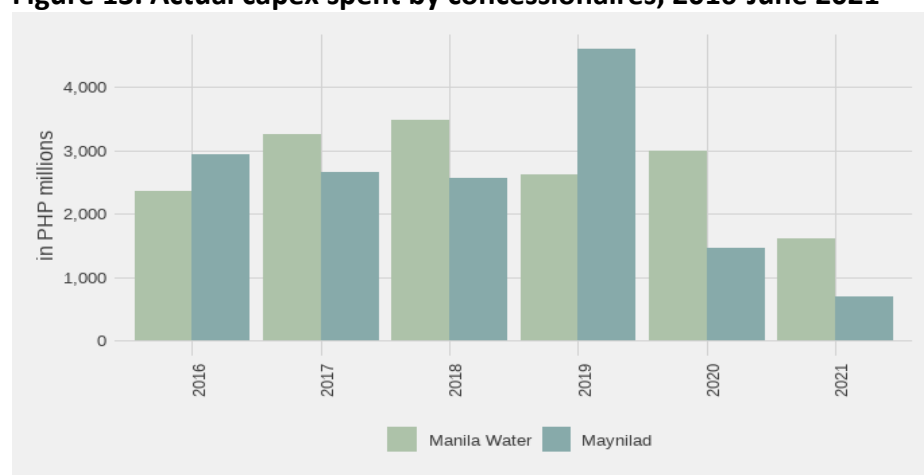
Notes: WWTP=Wastewater Treatment Plants; Pipelines=cumulative laid pipelines since privatization

Source: MWSS 2021

²⁶ Desludging of septic tanks is conducted once every five years.

The next graph looked at the annual capital expenditures spent by each concessionaire. Values tended to fluctuate, but Manila Water more or less maintained its investments. In 2019, Maynilad drastically increased its capital costs of more than PHP 4,000 million, but this decreased to just roughly PHP 1,500 million in 2021. This was around the same time that the concessionaire added two more treatment facilities.

Figure 13. Actual capex spent by concessionaires, 2016-June 2021



Source: MWSS 2021

Considerations for wastewater management program included inheritance of century-old sewerage system, particularly in Manila, and overlapping spaces with utility lines.

The increase in future demand in water supply also meant an expanded service area for wastewater; MWCI planned to increase the number of their facilities while Maynilad projected PHP 37 billion to upgrade all pipes and additional PHP 1 billion per plant. Higher operational costs, to be lodged in user tariffs, were considered by both companies to cushion the investment.

Baguio City had its sewerage system built by JICA back in 1985 which now serviced 65 barangays or 10,300 household connections within the CBD with some having full connection (i.e. septic tank connected to sewer network) and others partial (i.e. without septic tank but connected to a sewer line). To fully service all 65 barangays, the local government would need an additional USD 35 million.

Effluents entering treatment facilities in Baguio averaged around 4,000-5,000 cubic meters per day. An upgrading of WWTP will increase the treatment capacity to 20,000 cubic meters per day which is two to three times higher.

3.2.2. Regulation

The DENRs DAO 1990-35 contained the previous general guidelines on effluent standards, but these were recently updated by DAO 2016-08 with particular focus on nutrient parameters like ammonia, nitrates, phosphates, and fecal coliform which were not present in the former issuance. The standard values also increased for surfactants and total suspended solids while BOD, COD, and oil and grease remained the same.

Table 11. Comparison of parameters between DAO 1990-35 and DAO 2016-08

Significant parameters	Unit	DAO 1990-35 Class C	DAO 2016-08 Class C
Biochemical Oxygen Demand (BOD)	mg/L	50	50
Fecal coliform	MPN/100mL	-	400
Ammonia	mg/L	-	0.5
Nitrate	mg/L	-	14
Phosphates	mg/L	-	1
Oil and grease	mg/L	5	5
Surfactants	mg/L	5	15
Chemical oxygen demand	mg/L	100	100
Total suspended solids	mg/L	70	100

Source: Maynilad Position Paper 2020

The newly provided parameters were also more stringent than other countries; the strictest among which was ammonia with only 0.5 mg/L whereas India allowed up to 50 mg/L (for Asia) and Chile up to 80 mg/L (for non-Asia). Concessionaires suggested following US EPA's watershed-based national pollutant discharge elimination system (NPDES), dependent on the water quality of a catchment basin and accounts for the assimilative capacity of the receiving bodies of water (RBW) that the regulation did not consider (Maynilad Position Paper 2020).

Table 12. DAO 2016-08 standards of Philippines versus Asian and non-Asian countries

Country	Total Phosphorus	Total Phosphate	Nitrate	Ammonia	Total Nitrogen	Reference
Philippines		1	14	0.5		
<i>Asia</i>						
Laos	1			4		CTI Engineering International Co, Ltd., 2009
Cambodia		3-6	10-20	5-7		Royal Government of Cambodia, 2009
Thailand	2				20	Secot Co, Ltd, n.d.
Taiwan	2	4	50	10		Environmental Protection Administration of the Republic of China on Taiwan, 1997
Japan	16				120	Ministry of Environment Government of Japan, 2017
Singapore	2		20			Singapore National Environment Agency, 2008
India		5	10	50	100	Ministry of Environment, Forest and Climate Change, 2016
Malaysia	5-10	10-50	5-20			Embas, 2009
<i>Non-Asia</i>						
Canada	10					Coronado
Chile	45			80		Chilean Ministry of Public Works, 1998
Peru	10				80	Ministry of Housing
Ecuador	15			40		Congreso Nacional
Mexico	20				40	Gutierrez 2008
Paraguay	10					Reglamento de Calidad en la Prestacion del Servicio Permisarios
EU	1-2				10-15	Council of the European Communities, 1991

Source: Maynilad Position Paper 2020

Despite closing its final year for compliance, provisions of the issuance were rarely met. Concessionaires were yet to upgrade their facilities and the treatment technology. Apart from current setups not being able to filter pharmaceutical and personal care products yet, limited technology providers and contractors in the country were limited. Further, present concerns on space availability and competing rights for other utilities hampered ease of implementation.

MWSS and its concessionaires, with assistance from DOST and PNRI lobbied for specific items in the new guideline issuance, specifically proposing alternative parameters and the equivalent economic effects once considered.

Combined operating expenses would exceed 500 percent if concessionaires were to follow the DAO 2016-08 parameters. The projected cost included facility and pipe upgrading as well as construction of new treatment plants. If this was considered expensive by large, private concessionaires, the financial burden would be heavier for LGU-led utilities and smaller service providers. An adjustment to the proposed limits would give a 100 percent reduction in the presumed OPEX increase. This would curb a spike in user tariff as well.

Table 13. Recommended changes to DAO 2016-08

DAO 2016-08 parameters	OPEX increase due to DAO 2016 (%)	Proposed parameter	Proposed limits (ppm ²⁷)	OPEX increase due to proposed limits (baseline from DAO 1990-35) (%)	OPEX Reduction from DAO 2016 (%)
Ammonia	265	Total Nitrogen	20	47	94
Nitrates					
Phosphates	370	Total Phosphate	5	115	58
Fecal coliform	54	Geometric mean		0-45	17-100

Note: Values given by Maynilad are projected from a facility using CAS-MLE technology

Source: Maynilad Position Paper 2020

4. Challenges

a. Institutional and implementation fragmentation

Fragmentation riddled the landscape of supply and sanitation. While agencies have been given respective mandates corresponding to particular aspects (supply, quality, servicing, wastewater), overarching framework and direction were absent. Broad provisions albeit encompassing in their scope induced mandate overlaps thus resulting to disaggregated efforts in the sector.

One manifestation of this was among national policies, local governments, and indigenous peoples in provisioning priorities. COA's 2020 audit report flagged the continuation of Kaliwa Dam Project despite the absence of permits for the National Integrated Protected Areas System (NIPAS) and indigenous peoples' consent. The project was said to displace the Dumagat-Remontado IP groups from their ancestral domain (Sarao 2021; Chavez 2019).

b. Weak regulatory teeth

WQMAs and watersheds were managed by the National Water Resources Board, but they have no regional offices and thus have no capacity to go after polluters of primary water sources. Tributaries and other water bodies have easier and more grounded regulation, but the cease and desist orders for discharge violators were yet to translate to lower pollution load.

²⁷ parts per million

c. Unfeasible regulatory standards

As seen in the comparison of parameter limits via older guidelines and cross-country levels, it was evident that current concessionaires and implementers will not be able to comply given the state of facilities, the amount of investment needed, and the limited technology options. Effluent standards were designed more after drinking water quality, not treated wastewater. Non-compliance to DAO 2016-08 will reportedly result to PHP 20,000 per day of violation.

d. Lack of national guidance

The absence of national plan and roadmap compounded the fragmentation on the sector. Without a cohesive direction, most burdens fell on local implementers while investment became highly dependent on private sector extension. The urgency for accomplishing supply and sanitation targets did reflect in the infusion of foreign investment in contrast with other sectors.

e. Issues on NSSMP

Given the current landscape in the country, total sewerage coverage would not be possible for 2030. It should be treated as a large-scale project crosscutting local governments and administrations. As there had been low interest on sewerage investments from incumbents, septage standardization would be a feasible and practical entry point in the short run. Sewerage systems ranged from PHP 5,000 to PHP 10,000 per capita whereas septage only estimated costs of PHP 230 to PHP 445 per capita.

Interest revival in septage systems should be encouraged for the uptake of NSSMP with the amended coverage and increased subsidy share. In the case of Baguio City, the program was not pursued as it will not be able to cover maintenance and operating costs which are the bulkiest and most difficult to sustain. On the other hand, DPWH reasoned that the low uptake was due to ineligibility of most LGUs.

Additional expenses from permitting, right of way, and clearances should also be taken into account. Political boundaries often hindered the proposal of multi-city treatment plants, considering difficulties on land availability and contesting spaces for utilities. These compounding matters all pointed to a need of proper urban planning where institutions, concessionaires, and service providers have access to comprehensive maps of drainages and utilities to avoid overlapping and disruptions.

Future challenges would involve continued deforestation and depletion of watersheds which would, in turn, increase turbidities beyond the capacities of treatment plants and introduce more frequent delays in water delivery. A concentrated effort in conserving these resources must be imminent.

5. Conclusion

Wastewater and pollution management issues are usual negative externalities in the pursuit of economic development. This is true in the Philippines where industrial and domestic refuse often end up being released in tributaries and major water ways, sometimes even contaminating ground water due to improper septage and sewerage design. But this does not mean that there is no apt policy prodding to exact waste management and sanitary compliance. Weaknesses lie in policy grounding and central and subnational guidance.

Sewerage systems are often less preferred to individual septages due to its large investment requirement and necessity for complex, large scale and coordinated implementation. Development initiatives also operate within the confines of a fragmented sector where there are a multitude of stakeholders engaged in scattered efforts through mostly independent decision-making processes. Although some low-income regions such as BARMM suffer from both water supply and sanitation issues, a majority of LGUs show relatively good current standing in terms of water supply, but with compromised sanitation and environmental integrity compliances.

The Clean Water Act frames the standards and enjoins compliance to environmental integrity provisions. It also launched the NSSMP to address the shortfalls on fiscal resource, and to ramp up initiatives on the ground for septage and sewerage projects. But even these interventions remained largely untapped due to the inability of subnational counterparts to cover counterpart funds and maintenance costs. Both short and long-term gains are difficult to pursue when there is failure in most LGUs to mainstream wastewater management in local development plans and thematic documents.

The country is prone to imposing regulations within a sector with fragmented institutions and policy backgrounds, and priorities. This dissonance between vision and structure ultimately led to contesting strategies, and parameters with differing approaches and accomplishments. The current framework depends largely on political will, instead of a functioning long term plan under a supposedly organized water management regime.

Among highly urbanized cities, the challenges on water management and sewerage establishment were on space availability and right of way. Another articulated concern is the infeasibility of needed compliance with new water quality standards and parameters. Albeit consistent with environmental integrity targets, water concessionaires and other stakeholders were apprehensive about complying with standards given present facilities, technology, and investment. Further sector performance benchmarking, and thorough consultations with implementers, are required to enjoin compliance to regulatory issuances and guidelines.

An empowered regulatory body with a well-crafted master plan should inform the direction and strategic approach in water supply and waste water management both at the national and subnational levels. Large scale capital investments were often overlooked in wastewater management hence policies should not cram compliance, especially if not accompanied with fiscal assistance or any sort of facilitation. Local government politics are also not conducive to big public investment projects like sewerage networks and waste water treatment facilities, hence the need for a well-endowed central institution.

A feasible intervention in the short run would be to focus on septage access, coverage, and standardization while exploring other green technology, financing mechanisms, and investment strategies for the long haul. These discussions are further expounded in the next section.

6. Recommendations

6.1. *Revamping institutions: Lessons from Singapore*

The harmonization of the country's fragmented approach to water and waste water management can be patterned over learnings from neighboring countries. Inter- and intra-institutional machinations have evolved among both public and private stakeholders over the

years, even at the subnational levels, but it may require a bureaucratic body in the mold of Singapore's Public Utility Board to effect needed reforms.

Singapore's inherent limitations and problems on both land and aquifer caused numerous water crises in the past²⁸ and heavy reliance to water importation from Malaysia. To augment natural water supply, they took advantage of local water catchments, desalination facilities, and NEWater or reclaimed-water use, to the extent that reclaimed water served 70 percent of their local water demand. Although the Philippines cannot compare with Singapore's technical acumen and facility for huge public investments, the country can capitalize on a similar institutional set-up for water and waste-water management.

The institutional aspect, Public Utilities Board (PUB) Singapore handles the oversight and integrates management of the country's water supply up to the water provisioning networks where the private sector contributes service²⁹. The same agency handles research and development and numerous collaborations with domestic and international experts and study centers. The arrangement allows for greater retention of in-house experts and personnel (e.g. development of membrane bioreactor technology³⁰, reservoir monitoring³¹, electrochemical desalination³² among others) (PwC 2018), sustaining institutional capacity in the long run. Singapore's approach encompasses the full water management cycle, unlike in the Philippines where water supply and waste water management/sanitation are treated differently.

Unified utility layouts or maps are most useful in trying to work out sewerage systems especially in highly urbanized domains like Metro Manila. Drainage systems, water lines, and interconnectivity cables all need to be accounted for to facilitate sewerage system planning and establishment. Although admittedly not suitable for all cities and municipalities, sewerage systems if viable, must be given priority in local development formulations. While Metro Manila's convoluted subterranean networks of cables and pipes may curtail sewerage expansion plans, this long-term thinking can still be pursued and applied in provinces and local areas, including in big private real estate development projects.

The septage option also needs to be rationalized. Appropriate standards should be applied in septage construction and rehabilitation, taking into consideration the possible contamination of ground water reservoirs. Old houses or establishments may also need structural augmentation and retrofitting to pass environmental integrity compliance. Capacity building on wastewater treatment from national to subnational levels should accompany that perspective. Information and awareness alone on wastewater and its relation to health and economy could help customer acceptance and negate the not-in-my-backyard mindset. Repercussions on not meeting even the barest of septage standards should be communicated clearly to the general public.

6.2. Regulations and standards

Benchmarking of technology and facilities in the sector should be reviewed prior to imposition of standards and guidelines. Unless funded, assisted with grants or loans, or funneled with an

²⁸ Singapore went through 10-month water rationing exercises during April 1963-February 1964.

²⁹ Meter reading, billing, and collection of charges

³⁰ Alternative to the current microfiltration/ultrafiltration-reverse osmosis (MF/UF-RO system) in an effort to reduce costs of water reclamation efforts.

³¹ One monitoring tool is eutrophication warning tool with set triggers for algal blooms in catchments and reservoirs. Another is a tracker for gradient changes and spikes from drastic land use changes. The last is the development of SingScore Index which uses insects and invertebrates as long term indicators of waterways health in addition to the water quality index in place. This better informs long-term strategies of the country.

³² Uses less water than the current high-pressure desalination.

investment, the urgency of implementation should consider the feasibility. As the compliance remain unmet from concessionaires, DENR and other oversight and regulatory agencies should reconsider the alternative parameters listed in the position paper.

A more workable request would be for DPWH to provide technical inputs or reference notes on standard designs of WWTPs or any waste-related infrastructure³³ in the context of the country's topography and use patterns. It could be a fitting function for a department familiar with horizontal linkages and facilities and a viable intervention point for streamlining water supply and sanitation master plans and utility maps.

6.3. Ramping up investments

The Philippine Water Supply and Sanitation Master Plan (PWSSMP) provided an investment breakdown for the water sector to bridge the gap in sectoral and policy goals namely, 95 percent access to water supply and 97 percent access to basic sanitation by 2022, and universal access by 2030.

Proposed investments were categorized into two. Physical requirements were projected to reach Php 1.07 trillion to meet targets set by PDP and SDG. Non-physical requirements in this case referred to key reform agenda³⁴ and program management, eventually amounting to PHP 1.13 billion.

The estimated investment figures are already huge as indicated, but one can't help think that such are still massive underestimates of what is truly required down the line.

³³ Per KII with DENR-EMB, no standards are given for waste pollution facilities, only minimum requirements since they need to be retrofitted to the type of pollutants, geography, and other needs (reuse, graywater, etc.)

³⁴ KRA: establishing effective WSS sector institutions; strengthening regulatory environment; creating and ensuring effective WSS services; balancing water supply and demand; building climate resiliency; enabling access to funding and financing; managing data and information; and driving research and development.

Table 14. Total investment requirements from 2020-2030, in PHP billion

Requirements	2020-2023	2024-2030	Total
<i>Physical</i>	733.66	334.53	1068.19
<i>Water Supply</i>	278.07	233.01	511.08
Level 3	234.11	216.95	451.06
Level 2	37.56	15.32	52.88
Level 1	6.40	0.74	7.15
<i>Sanitation</i>	455.59	101.52	557.11
Improved/Basic	349.50	84.02	433.52
Septage	48.89	6.00	54.89
Sewerage	57.20	11.50	68.70
<i>Non-physical</i>	0.66	0.47	1.13
Eight KRA	0.32		0.32
Project management	0.34	0.47	0.81
<i>Total (in PHP billion)</i>	734.32	335.00	1069.31

6.4. Research and development

Water bodies have respective carrying capacities and saturation points. A lesson could be gleaned from Singapore's upgrading of water supply systems and development of technologies of wastewater reuse to reduce reliance on Malaysia supply.

Like solid waste management, sludge to energy recovery had been in use, thus proposals on waste to energy investment and enabling policies will cover both solid and water waste management.

6.5. Private sector participation

The private sector finds itself nestled in small pockets of rural areas and small towns which national water services cannot reach. Current arrangements in place are Build-Operate-Transfer (BOT), and joint venture agreements. Their role can be further enhanced, particularly in septage services where lesser capital is needed but a lot of households are in need.

As the sector steers towards greater privatization, regulations should expand provisions on private domestic supply providers with uniform standards given the benchmark technology and facilities. Status quo paints private providers as loosely governed by contracts.

The private sector is poised to better fulfill the required service provisioning from water supply concessions to wastewater management treatment either through septage or sewerage system options.

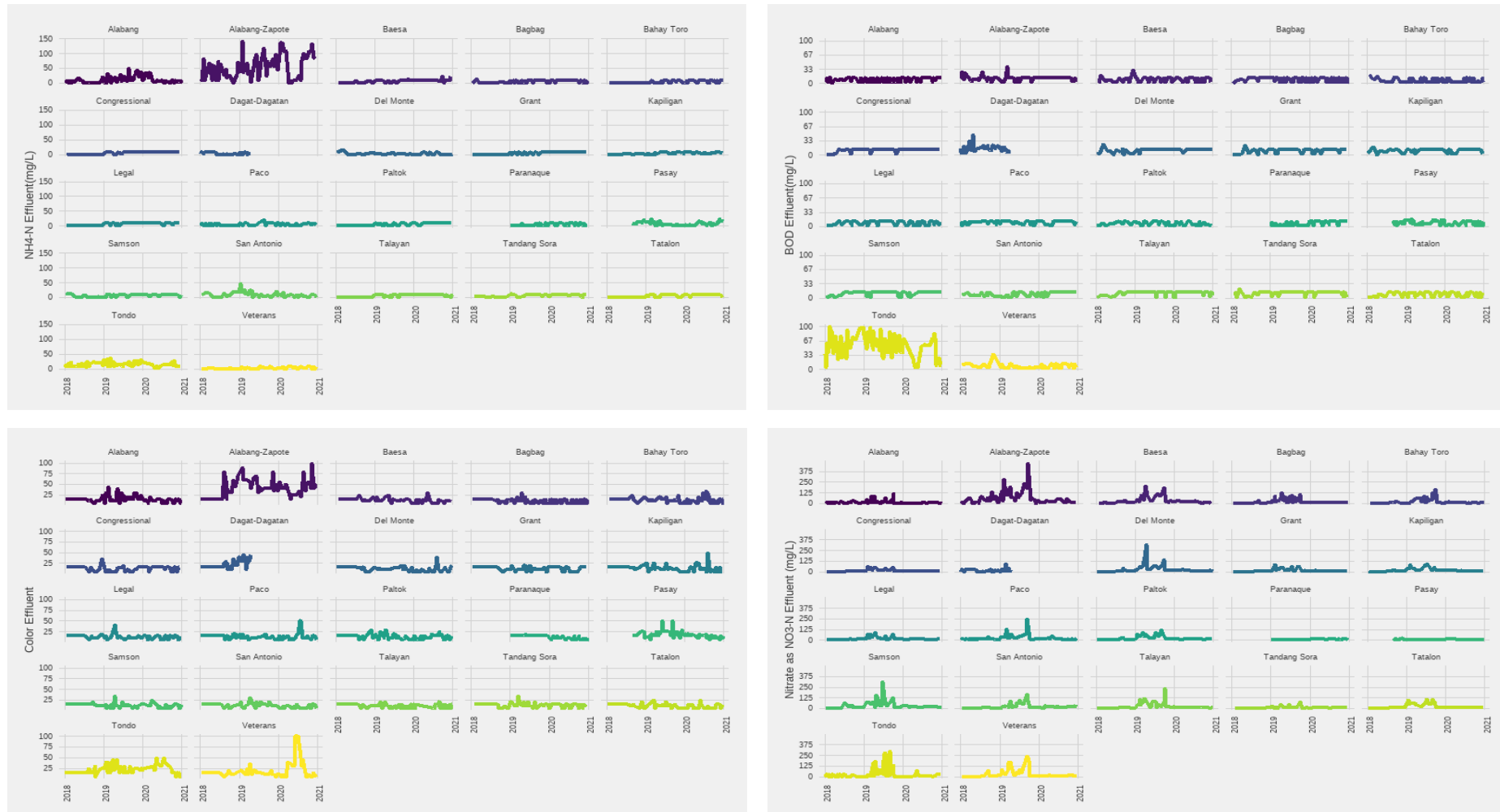
The national government now finds itself questioning the wisdom of a largely devolved waste water management service provisioning system. Local government units can only do so much in terms of development planning and investment programming. It appears that it will take no less than a well-funded and endowed central government orchestration, rather than just half-hearted prodding and incentivization, to effect much needed changes in water supply and waste water governance and infrastructure build-up.

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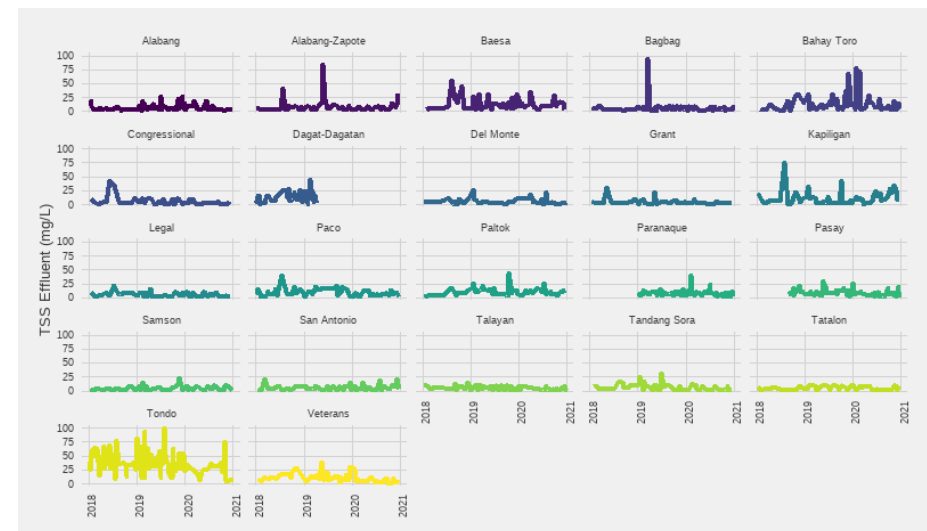
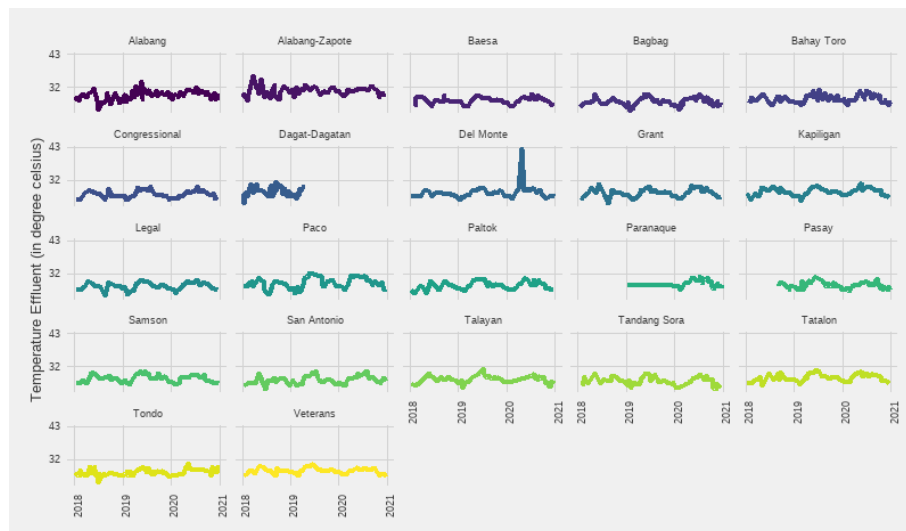
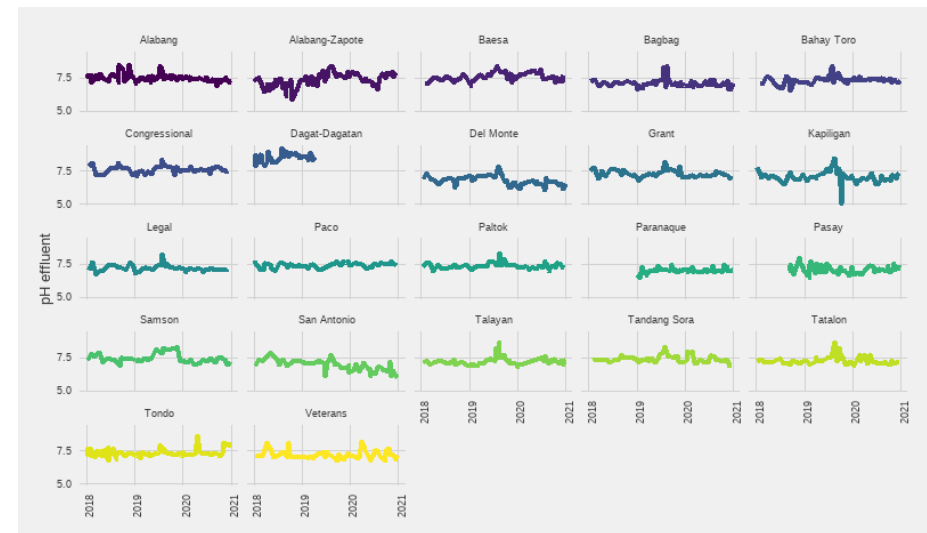
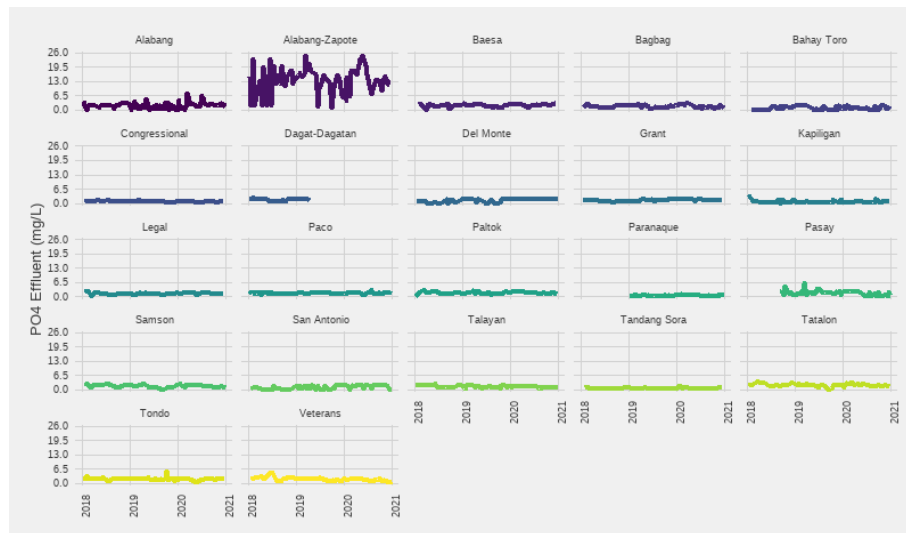
8. Annexes

Figure 14. Maynilad wastewater laboratory results, 2018-2020

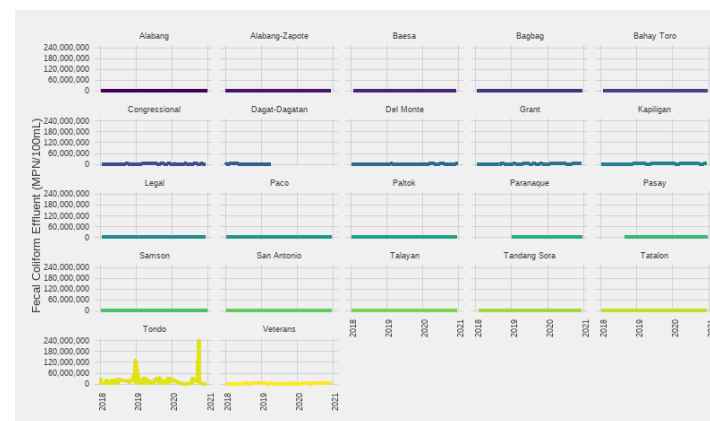
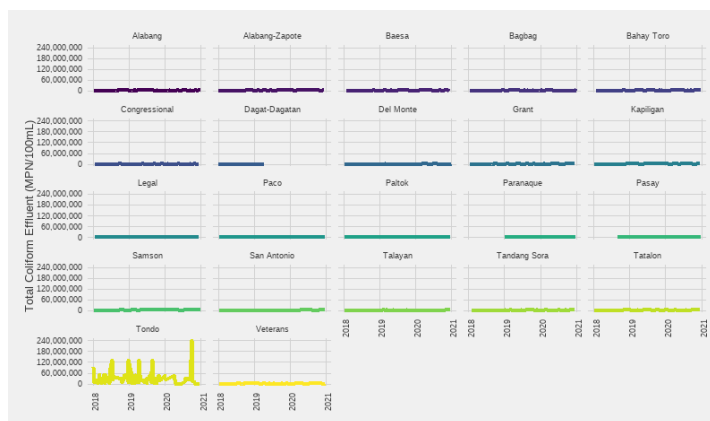
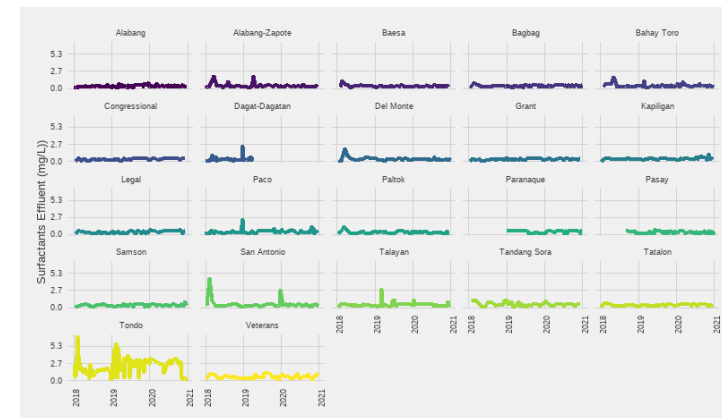
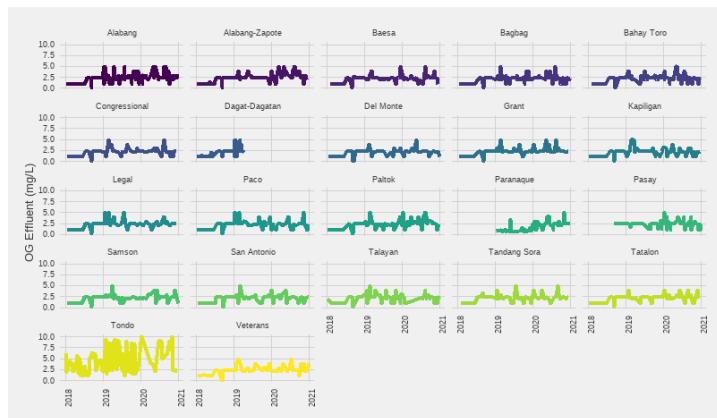


Note: NH4-N=Ammonia; BOD=Biological Oxygen Demand; NO3-N=Nitrate

Source: Maynilad 2021



Notes: PO4=Phosphate; TSS=Total Suspended Solids
Source: Maynilad 2021



Note: COD=Chemical Oxygen Demand
Source: Maynilad 2021