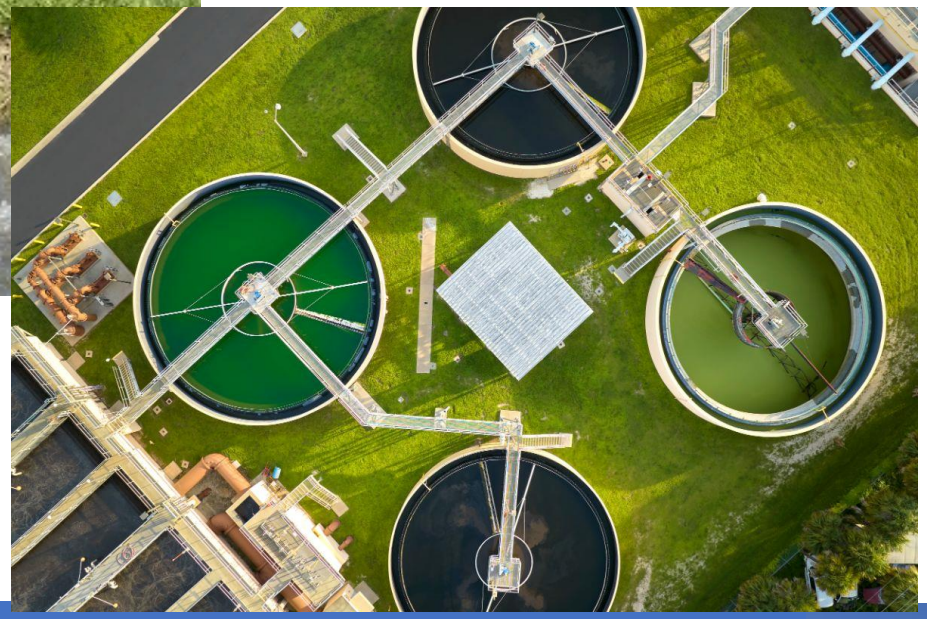
Training on 2006 IPCC Guidelines for preparing National GHG Inventory: Energy and Waste Sector

Introduction to Wastewater handling in Philippines



Present By:

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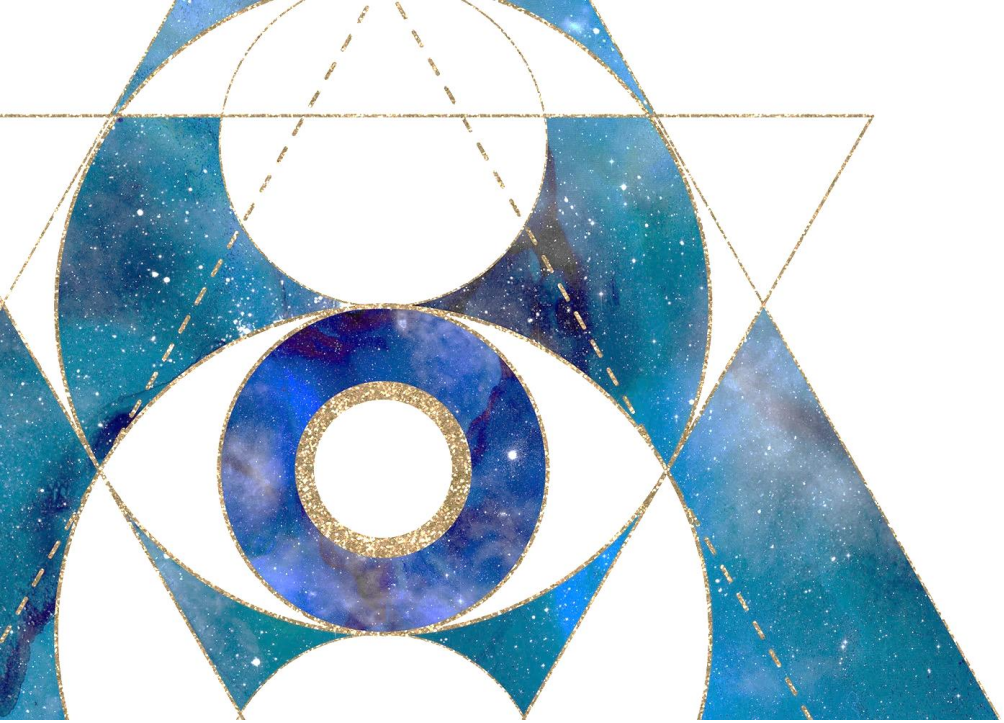
International MRV Transparency Advisor to CBIT-GSP

Organized by the Capacity Building Initiative for Transparency
Global Support Programme (CBIT-GSP)



Contents

1. Introduction

What is wastewater?

- Wastewater or sewage is the byproduct of many uses of water.

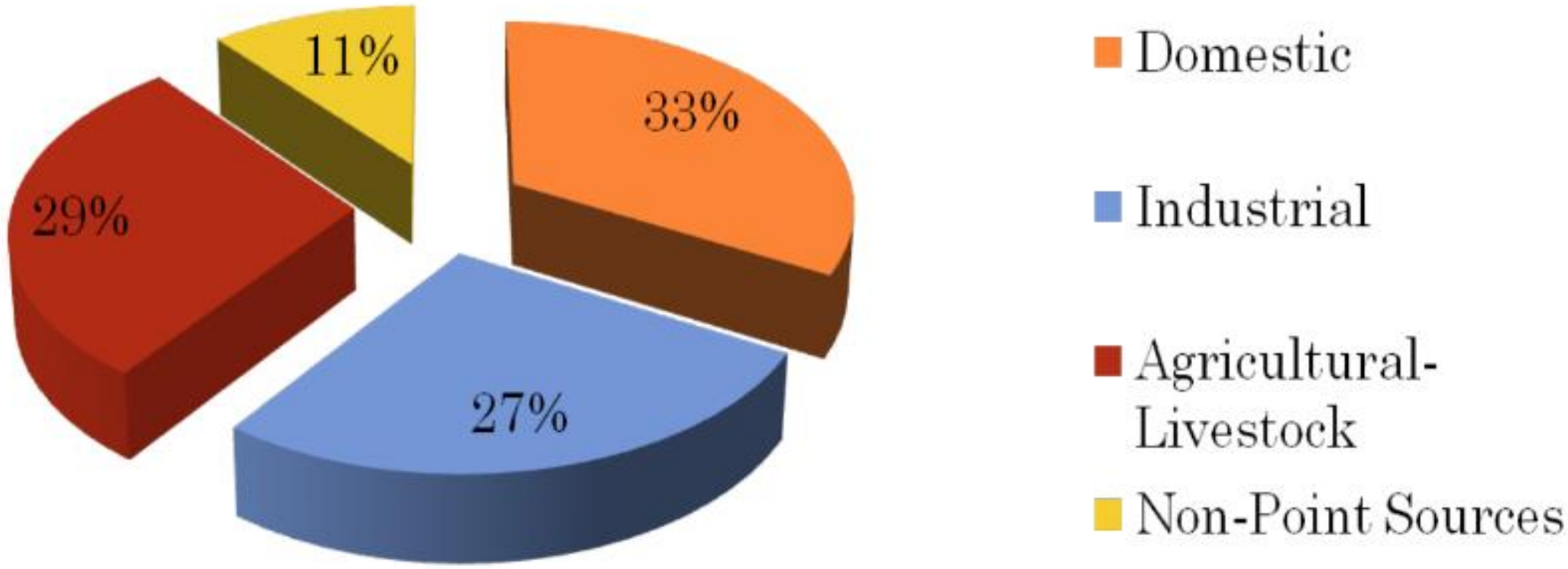
- Wastewater can categorize into two categories as

  - ✓ Domestic wastewater – Wastewater produced by household uses such as showering, dishwashing, laundry and, of course, flushing the toilet.

  - ✓ Industrial wastewater - Wastewater produced by industrial use water for many purposes including processes, products, and cleaning or rinsing of parts.

- After the water has been used, it enters the wastewater stream, and ended up in the wastewater treatment plant for treatment or directly flows to waterways untreated.

Wastewater sources in Philippines



Source: National Water Quality Status Report, EMB (Based on BOD loadings

Increasing trend of Wastewater volume in the country

- Over the years, the volume of wastewater has steadily increased as expected due to the rise in population.
- According to the Philippine Statistics Authority (PSA), from 2010 to 2019, the volume of polluted water increased by 32% using the data imported from Manila Water Co. Inc and Maynilad Water Services Inc.
- The numbers will be permanently increasing since the country's growth rate was a lively 1.5% last 2021 with a fertility rate of almost 2.8 births per woman.

Legal framework related to wastewater treatment in the Philippines

PHILIPPINE CLEAN WATER ACT OF 2004 (Republic Act No. 9275)

The Act and its Implementing Rules and Regulations (IRR) is the principal regulation for a comprehensive water quality management in Philippines

It sets standards to impede and reduce further water pollution by involving the participation of multiple municipal and industrial stakeholders

The Department of Environment and Natural Resources (DENR) is responsible for the implementation and enforcement of this act.

Provides a comprehensive and integrated strategy to prevent and minimize pollution through a Multi-Sectoral and participatory approach involving all the stakeholders.

The Clean Water Act applies to:

- ❑ Water quality management in all water bodies
- ❑ Abatement and control of pollution from land-based sources
- ❑ Enforcement of water quality standards, regulations and penalties

Legal framework related to wastewater treatment in the Philippines CONT…

PHILIPPINE CLEAN WATER ACT OF 2004 (Republic Act No. 9275) CONT…

To control wastewater discharges, DENR has enforced the Wastewater Discharge Permitting System

- ❑ All Owners Or Operators Of Facilities That Discharge Regulated Effluents Shall Secure Wastewater Discharge Permit (DP)
- ❑ DP is the legal authorization granted by the DENR to discharge wastewater into a water body
- ❑ The DENR Implements Wastewater Charge System (WCS) in all Management Areas and Regional Industrial Centers through the Collection of Wastewater Charges/Fees.

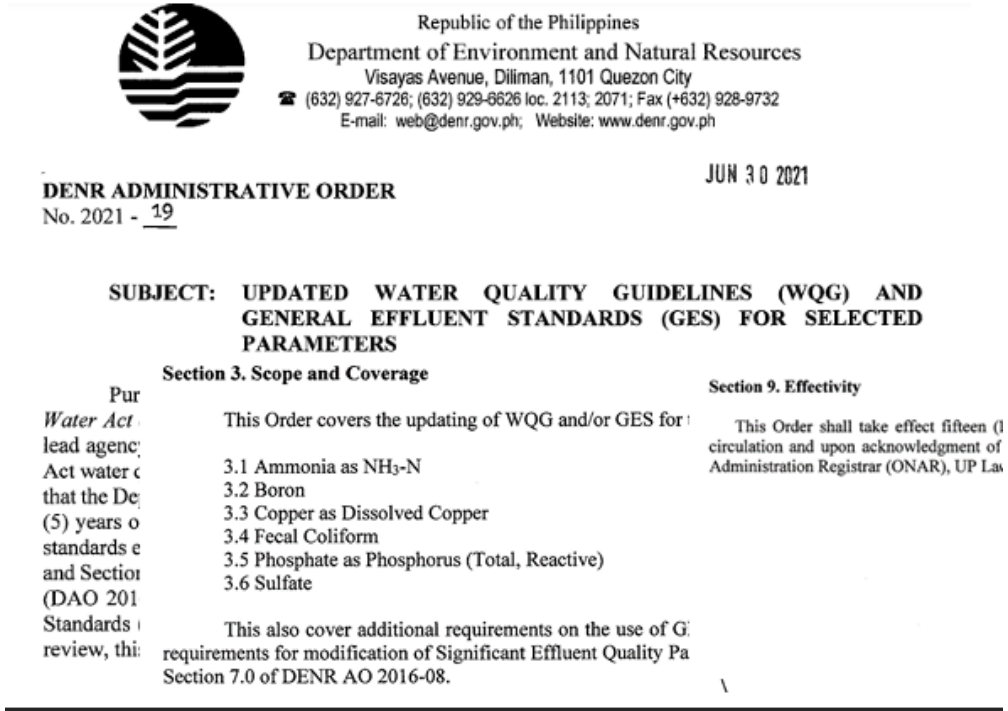
Legal framework related to wastewater treatment in the Philippines CONT…

WATER QUALITY GUIDELINES AND GENERAL EFFLUENT STANDARDS of 2016

Discharges from any point source shall at all-times meet the general effluent standards.

- Applies to all point sources of pollution, regardless of volume
- The General Effluent Standards shall be used regardless of the industry category.
- Effluent used for agricultural purposes shall conform to the DA Administrative Order No. 2007-26.

DENR Administrative Order 2021-19: Updated Water Quality Guidelines (WQG) and General Effluent Standards (GES) For Selected Parameters.



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JUN 30 2021

DENR ADMINISTRATIVE ORDER
No. 2021 - 19

SUBJECT: UPDATED WATER QUALITY GUIDELINES (WQG) AND GENERAL EFFLUENT STANDARDS (GES) FOR SELECTED PARAMETERS

Section 3. Scope and Coverage

This Order covers the updating of WQG and/or GES for

3.1 Ammonia as NH_3-N
3.2 Boron
3.3 Copper as Dissolved Copper
3.4 Fecal Coliform
3.5 Phosphate as Phosphorus (Total, Reactive)
3.6 Sulfate

This also cover additional requirements on the use of G
requirements for modification of Significant Effluent Quality Pa
Section 7.0 of DENR AO 2016-08.

Section 9. Effectivity

This Order shall take effect fifteen
circulation and upon acknowledgment of
Administration Registrar (ONAR), UP La

Responsibility for effluent monitoring

Republic Act 9275 mandates the DENR, through the Environmental Management Bureau (EMB), to be the national authority responsible for pollution prevention and control, environmental impact assessment in pursuit of sustainable development.

The implementation of the Clean Water Act is caried out by the 17 Administrative Regions:

- National Capital Region (NCR)
- Cordillera Administrative Region (CAR)
- Region I (Ilocos Region)
- Region II (Cagayan Valley)
- Region III (Central Luzon)
- Region IV-A (CALABARZON)
- MIMAROPA Region
- Region V (Bicol Region)
- Region VI (Western Visayas)
- Region VII (Central Visayas)
- Region VIII (Eastern Visayas)
- Region IX (Zamboanga Peninsula)
- Region X (Northern Mindanao)
- Region XI (Davao Region)
- Region XII (SOCCSKSARGEN)
- Region XIII (Caraga)
- Autonomous Region in Muslim Mindanao (ARMM)

EMB mission is to restore, protect, and enhance environmental quality towards good public health, environmental integrity, and economic viability including the protection, preservation, and revival of the quality of the country's fresh, brackish, and marine waters by implementing the other activities, among others:

- Formulate policies and guidelines
- Issuance of Wastewater Discharge Permits (WWDP)
- Compliance Monitoring of Establishments
- Water Quality Monitoring
- Issuance of Notices of Violation (NOVs) and Cease and Desist Orders (CDOs)to Facilities found in violation of RA 9275

Waste Water Treatment

- The quality of wastewater does not meet the standards of DENR for it to be safely released into a body of water. Hence, you need a series of treatment processes which utilizes various chemicals to ensure that the effluent to be released meet the environmental requirements.

- Wastewater treatment is a process which removes and eliminates contaminants from wastewater and converts this into an effluent that can be returned to the water cycle. Once returned to the water cycle, the effluent creates an acceptable impact on the environment or is reused for various purposes.

- There are different initiatives for Wastewater Management in Philippines

Wastewater Treatment Facility of the Authority of the Freeport Area of Bataan (AFAB) located in Mariveles, Bataan

Initiatives for Wastewater Management in Philippines

The Pilot Septage Treatment Facility at Meymart Market, Brgy. Zamora, City of Meycauayan, Bulacan

Manila Water Septage Treatment Facilities:
San Mateo Septage Treatment Plant

UP SEWAGE TREATMENT PLANT

Operated by Manila Water Co. Inc. (MWCI)

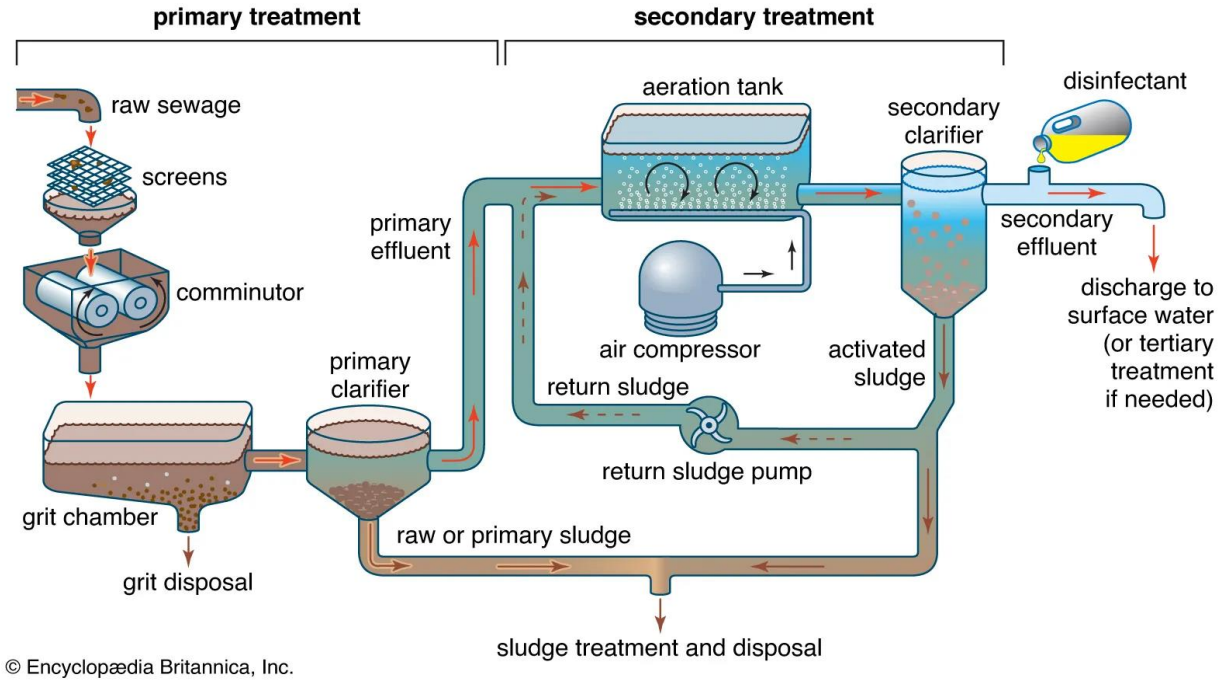
BAGUIO SEWAGE TREATMENT PLANT

Oxidation Ditch System. Funded by a grant from the Japan International Cooperation Agency (JICA)

Technologies and Processes

- There are many processes that encompass wastewater treatment.
- In fact, there are almost 80 different kinds of treatment technologies. However, it can be simplified into three phases
  - phase separation
  - biological and chemical processes
  - polishing.
- Phase separation removes solids and non-water materials, while biochemical treatment improves water quality by removing organic matter. Polishing is a final step to adjust pH levels or decrease chemical reactivity.

The Aglipay Sewage Treatment Plant in the Philippines utilizes advanced techniques like the Moving Bed Biofilm Reactor (MBBR) with Biological Nutrient Removal (BNR) technology for the secondary treatment of sewage water. The MBBR process uses an aeration tank with specialized carriers that support the growth of biofilm, making it more effective than other secondary biological or chemical treatments.



GHG emissions from wastewater

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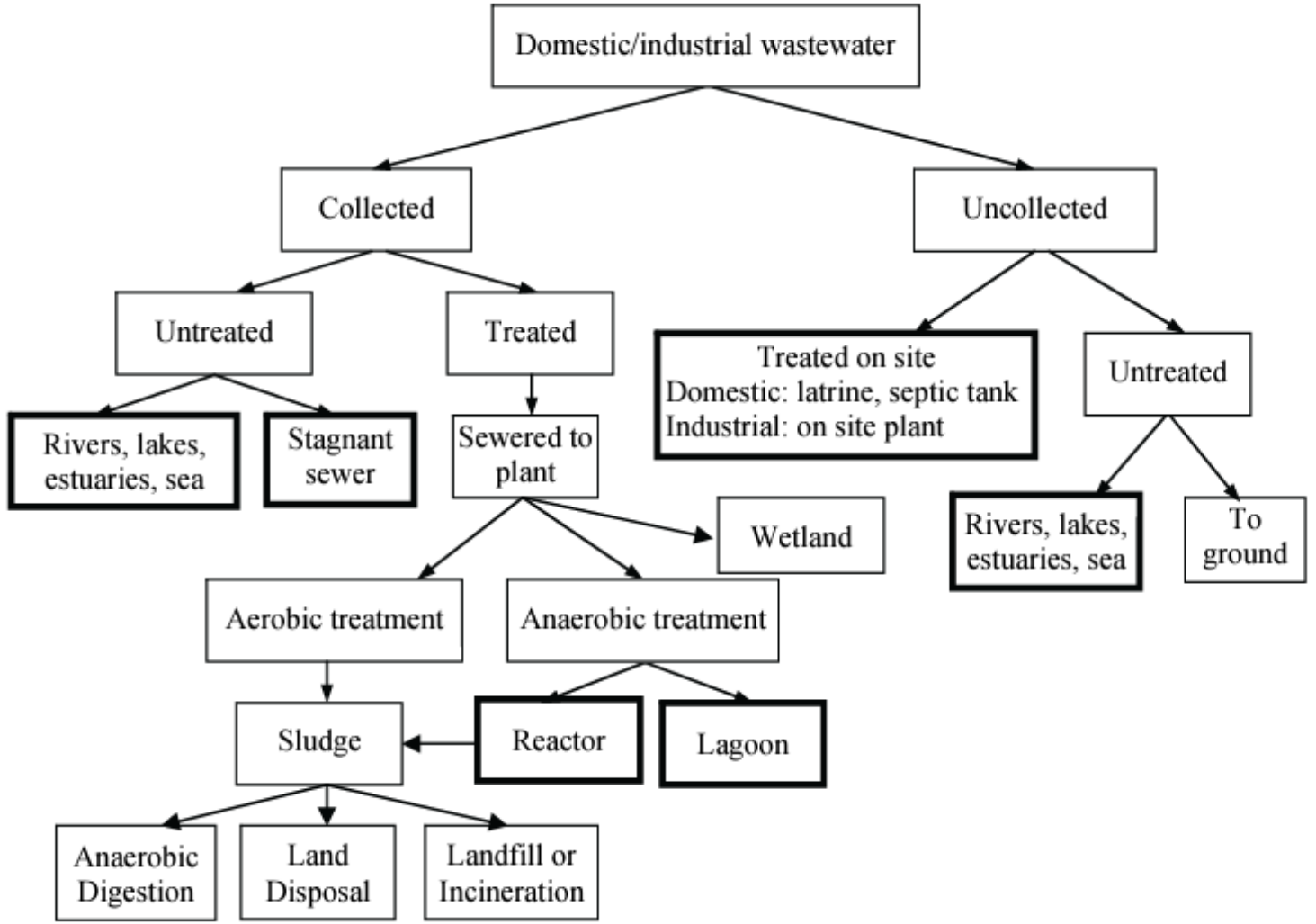
Wastewater can be a source of methane (CH_4) when treated or disposed anaerobically. It can also be a source of nitrous oxide (N_2O) emissions.

Carbon dioxide (CO_2) emissions from wastewater are not considered in the IPCC Guidelines because these are of biogenic origin and should not be included in national total emissions.



Wastewater treatment systems and discharge pathways

GHG emissions from wastewater CONT…

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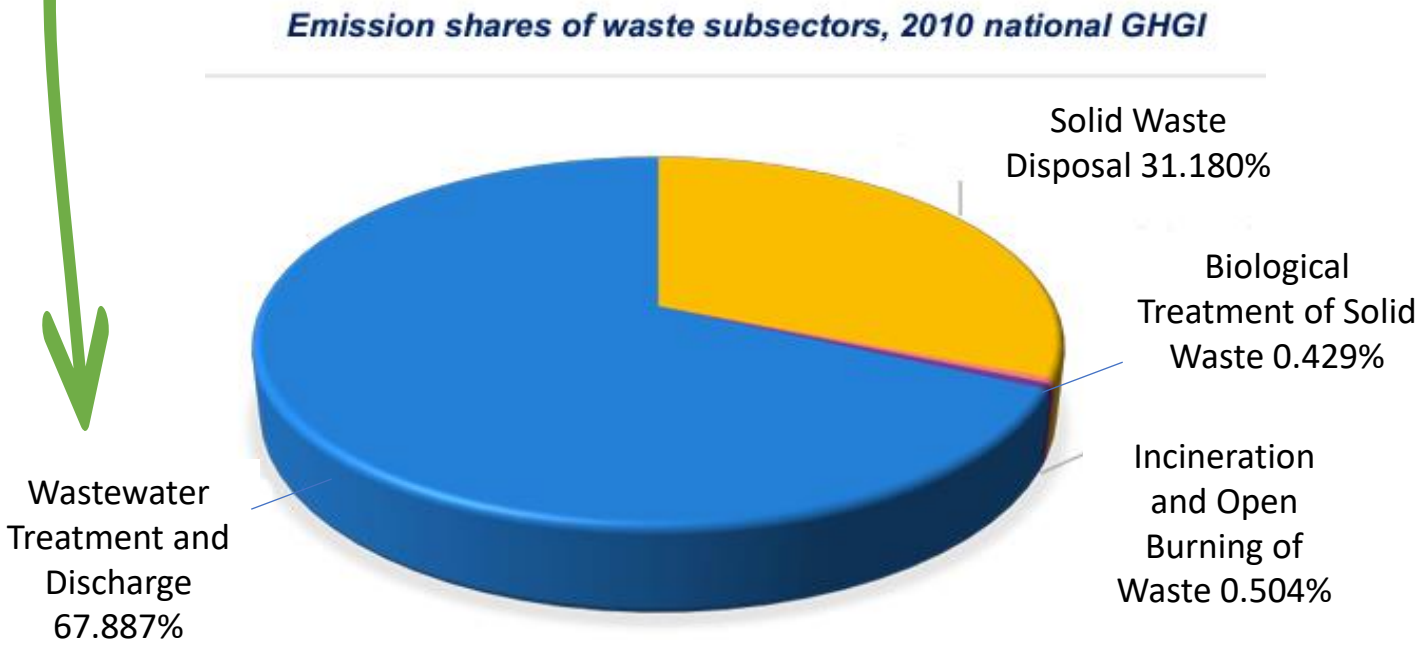
According to the recent GHG inventory in Philippines (GHGI 2010), emissions from wastewater treatment and discharge made up the majority of the waste sector emissions at 67.887%

Summary of 2010 waste sector emissions, per subsector and per gas (values in Mt CO_2e)

	CO_2	CH_4	N_2O	Total
Solid Waste Disposal	-	4.851	-	4.851
Biological Treatment of Solid Waste	-	0.035	0.032	0.067
Incineration and Open Burning of Waste	0.015	0.053	0.011	0.078
Wastewater Treatment and Discharge	-	9.588	0.974	10.562
TOTAL				15.559

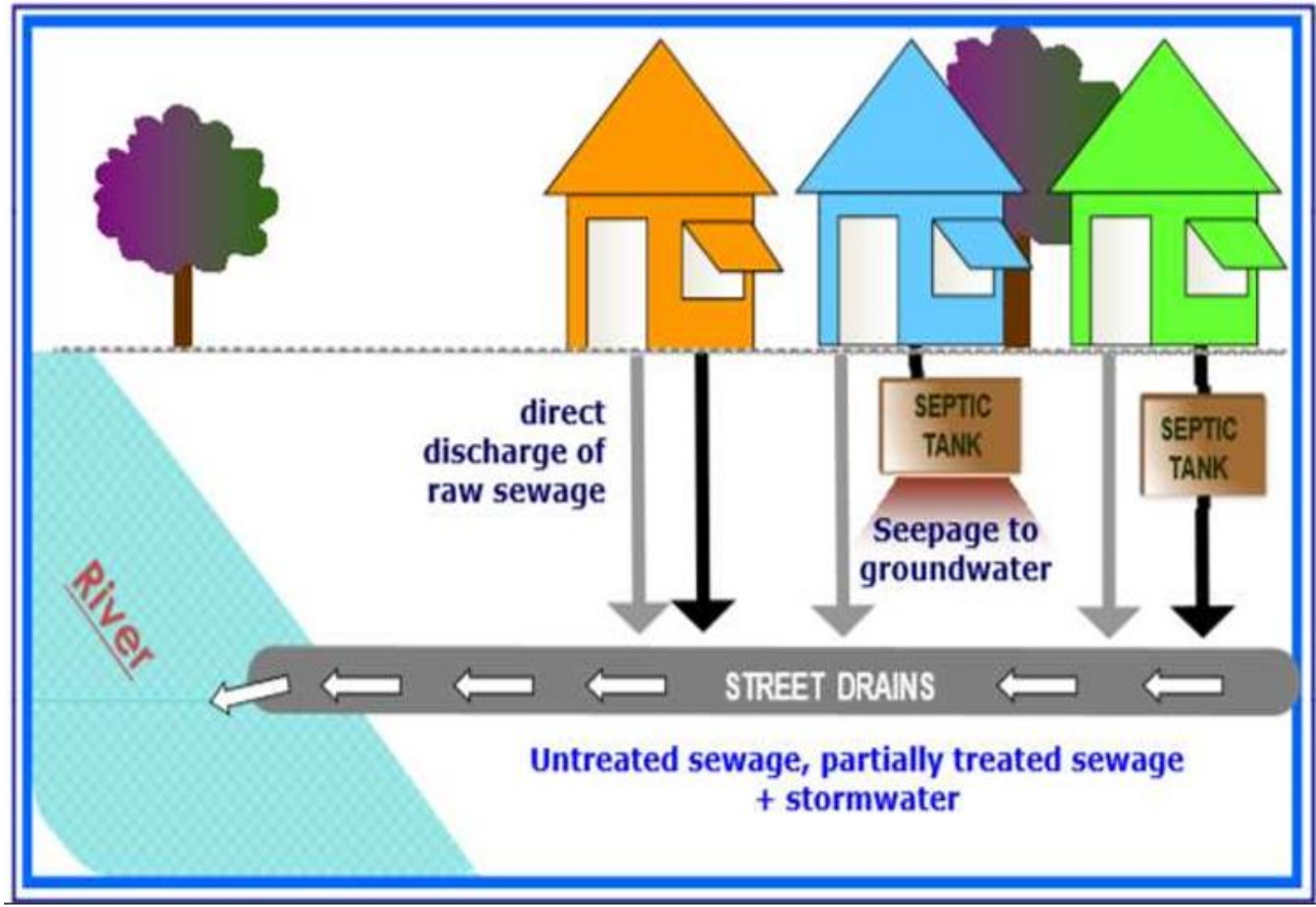


2. Wastewater Handling: Domestic

Facts and Statistics of Domestic Wastewater Management in the Philippines

- Only 10% of domestic wastewater is treated
- Only 5% of the total population is connected to a sewer network. The vast majority uses flush toilets connected to septic tanks
- 76.8 percent of families in the Philippines have sanitary toilet facilities (DOH, 2008).
- Less than 10 percent have access to piped sewerage systems. Those that are not connected to a sewerage network rely on septic tanks, pit latrines, or practice open defecation.
- In Metro Manila, 43 sewage treatment plants (STPs) and septage treatment plants (SpTPs) provide service to more than a million residents or around 10 percent of the region's entire population.
- An average of 9.4 million kilograms of BOD was removed per year. The highest pollution load reduction was attained in 2012 with 9.5 million kilograms of BOD removed

Existing sanitation infrastructure for urban areas in the Philippines



Domestic Wastewater Sewage Treatment Plant (STP), Manila, Philippines

(Date started operation: July 30, 2020)

- Capacity: 500,000 liters per day
- Feature: Solar Powered, treatment of wastewater will be done through the installed wastewater interceptor on different drainage outfalls that lead to Manila Bay to receive and control the untreated wastewater from households within the Metro Manila
- communities.
- The STP then process and treat the domestic WW coming from the interceptors before releasing it into the Manila Bay

Future targets/plans for proper domestic wastewater management

- By 2037, 100 percent of all households (with projected population of 15 million) and commercial establishments within Metro Manila should have connected to sewer lines for the wastewater treatment facilities/ plants

- It will be put up and operated by the Manila Water Company and Maynilad Water Services Co. in line with the 25-year contracts signed between said companies and the government through the Metropolitan Waterworks, and Sewerage System (MWSS)

- All Local Government Units (LGUs) should have developed septage management systems as per Philippine Development Plan (PDP)

- Approximately 43.6 million people have access to septage treatment plants (SpTPs) and about 3.2 million will have access to STPs

- About 346 million kg of BOD is diverted from the environment per year as a result of the sewerage and septage management projects

Issues and challenges for proper domestic wastewater management in Philippines

- Need for **access to cost-effective and efficient Domestic Wastewater technologies**

- Increase **access to the new knowledge and technologies** generated from international/regional R&D

- Increase access to the **standards for the effective and efficient management of domestic wastewater** through Water Environment Partnership in Asia (WEPA)

- Participation to the global or regional network for the access to information on improved approaches/ strategies, and **access to financial and technical assistance** in the development of the country's comprehensive domestic wastewater treatment systems and facilities

Issues and challenges for proper domestic wastewater management in Philippines CONT…

Inadequate government funding resources to implement wider domestic wastewater management program with the increasing population and local economic activities

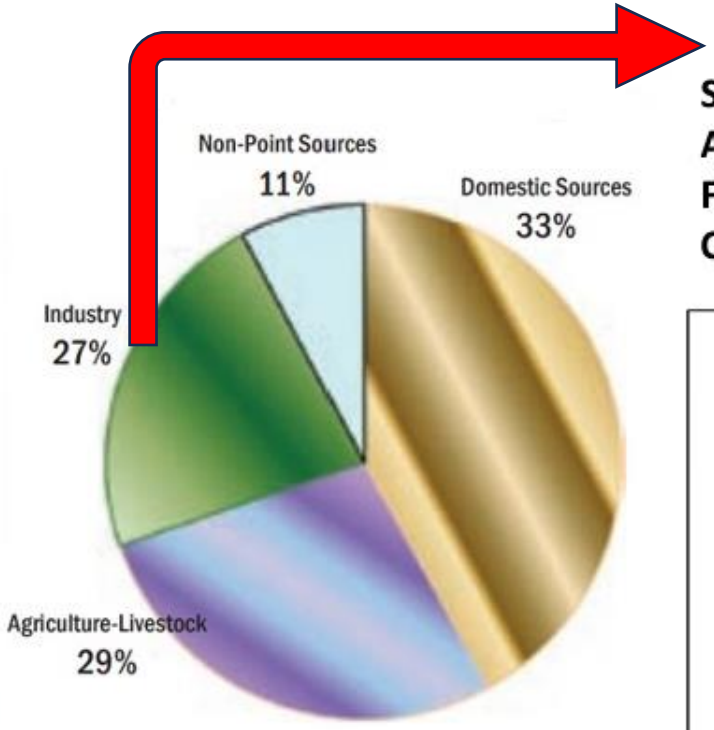
Encourage private investment (for localities outside the capital) and/or through options such as public-private partnership and Built-Operate Transfer Scheme.

With the foundation for domestic wastewater management already laid out, the main challenge now lies in the **provision of bigger budget under the general appropriation of the government**

Continuation of existing management policies and programs to strictly implement wider scope of domestic wastewater management programs in order to preserve the quality of the country's water bodies, and ultimately, achieve and sustain quality life for future generations

3. Wastewater Handling: Industrial

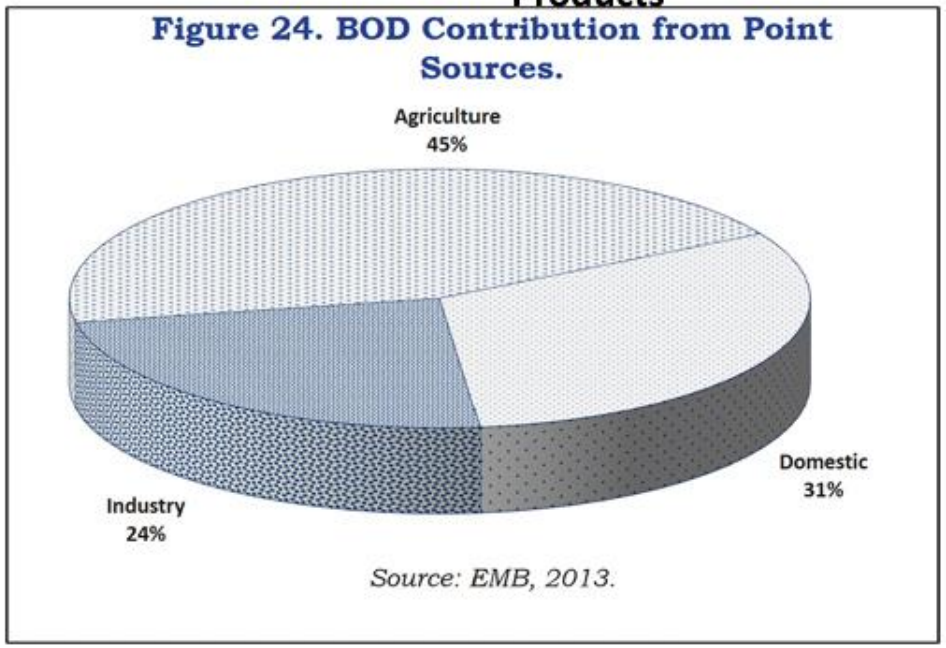
Industry sources of water pollution



Source: National Water Quality Status Report 2001-2005

INDUSTRY SOURCES

Sugar Mills	Pulp and Paper Mills
Alcohol Distillery	Glass Manufacturing
Food Processing	Copper Smelting
Cement Kilns	Plastic and Consumer Products



Overview of the Situation of Industrial Wastewater Management in the Philippines

- As of October 2017, there are 370 operating special economic zones in the Philippines; 261 Information Technology Parks,74 Manufacturing Economic Zones, 22 Agro-Industrial Economic Zones, 20 Tourism Economic Zones and 2 Medical Tourism Centers.
- Four of these are owned by Philippine Economic Zone Authority (PEZA) while the remaining are privately-owned.
- Ideally, the process wastewater and other non-domestic wastewater are pre-treated by industries before discharging the effluent into the sewerage system of the industrial park
- The centralized wastewater treatment facility (CWTF) within the industrial park shall further treat the effluent from industries before discharging it into bodies of water or reuse for landscaping, irrigation or other purposes

Overview of the Situation of Industrial Wastewater Management in the Philippines CONT…

- Industries that are known to generate large amount of wastewater are food and dairy manufacturing, pulp and paper products and textile products.
- The volume of wastewater generated by an industry highly depends on its technical level of process and on its production rate
- Individual companies have obligations to manage their industrial wastewater either as stand-alone entities or as part of an industrial park.
- There has been some difficulty in industrial wastewater management since proper treatment of wastewater is assigned to individual industries that have to develop their own expertise to comply with effluent standards set either by the special economic zone they are operating in or with general effluent standards.

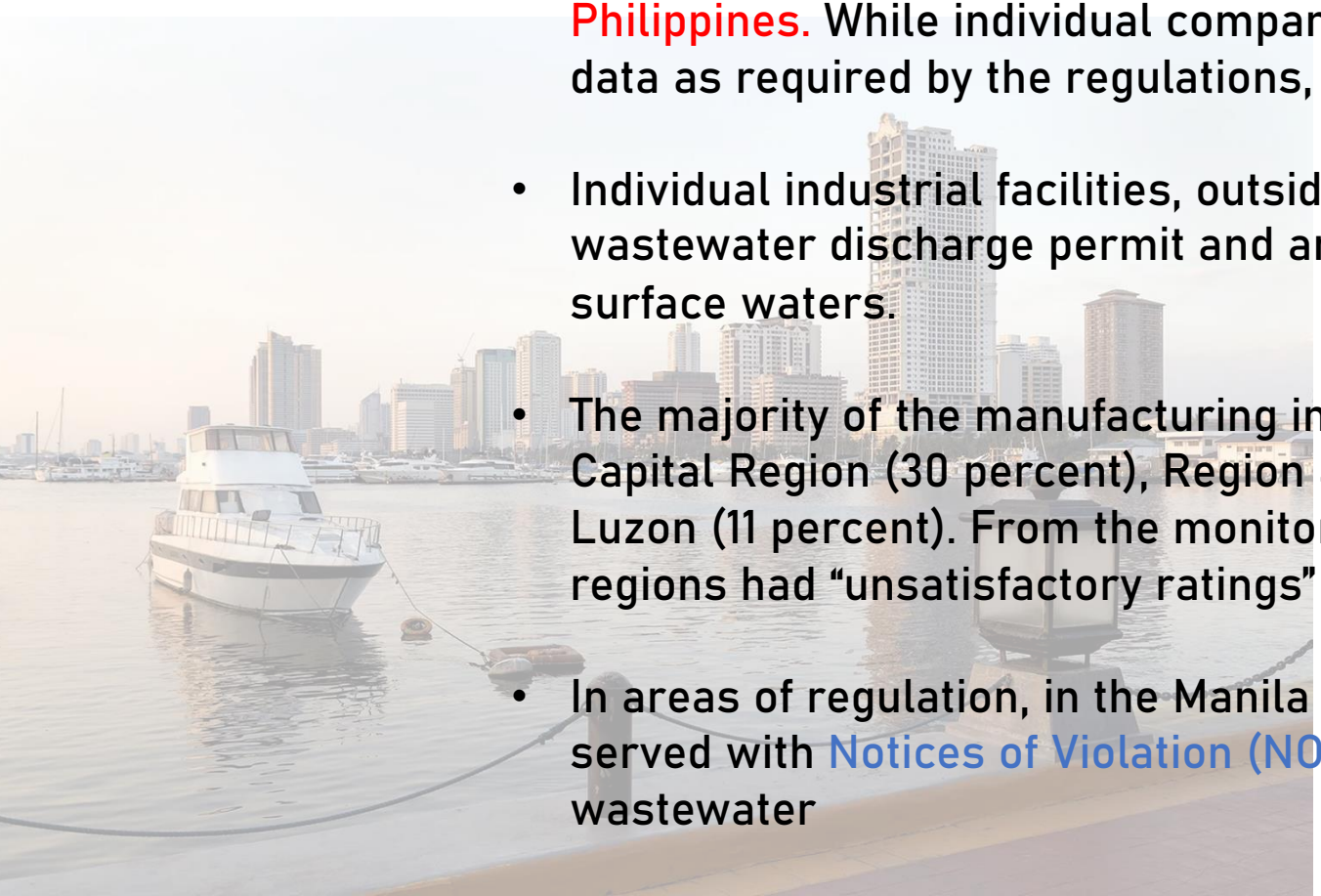
Overview of the Situation of Industrial Wastewater Management in the Philippines CONT…

- Recent regulations on nutrients have been a challenge for centralized wastewater treatment facility (CWTF) operators as existing treatment systems are not designed to remove nutrients such as nitrates and phosphates to the levels required

- Many industrial parks operate their own however, these are still required to comply with pre-treatment effluent standards established by the industrial park before discharge into the CWTF of the park

- Industries not located within an industrial park, effluent must comply with the Philippine Effluent Standards, DAO 2016-08

Overview of the Situation of Industrial Wastewater Management in the Philippines CONT…



- Data on the volume of wastewater generated by the industries are very limited in the Philippines. While individual companies do collect and report their wastewater volume data as required by the regulations, there is no national database collating all these data.

- Individual industrial facilities, outside of special economic zones, need to acquire a wastewater discharge permit and are responsible for the quality of their discharge to surface waters.

- The majority of the manufacturing industries in the Philippines are located in the National Capital Region (30 percent), Region 4ACalabarzon (17 percent) and Region 3-Central Luzon (11 percent). From the monitoring conducted by the EMB, rivers of the mentioned regions had “unsatisfactory ratings” for their water quality criteria

- In areas of regulation, in the Manila Bay Area alone, 5,228 out of 10,168 industries were served with Notices of Violation (NOV) for failure to acquire permits to discharge treated wastewater

Indicative Values of Wastewater Quality in Selected Industries in the Philippines*

Industry	BOD (mg/L)	COD(mg/L)	TSS(mg/L)	Temp(deg C)	pH
Sugarcane milling	2,000-3,500	6,000	800 – 1,000	-	6.5 - 8.0
Manufacture of ethanol	60,000	110,000	6,000	48-50	4 - 4.5
Canning of fish products	30,000	45,000	10,700	25	6.5 -7.5
Manufacture of beverages	900	1,500	250	25	11 - 12
Meat processing	1,000 – 1,500	2,000	250	-	7
Copper Cathode	-	-	43	30.4	8.15
Swine Farm	2,000- 4,200	4,000 – 5,429	1,600 – 5,380	-	-
Bottling Services	400	1,647.05	90	32.2	8.35
Manufacturing of Desiccated Coconut	6,000- 10,000	17,000-20,000	2,000 – 4,000	-	5.0-6.3
Pineapple Processing Plant	10,200	20,000	585	40-50	4.5-6.5

Source:

ARCOWA 2018. Wastewater Management and Resource Recovery in the Philippines: Current status and opportunities. GEF, UNDP, PEMSEA

Issues and challenges for proper industrial wastewater management

- Inadequate wastewater treatment facilities, such as septic tank, impounding tank, are still being used by commercial and some industrial establishments
- Absence of sewer lines/sewerage facilities in many areas specially in the Highly Urbanized Cities
- Absence/Lack of Centralized Wastewater Treatment Facilities to accommodate wastewater from condominiums, public markets, commercial buildings, small eateries

Government's future targets and plans to improve industrial wastewater management

- Designation of New Water Quality Management Area.
- Operationalization of Water Quality Management Area (WQMA) Action Plans.
- Monitoring of Ambient Water Quality (BOD, Dissolved Oxygen, Fecal Coliform, and other parameters).
- Implementation of Adopt-an-Estero Water body Program (wherein clean-up activities have been undertaken to reduce garbage (floating debris) in the waterbody. This is in collaboration with private sectors, academe, LGUs, stakeholders, etc.).
- Processing and issuance of Wastewater Discharge Permit (WWDP) to firms with effluent.
- Compliance monitoring of firms/industries with Wastewater Discharge Permit.
- Survey of firms/industries with no WWDP

Calculation of National Total Emissions

Wastewater

$$CH_4\ Emissions = \left[\sum_{i,j}\left(U_i \bullet T_{i,j} \bullet EF_j\right)\right](TOW - S) - R$$

Where:

CH_4 Emissions = CH_4 emissions in inventory year, kg CH_4/yr

TOW = total organics in wastewater in inventory year, kg BOD/yr

S = organic component removed as sludge in inventory year, kg BOD/yr

U_i = fraction of population in income group *i* in inventory year, See Table 6.5.

$T_{i,j}$ = degree of utilisation of treatment/discharge pathway or system, *j*, for each income group fraction *i* in inventory year, See Table 6.5.

i = income group: rural, urban high income and urban low income

j = each treatment/discharge pathway or system

EF_j = emission factor, kg CH_4 / kg BOD

R = amount of CH_4 recovered in inventory year, kg CH_4/yr

Total Emission = CH4 Emission x GWP_CH4 + N2O Emission x GWP_N20

N_2O EMISSIONS FROM WASTEWATER EFFLUENT

$$N_2O\ Emissions = N_{EFFLUENT} \bullet EF_{EFFLUENT} \bullet 44/28$$

Where:

N_2O emissions = N_2O emissions in inventory year, kg N_2O/yr

$N_{EFFLUENT}$ = nitrogen in the effluent discharged to aquatic environments, kg N/yr

$EF_{EFFLUENT}$ = emission factor for N_2O emissions from discharged to wastewater, kg N_2O-N/kg N

The factor 44/28 is the conversion of kg N_2O-N into kg N_2O.

TOTAL NITROGEN IN THE EFFLUENT

$$N_{EFFLUENT} = \left(P \bullet Protein \bullet F_{NPR} \bullet F_{NON-CON} \bullet F_{IND-COM}\right) - N_{SLUDGE}$$

Where:

$N_{EFFLUENT}$ = total annual amount of nitrogen in the wastewater effluent, kg N/yr

P = human population

Protein = annual per capita protein consumption, kg/person/yr

F_{NPR} = fraction of nitrogen in protein, default = 0.16, kg N/kg protein

$F_{NON-CON}$ = factor for non-consumed protein added to the wastewater

$F_{IND-COM}$ = factor for industrial and commercial co-discharged protein into the sewer system

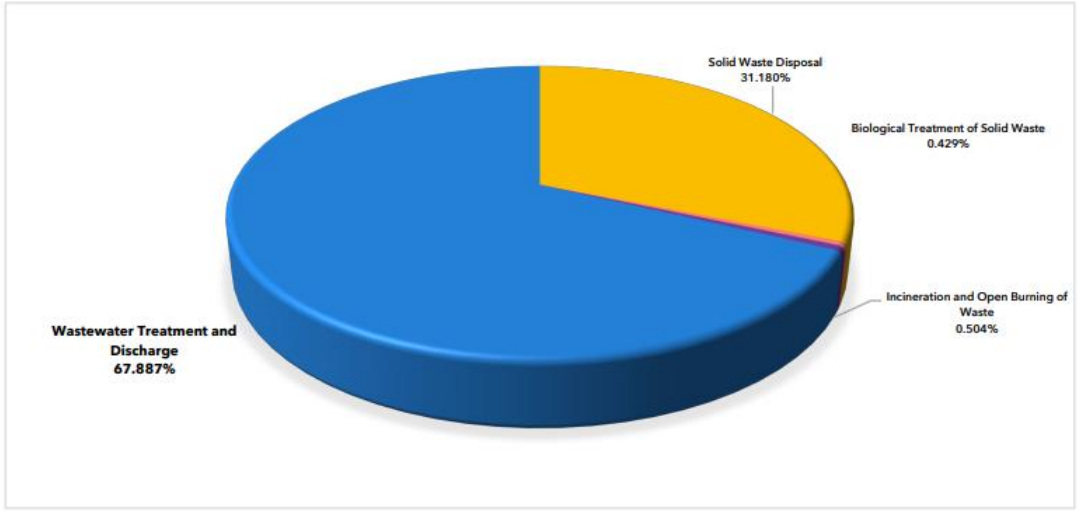
N_{SLUDGE} = nitrogen removed with sludge (default = zero), kg N/yr

Calculation of National Total Emissions

Table 8. Summary of 2010 waste sector emissions, per subsector and per gas (values in Mt CO2e)

	CO_2	CH_4	N_2O	Total
Solid Waste Disposal	-	4.851	-	4.851
Biological Treatment of Solid Waste	-	0.035	0.032	0.067
Incineration and Open Burning of Waste	0.015	0.053	0.011	0.078
Wastewater Treatment and Discharge	-	9.588	0.974	10.562
TOTAL				15.55

Figure 7. Emission shares of waste subsectors, 2010 national GHGI



Calculation of National Total Emissions

Table 2. Summary of 2010 National GHG Inventory, per sector and per gas (values in Mt CO_2e)

	CO_2	CH_4	N_2O	HFCs	Total
Energy	50.698	1.888	0.519	-	53.105
Agriculture	0.696	33.853	8.604	-	43.152
Transport	23.718	0.125	0.331	-	24.174
Waste	0.015	14.527	1.017	-	15.559
IPPU	7.564	0.009	0.019	0.771	8.363
FOLU	(37.016)	0.007	0.002	-	(37.007)
	TOTAL				*107.345*

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