Training on 2006 IPCC Guidelines for preparing National GHG Inventory:

IPCC Inventory tool: Solid Waste

Present By:

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

4.D – Wastewater treatment and discharge

4.D – Wastewater treatment and discharge

- 4.D.1 – Domestic Wastewater Treatment and Discharge

4.D.1 –Domestic Wastewater Treatment and Discharge CONT…

Step 01: Estimate total organically degradable carbon in wastewater (TOW)

Country specific

Please use national values, if available. IPCC default data are available in Table 6.4

EQUATION 6.3
TOTAL ORGANICALLY DEGRADABLE MATERIAL IN DOMESTIC WASTEWATER

$$TOW = P \bullet BOD \bullet 0.001 \bullet I \bullet 365$$

Where:

TOW	=	total organics in wastewater in inventory year, kg BOD/yr
P	=	country population in inventory year, (person)
BOD	=	country-specific per capita BOD in inventory year, g/person/day, See Table 6.4.
0.001	=	conversion from grams BOD to kg BOD
I	=	correction factor for additional industrial BOD discharged into sewers (for collected the default is 1.25, for uncollected the default is 1.00.)

Tier 1 Calculation

	Parameter	Value	Unit
P	Country population in inventory year, (person)	118,569,422	persons
BOD	Country-specific per capita BOD in inventory year, g/person/day	40	g/person/day
I	Correction factor for additional industrial BOD discharged into sewers	1	

EQUATION 6.3
TOTAL ORGANICALLY DEGRADABLE MATERIAL IN DOMESTIC WASTEWATER

$$TOW = P \bullet BOD \bullet 0.001 \bullet I \bullet 365$$

P	=	118,569,422	persons
BOD	=	40	g/person/day
I	=	1	
TOW	=	118569422*40*0.001*1*365	kg BOD/yr
	=	1,731,113,561.20	kg BOD/yr

Default

TABLE 6.4
ESTIMATED BOD_5 VALUES IN DOMESTIC WASTEWATER FOR SELECTED REGIONS AND COUNTRIES

Country/Region	BOD_5 (g/person/day)	Range	Reference
Africa	37	35 – 45	1
Egypt	34	27 – 41	1
Asia, Middle East, Latin America	40	35 – 45	1
India	34	27 – 41	1
West Bank and Gaza Strip (Palestine)	50	32 – 68	1

Tier 1 Calculation

EQUATION 6.3
TOTAL ORGANICALLY DEGRADABLE MATERIAL IN DOMESTIC WASTEWATER

$$TOW = P \bullet BOD \bullet 0.001 \bullet I \bullet 365$$

P	=	118,569,422	persons
BOD	=	40	g/person/day
I	=	1	
TOW	=	118569422*40*0.001*1*365	kg BOD/yr
	=	1,731,113,561.20	kg BOD/yr

Default

TABLE 6.4
ESTIMATED BOD_5 VALUES IN DOMESTIC WASTEWATER FOR SELECTED REGIONS AND COUNTRIES

Country/Region	BOD_5 (g/person/day)	Range	Reference
Africa	37	35 – 45	1
Egypt	34	27 – 41	1
Asia, Middle East, Latin America	40	35 – 45	1
India	34	27 – 41	1
West Bank and Gaza Strip (Palestine)	50	32 – 68	1

Tier 2 Calculation

EQUATION 6.3
TOTAL ORGANICALLY DEGRADABLE MATERIAL IN DOMESTIC WASTEWATER

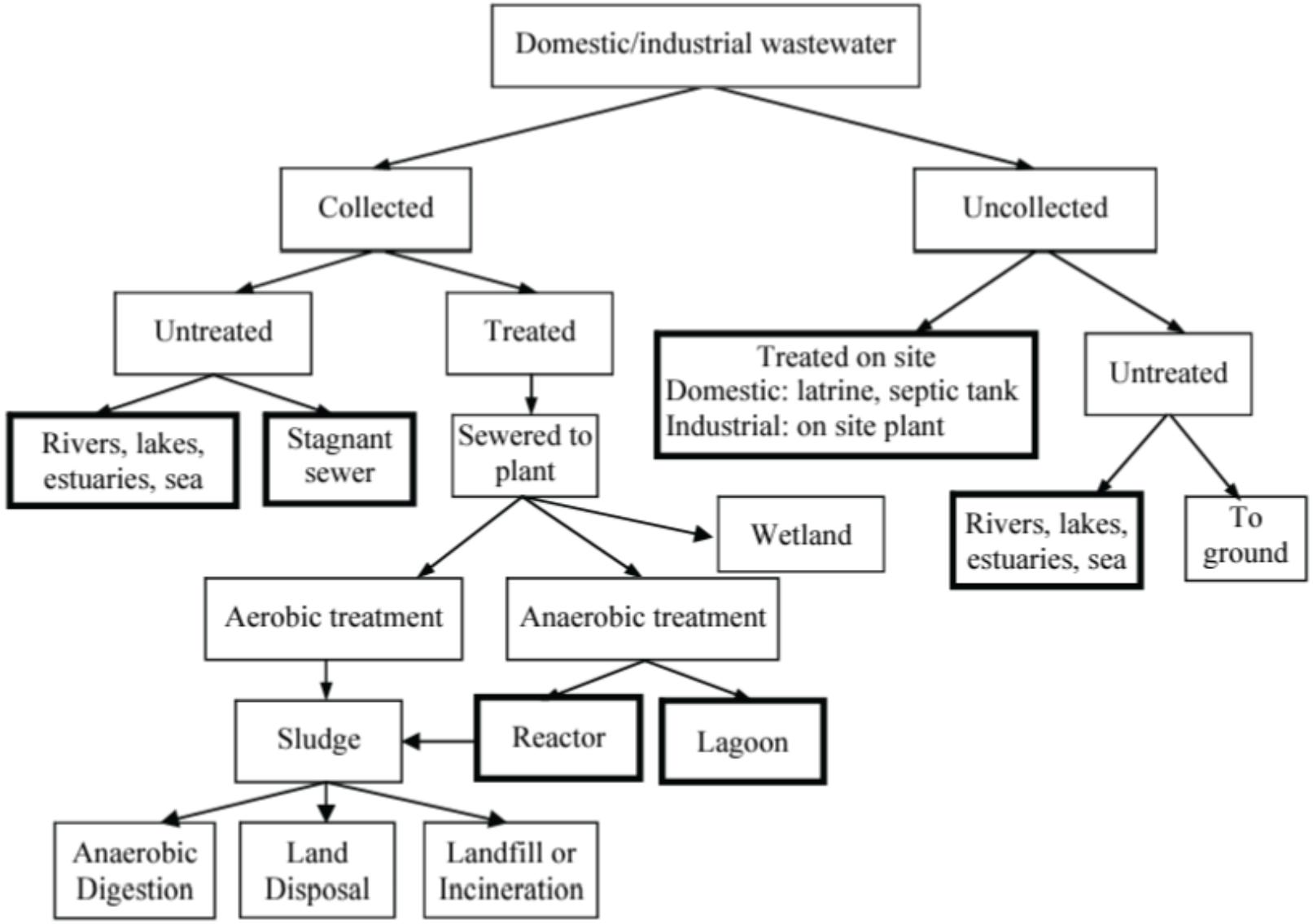
$$TOW = P \bullet BOD \bullet 0.001 \bullet I \bullet 365$$

P	=	118,569,422	persons
BOD	=	42	g/person/day
I	=	1.25	
TOW	=	118569422*42*0.001*1.25*365	kg BOD/yr
	=	2,272,086,549.08	kg BOD/yr

As country's wastewater BOD level is not available, value from the value range need to be used

4.D.1 –Domestic Wastewater Treatment and Discharge CONT...

Step 02: Select the pathway and systems according to country activity data



4.D.1 –Domestic Wastewater Treatment and Discharge CONT...

Step 03: Obtain the emission factor for each relevant domestic wastewater treatment/discharge pathway or system.

Good practice is to use country-specific data for Bo, where available. If country-specific data are not available, use IPCC default values in Table 6.2 of IPCC 2006

EQUATION 6.2
CH_4 EMISSION FACTOR FOR EACH DOMESTIC WASTEWATER TREATMENT/DISCHARGE PATHWAY OR SYSTEM

$$EF_j = B_o \bullet MCF_j$$

Where:

EF_j = emission factor, kg CH_4/kg BOD

j = each treatment/discharge pathway or system

B_o = maximum CH_4 producing capacity, kg CH_4/kg BOD

MCF_j = methane correction factor (fraction), See Table 6.3.

TABLE 6.3
DEFAULT MCF VALUES FOR DOMESTIC WASTEWATER

Type of treatment and discharge pathway or system	Comments	MCF [1]	Range
Untreated system			
Sea, river and lake discharge	Rivers with high organics loadings can turn anaerobic.	0.1	0 – 0.2
Stagnant sewer	Open and warm	0.5	0.4 – 0.8
Flowing sewer (open or closed)	Fast moving, clean. (Insignificant amounts of CH_4 from pump stations, etc)	0	0
Treated system			
Centralized, aerobic treatment plant	Must be well managed. Some CH_4 can be emitted from settling basins and other pockets.	0	0 – 0.1
Centralized, aerobic treatment plant	Not well managed. Overloaded.	0.3	0.2 – 0.4

Tier 1 Calculation

	Parameter	Value	Unit
j	Treatment/discharge pathway or system	Stagnant sewer	
Bo	Maximum CH4 producing capacity	0.6	kg CH4/kg BOD
MCFj	Methane correction factor	0.5	fraction

EQUATION 6.2
CH_4 EMISSION FACTOR FOR
EACH DOMESTIC WASTEWATER TREATMENT/DISCHARGE PATHWAY OR SYSTEM

$$EF_j = B_o \bullet MCF_j$$

B_o	=	0.6	kg CH_4/kg BOD
MCF_j	=	0.5	
j	=	Stagnant sewer	
EF_j	=	0.6*0.5	kg CH_4/kg BOD
	=	0.3	kg CH_4/kg BOD

IPCC default value

TABLE 6.2
DEFAULT MAXIMUM CH_4 PRODUCING CAPACITY (B_o) FOR DOMESTIC WASTEWATER

0.6 kg CH_4/kg BOD
0.25 kg CH_4/kg COD
Based on expert judgment by lead authors and on Doorn *et al.*, (1997)

TABLE 6.3
DEFAULT MCF VALUES FOR DOMESTIC WASTEWATER

Type of treatment and discharge pathway or system	Comments	MCF [1]	Range
Untreated system			
Sea, river and lake discharge	Rivers with high organics loadings can turn anaerobic.	0.1	0 – 0.2
Stagnant sewer	Open and warm	0.5	0.4 – 0.8
Flowing sewer (open or closed)	Fast moving, clean. (Insignificant amounts of CH_4 from pump stations, etc)	0	0
Treated system			
Centralized, aerobic treatment plant	Must be well managed. Some CH_4 can be emitted from settling basins and other pockets.	0	0 – 0.1
Centralized, aerobic treatment plant	Not well managed. Overloaded.	0.3	0.2 – 0.4

Tier 1 Calculation

EQUATION 6.2
CH_4 EMISSION FACTOR FOR
EACH DOMESTIC WASTEWATER TREATMENT/DISCHARGE PATHWAY OR SYSTEM

$$EF_j = B_o \bullet MCF_j$$

B_o	=	0.6	kg CH_4/kg BOD
MCF_j	=	0.5	
j	=	Stagnant sewer	
EF_j	=	0.6*0.5	kg CH_4/kg BOD
	=	0.3	kg CH_4/kg BOD

IPCC default value

TABLE 6.2
DEFAULT MAXIMUM CH_4 PRODUCING CAPACITY (B_o) FOR DOMESTIC WASTEWATER

0.6 kg CH_4/kg BOD
0.25 kg CH_4/kg COD
Based on expert judgment by lead authors and on Doorn *et al.*, (1997)

Tier 2 Calculation

EQUATION 6.2
CH_4 EMISSION FACTOR FOR
EACH DOMESTIC WASTEWATER TREATMENT/DISCHARGE PATHWAY OR SYSTEM

$$EF_j = B_o \bullet MCF_j$$

B_o	=	0.8	kg CH_4/kg BOD
MCF_j	=	0.6	
j	=	Stagnant sewer	
EF_j	=	0.8*0.6	kg CH_4/kg BOD
	=	0.48	

Just an assumption as country specific values are not available

Just an assumption within the range as country specific values are not available

TABLE 6.3
DEFAULT MCF VALUES FOR DOMESTIC WASTEWATER

Type of treatment and discharge pathway or system	Comments	MCF [1]	Range
Untreated system			
Sea, river and lake discharge	Rivers with high organics loadings can turn anaerobic.	0.1	0 – 0.2
Stagnant sewer	Open and warm	0.5	0.4 – 0.8
Flowing sewer (open or closed)	Fast moving, clean. (Insignificant amounts of CH_4 from pump stations, etc)	0	0
Treated system			
Centralized, aerobic treatment plant	Must be well managed. Some CH_4 can be emitted from settling basins and other pockets.	0	0 – 0.1
Centralized, aerobic treatment plant	Not well managed. Overloaded.	0.3	0.2 – 0.4

4.D.1 –Domestic Wastewater Treatment and Discharge CONT…

Step 04: Estimate emissions, adjust for possible sludge removal and/or CH4 recovery and sum the results for each pathway/system

Derived from previous equation

Country specific

Country specific value or IPCC defaults values for countries in the same region can be used

Derived from previous equation

The amount of CH_4 that is flared or recovered for energy use should be subtracted from total emissions through the use of a separate CH_4 recovery parameter.

EQUATION 6.1
TOTAL CH_4 EMISSIONS FROM DOMESTIC WASTEWATER

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

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

Tier 1 Calculation

	Parameter	Value	Unit
TOW	Total organics in wastewater in inventory year	1731113561	kg BOD/yr
S	Organic component removed as sludge in inventory year	100	kg BOD/yr
Ui	Fraction of population in income group i in inventory year	0.06	
Ti,j	Degree of utilisation of treatment/discharge pathway or system, j, for each income group fraction i in inventory year	0.67	
i	Income group: rural, urban high income and urban low income	Urban High Income	
j	Each treatment/discharge pathway or system	Sewer	
EFj	Emission factor	0.3	kg CH4 / kg BOD
R	Amount of CH4 recovered in inventory year	0	kg CH4/yr

EQUATION 6.1
TOTAL CH_4 EMISSIONS FROM DOMESTIC WASTEWATER

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

TOW	=	1,731,113,561.20	kg BOD/yr
S	=	100	kg BOD/yr
U_i	=	0.06	
$T_{i,j}$	=	0.67	
i	=	Urban High Income	
j	=	Sewer	
EF_j	=	0.3	kg CH4 / kg BOD
R	=	0	kg CH4/yr
CH_4 Emissions	=	$[\sum_{i,j}(0.06 \times 0.67 \times 0.3)](1{,}731{,}113{,}561.208 - 100) - 0$	kg CH4/yr
	=	$[\sum_{i,j}(0.01206)](1{,}731{,}113{,}461.20) - 0$	kg CH4/yr
	=	20,877,228.34	kg CH4/yr

Previous calculations

Assumed value as default value or country specific values are not available

From Table 6.5 (India – under Asian region, Urban High income), as country specific values is not available

IPCC default

Tier 1 Calculation

EQUATION 6.1
TOTAL CH_4 EMISSIONS FROM DOMESTIC WASTEWATER

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

TOW	=	1,731,113,561.20	kg BOD/yr
S	=	100	kg BOD/yr
U_i	=	0.06	
$T_{i,j}$	=	0.67	
i	=	Urban High Income	
j	=	Sewer	
EF_j	=	0.3	kg CH4 / kg BOD
R	=	0	kg CH4/yr
CH_4 Emissions	=	$[\sum_{i,j}(0.06 \times 0.67 \times 0.3)](1{,}731{,}113{,}561.208 - 100) - 0$	kg CH4/yr
	=	$[\sum_{i,j}(0.01206)](1{,}731{,}113{,}461.20) - 0$	kg CH4/yr
	=	20,877,228.34	kg CH4/yr

IPCC default

From Table 6.5 (India – under Asian region, Urban High income), as country specific values is not available

Average value considering other country defaults, as value for Philippine sis not available

Previous calculations

Assumed value as default value or country specific values are not available

Tier 2 Calculation

EQUATION 6.1
TOTAL CH_4 EMISSIONS FROM DOMESTIC WASTEWATER

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

TOW	=	55,717,613.18	kg BOD/yr
S	=	100	kg BOD/yr
U_i	=	0.06	
$T_{i,j}$	=	0.9	
i	=	Urban High Income	
j	=	Sewer	
EF_j	=	0.48	kg CH4 / kg BOD
R	=	12	kg CH4/yr
CH_4 Emissi	=	$[\sum_{i,j}(0.06 \times 0.9 \times 0.48)](55{,}717{,}613.18 - 100) - 12$	kg CH4/yr
	=	$[\sum_{i,j}(0.02592)](55{,}717{,}513.18) - 12$	kg CH4/yr
	=	1,444,185.94	kg CH4/yr

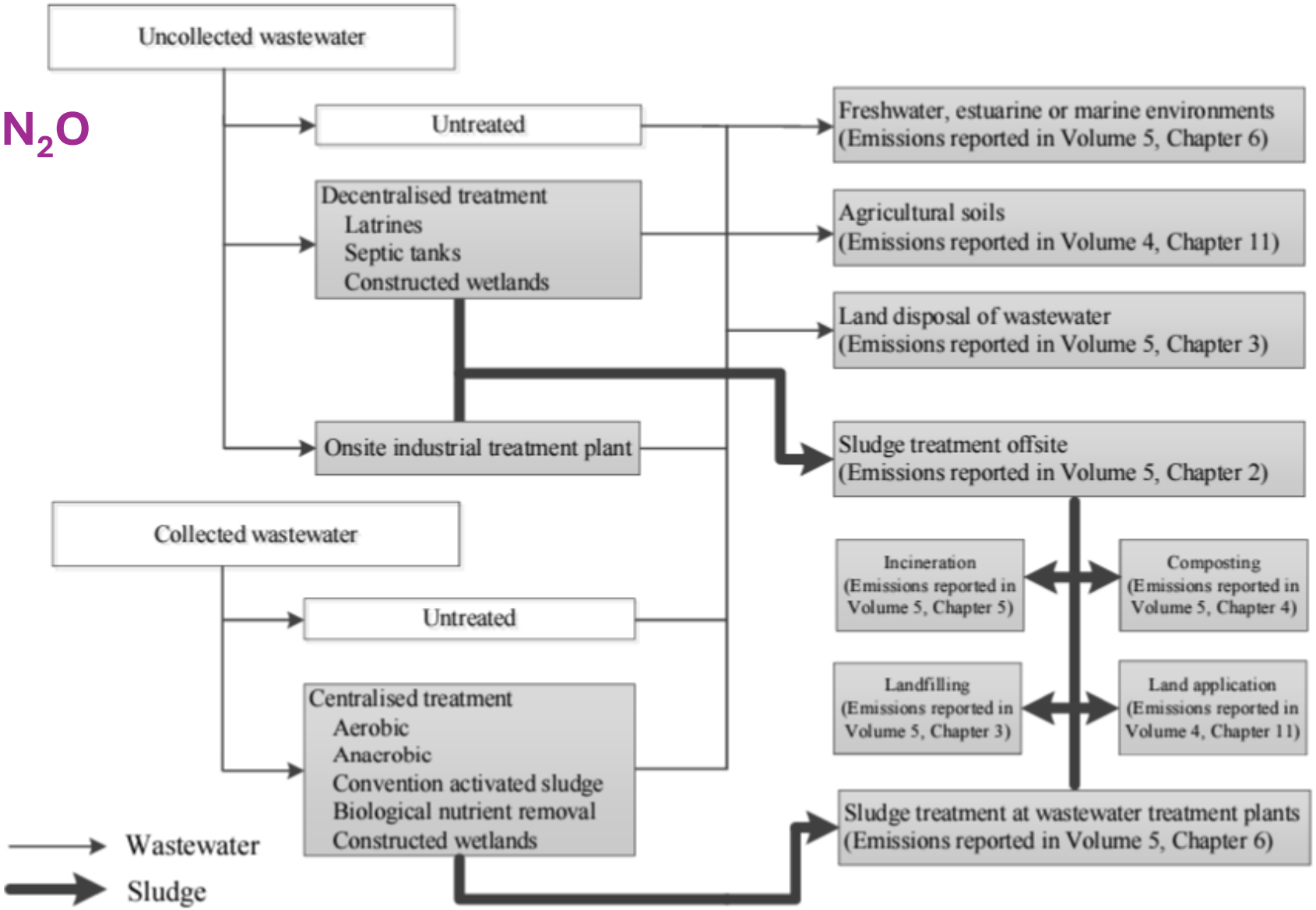
Assumed value

4.D.1 –Domestic Wastewater Treatment and Discharge

Emission calculation – N_2O

Step 01: Select the pathway and systems according to country activity data

From IPCC 2019 Refinement



4.D.1 –Domestic Wastewater Treatment and Discharge CONT…

Step 02: Estimate annual per capita protein consumption

If national statistics on protein consumed or protein supply are not available, Food Balance Sheets of FAOSTAT can be used as activity data on per capita "protein supply quantity."

EQUATION 6.10A (NEW)
ESTIMATION OF PROTEIN CONSUMED

$$Protein = Protein_{SUPPLY} \bullet FPC$$

Where:

$Protein_{SUPPLY}$ = annual per capita protein supply, kg protein/person/yr

FPC = Fraction of protein consumed. Default regional values are listed in the new Table 6.10a

TABLE 6.10A (NEW)
DEFAULT FACTORS FOR DOMESTIC WASTEWATER

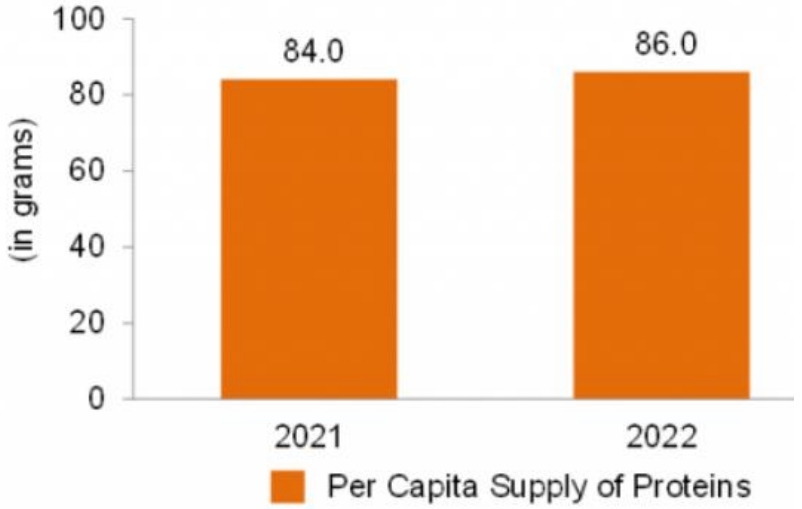
Region[1]	Protein consumed[2] as fraction of protein supply	$F_{NON-CON}$[2] in case food waste is disposed in sewer	Additional N from households' chemicals
Europe	0.85	1.09	1.08
North America and Oceania	0.80	1.13	1.17 (USA) 1.07 (Australia)
Industrialised Asia	0.86	1.08	No data
Sub-Saharan Africa	0.98	1.01	No data
North Africa, West and central Asia	0.90	1.06	No data
South and Southeast Asia	0.96	1.02	1.13 (India)
Latin America	0.92	1.04	No data

[1] See Annex 6A.7 for a list of countries by region
[2] Based on FAO (2011)

Tier 1 Calculation

= 86*365/1000
= 31.39

	Parameter	Value	Unit
$Protein_{SUPPLY}$	Annual per capita protein supply	31.39	kg protein/person/yr
FPC	Fraction of protein consumed	0.96	



Source: Food balance sheets of Philippines, PSA

EQUATION 6.10A (NEW)
ESTIMATION OF PROTEIN CONSUMED

$$Protein = Protein_{SUPPLY} \bullet FPC$$

$Protein_{SUPPLY}$	=	31.39	kg protein/person/yr
FPC	=	0.96	
Protein	=	31.39*0.96	kg protein/person/yr
	=	30.13	kg protein/person/yr

TABLE 6.10A (NEW)
DEFAULT FACTORS FOR DOMESTIC WASTEWATER

Region[1]	Protein consumed[2] as fraction of protein supply	$F_{NON-CON}$[2] in case food waste is disposed in sewer	Additional N from households' chemicals
Europe	0.85	1.09	1.08
North America and Oceania	0.80	1.13	1.17 (USA) 1.07 (Australia)
Industrialised Asia	0.86	1.08	No data
Sub-Saharan Africa	0.98	1.01	No data
North Africa, West and central Asia	0.90	1.06	No data
South and Southeast Asia	0.96	1.02	1.13 (India)
Latin America	0.92	1.04	No data

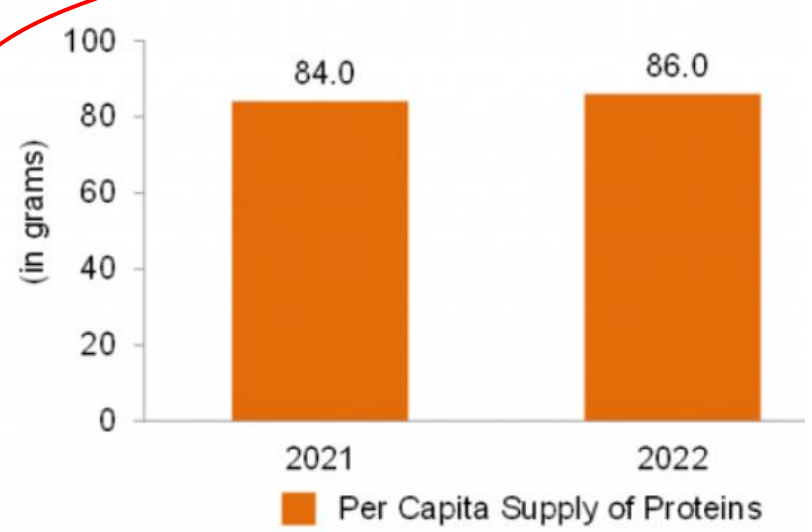
Tier 1 Calculation

EQUATION 6.10A (NEW)
ESTIMATION OF PROTEIN CONSUMED

$$Protein = Protein_{SUPPLY} \bullet FPC$$

$Protein_{SUPPLY}$	=	31.39	kg protein/person/yr
FPC	=	0.96	
Protein	=	31.39*0.96	kg protein/person/yr
	=	30.13	kg protein/person/yr

= 86*365/1000
= 31.39



Source: Food balance sheets of Philippines, PSA

TABLE 6.10A (NEW)
DEFAULT FACTORS FOR DOMESTIC WASTEWATER

Region[1]	Protein consumed[2] as fraction of protein supply	$F_{NON-CON}$[2] in case food waste is disposed in sewer	Additional N from households' chemicals
Europe	0.85	1.09	1.08
North America and Oceania	0.80	1.13	1.17 (USA) 1.07 (Australia)
Industrialised Asia	0.86	1.08	No data
Sub-Saharan Africa	0.98	1.01	No data
North Africa, West and central Asia	0.90	1.06	No data
South and Southeast Asia	0.96	1.02	1.13 (India)
Latin America	0.92		

Just an assumed value as country specific value is not available

Tier 2 Calculation

EQUATION 6.10A (NEW)
ESTIMATION OF PROTEIN CONSUMED

$$Protein = Protein_{SUPPLY} \bullet FPC$$

$Protein_{SUPPLY}$	=	31.39	kg protein/person/yr
FPC	=	0.8	
Protein	=	31.39*0.8	kg protein/person/yr
	=	25.11	kg protein/person/yr

4.D.1 –Domestic Wastewater Treatment and Discharge CONT…

Step 03: Estimate total nitrogen in wastewater

Country specific

Derived from previous equation

Can range from 0.15 – 0.17

EQUATION 6.10 (NEW)
TOTAL NITROGEN IN DOMESTIC WASTEWATER BY TREATMENT PATHWAY

$$TN_{DOM\_j} = \left(P_{treatment\_j} \bullet Protein \bullet F_{NPR} \bullet N_{HH} \bullet F_{NON-CON} \bullet F_{IND-COM} \right)$$

Where:

TN_{DOM_j} = total annual amount of nitrogen in domestic wastewater for treatment pathway j, kg N/yr

$P_{treatment\_j}$ = human population who are served by the treatment pathway j, person/yr

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

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

$F_{NON-CON}$ = factor for nitrogen in non-consumed protein disposed in sewer system, kg N/kg N. See new Table 6.10a.

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

N_{HH} = additional nitrogen from household products added to the wastewater, default is 1.1 (some country data are in new Table 6.10a).

TABLE 6.10A (NEW)
DEFAULT FACTORS FOR DOMESTIC WASTEWATER

Region[1]	Protein consumed[2] as fraction of protein supply	$F_{NON-CON}$[2] in case food waste is disposed in sewer	Additional N from households' chemicals
Europe	0.85	1.09	1.08
North America and Oceania	0.80	1.13	1.17 (USA) 1.07 (Australia)
Industrialised Asia	0.86	1.08	No data
Sub-Saharan Africa	0.98	1.01	No data
North Africa, West and central Asia	0.90	1.06	No data
South and Southeast Asia	0.96	1.02	1.13 (India)
Latin America	0.92	1.04	No data

Tier 1 Calculation

	Parameter	Value	Unit
$P_{treatment\_j}$	Human population who are served by the treatment pathway j	106,712,480	person/yr
Protein	Annual per capita protein consumption	0.96	kg protein/person/yr
F_{NPR}	Fraction of nitrogen in protein	0.16	kg N/kg protein
$F_{NON-CON}$	Factor for nitrogen in non-consumed protein disposed in sewer system	1.1	kg N/kg N
$F_{IND-COM}$	Factor for industrial and commercial co-discharged protein into the sewer system	1.25	kg N/kg N
N_{HH}	Additional nitrogen from household products added to the wastewater	1.1	

EQUATION 6.10 (NEW)
TOTAL NITROGEN IN DOMESTIC WASTEWATER BY TREATMENT PATHWAY

$$TN_{DOM\_j} = \left(P_{treatment\_j} \bullet Protein \bullet F_{NPR} \bullet N_{HH} \bullet F_{NON-CON} \bullet F_{IND-COM} \right)$$

$P_{treatment\_j}$	=	106,712,480	person/yr
Protein	=	30.13	kg protein/person/yr
F_{NPR}	=	0.16	kg N/kg protein
$F_{NON-CON}$	=	1.1	kg N/kg N
$F_{IND-COM}$	=	1.25	kg N/kg N
N_{HH}	=	1.1	
TN_{DOM_j}	=	106712479.8*30.13*0.16*1.1*1.1*1.25	kg N/yr
	=	778,203,405.41	kg N/yr

Philippines Population 2024 is 118,569,422
Taken as 90% of the total population
=118,569,422*90%
=106,712,480

Derived from previous calculation

IPCC Default

Default for South and Southeast Asia

IPCC Default

Tier 1 Calculation

EQUATION 6.10 (NEW)
TOTAL NITROGEN IN DOMESTIC WASTEWATER BY TREATMENT PATHWAY

$$TN_{DOM\_j} = \left(P_{treatment\_j} \bullet Protein \bullet F_{NPR} \bullet N_{HH} \bullet F_{NON-CON} \bullet F_{IND-COM} \right)$$

$P_{treatment\_j}$	=	106,712,480	person/yr
Protein	=	30.13	kg protein/person/yr
F_{NPR}	=	0.16	kg N/kg protein
$F_{NON-CON}$	=	1.1	kg N/kg N
$F_{IND-COM}$	=	1.25	kg N/kg N
N_{HH}	=	1.1	
TN_{DOM_j}	=	106712479.8*30.13*0.16*1.1*1.1*1.25	kg N/yr
	=	778,203,405.41	kg N/yr

Philippines Population 2024 is 118,569,422
Taken as 90% of the total population
=118,569,422*90%
=106,712,480

Derived from previous calculation

IPCC Default

Default for South and Southeast Asia

IPCC Default

Tier 2 Calculation

EQUATION 6.10 (NEW)
TOTAL NITROGEN IN DOMESTIC WASTEWATER BY TREATMENT PATHWAY

$$TN_{DOM\_j} = \left(P_{treatment\_j} \bullet Protein \bullet F_{NPR} \bullet N_{HH} \bullet F_{NON-CON} \bullet F_{IND-COM} \right)$$

$P_{treatment\_j}$	=	106,712,480	person/yr
Protein	=	25.11	kg protein/person/yr
F_{NPR}	=	0.2	kg N/kg protein
$F_{NON-CON}$	=	1.1	kg N/kg N
$F_{IND-COM}$	=	1.5	kg N/kg N
N_{HH}	=	1.13	
	=	106712479.8*30.13*0.16*1.13*1.1*1.5	kg N/yr
	=	999,283,918.31	kg N/yr

Just an assumed value as country specific value is not available

Default for South and Southeast Asia

Default for South and Southeast Asia (India)

$F_{IND-COM}$	Factor to allow for co-discharge of industrial nitrogen into sewers. For countries with significant fish processing plants, this factor may be higher. Expert judgment is recommended.	1.25	1.0 – 1.5

4.D.1 –Domestic Wastewater Treatment and Discharge CONT...

Step 04: Estimate emissions from wastewater treatment and sum the results for each treatment pathway/system.

Derived from previous equation

Country specific value or IPCC defaults values for countries in the same region can be used

Default values are given in Table 6.8a

EQUATION 6.9 (UPDATED)
N_2O EMISSIONS FROM DOMESTIC WASTEWATER TREATMENT PLANTS

$$N_2O\ Plants_{DOM} = \left[\sum_{i,j}\left(U_i \bullet T_{ij} \bullet EF_j\right)\right] \bullet TN_{DOM} \bullet \frac{44}{28}$$

Where:

N_2O Plants $_{DOM}$ = N_2O emissions from domestic wastewater treatment plants in inventory year, kg N_2O/yr

TN_{DOM} = total nitrogen in domestic wastewater in inventory year, kg N/yr. See new Equation 6.10.

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

T_{ij} = 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 for treatment/discharge pathway or system *j*, kg N_2O-N/kg N

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

Tier 1 Calculation

	Parameter	Value	Unit
TN_{DOM}	Total nitrogen in domestic wastewater in inventory year	778,203,405.41	kg N/yr
U_i	Fraction of population in income group i in inventory year	0.06	
T_{ij}	Degree of utilisation of treatment/discharge pathway or system j, for each income group fraction i in inventory year	0.67	
i	Income group: rural, urban high income and urban low income	Urban High Income	
j	Each treatment/discharge pathway or system	Centralised, aerobic treatment plant	
EF_j	Emission factor for treatment/discharge pathway or system j, kg N2O-N/kg N	0.016	kg N2O-N/kg N

EQUATION 6.9 (UPDATED)
N_2O EMISSIONS FROM DOMESTIC WASTEWATER TREATMENT PLANTS

$$N_2O\ Plants_{DOM} = \left[\sum_{i,j}\left(U_i \bullet T_{ij} \bullet EF_j\right)\right] \bullet TN_{DOM} \bullet \frac{44}{28}$$

TN_{DOM}	=	778,203,405.41	kg N/yr
U_i	=	0.06	
T_{ij}	=	0.67	
i	=	Urban High Income	
j	=	Centralised, aerobic treatment plant	
EF_j	=	0.016	kg N2O-N/kg N
N_2O Plants $_{DOM}$	=	$[\sum_{i,j}(0.06 \times 0.67 \times 0.016) + (n) \ldots.] \times 721{,}606{,}794.11 \times \frac{44}{28}$	kg N_2O/yr
	=	$[\sum_{i,j}(0.000643) + (n) \ldots.] \times 721{,}606{,}794.11 \times \frac{44}{28}$	kg N_2O/yr
	=	786,563.53	kg N_2O/yr

Derived from previous calculation

IPCC default

From Table 6.5 (India – under Asian region, Urban High income), as country specific values are not available

Wastewater treatment system, EF_{plants}			
Centralised, aerobic treatment plant	N_2O is variable and can be significant	0.016[1]	0.00016 – 0.045
Anaerobic reactor	N_2O is not significant	0	0 – 0.001
Anaerobic lagoons	N_2O is not significant	0	0 – 0.001
Constructed wetlands	See *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*: Wetlands (IPCC 2014)		

Tier 1 Calculation

EQUATION 6.9 (UPDATED)
N_2O EMISSIONS FROM DOMESTIC WASTEWATER TREATMENT PLANTS

$$N_2O\ Plants_{DOM} = \left[\sum_{i,j}\left(U_i \bullet T_{ij} \bullet EF_j\right)\right] \bullet TN_{DOM} \bullet \frac{44}{28}$$

TN_{DOM}	=	778,203,405.41	kg N/yr
U_i	=	0.06	
T_{ij}	=	0.67	
i	=	Urban High Income	
j	=	Centralised, aerobic treatment plant	
EF_j	=	0.016	kg N2O-N/kg N
N_2O Plants $_{DOM}$	=	$[\sum_{i,j}(0.06 \times 0.67 \times 0.016) + (n) \ldots.] \times 721{,}606{,}794.11 \times \frac{44}{28}$	kg N_2O/yr
	=	$[\sum_{i,j}(0.000643) + (n) \ldots.] \times 721{,}606{,}794.11 \times \frac{44}{28}$	kg N_2O/yr
	=	786,563.53	kg N_2O/yr

Derived from previous calculation

Wastewater treatment system, EF_{plants}			
Centralised, aerobic treatment plant	N_2O is variable and can be significant	0.016[1]	0.00016 – 0.045
Anaerobic reactor	N_2O is not significant	0	0 – 0.001
Anaerobic lagoons	N_2O is not significant	0	0 – 0.001
Constructed wetlands	See *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*: Wetlands (IPCC 2014)		

IPCC default

From Table 6.5 (India – under Asian region, Urban High income), as country specific values are not available

Tier 2 Calculation

EQUATION 6.9 (UPDATED)
N_2O EMISSIONS FROM DOMESTIC WASTEWATER TREATMENT PLANTS

$$N_2O\ Plants_{DOM} = \left[\sum_{i,j}\left(U_i \bullet T_{ij} \bullet EF_j\right)\right] \bullet TN_{DOM} \bullet \frac{44}{28}$$

TN_{DOM}	=	999,283,918.31	kg N/yr
U_i	=	0.06	
T_{ij}	=	0.67	
i	=	Urban High Income	
j	=	Centralised, aerobic treatment plant	
EF_j	=	0.02	kg N2O-N/kg N
N_2O Plants $_{DOM}$	=	$[\sum_{i,j}(0.06 \times 0.67 \times 0.02) + (n) \ldots.] \times 721{,}606{,}794.11 \times \frac{44}{28}$	kg N_2O/yr
	=	$[\sum_{i,j}(0.000804) + (n) \ldots.] \times 926{,}608{,}724.25 \times \frac{44}{28}$	kg N_2O/yr
	=	1,262,523.85	kg N_2O/yr

4.D.1 –Domestic Wastewater Treatment and Discharge CONT...

Step 05: Estimate total nitrogen in the wastewater effluent discharged to aquatic environments

Derived from previous equation

If country specific values are not available, defaults values for countries in the same region can be taken from Table 6.5

IPCC default values

TABLE 6.10C (NEW)
WASTEWATER TREATMENT NITROGEN REMOVAL FRACTIONS (N_{REM}) ACCORDING TO TREATMENT TYPE

Treatment Type	Default	Range
No treatment	0[1–3]	0[1–3]
Primary (mechanical)	0.10[1–3]	0.05 – 0.20[1–3]
Secondary (biological)	0.40[1–3]	0.35 – 0.55[1–3]
Tertiary (advanced biological)	0.80[1–4]	0.45 – 0.85[1–4]
Septic tank	0.15[1–3]	0.10 – 0.25[1–3]
Septic tank + land dispersal field	0.68[5]	0.62 – 0.73[5]
Latrine	0.12[6]	0.07 – 0.21[6]

EQUATION 6.8 (UPDATED)
TOTAL NITROGEN IN DOMESTIC WASTEWATER EFFLUENT

$$N_{EFFLUENT,DOM} = \sum_j \left[(TN_{DOM} \bullet T_j) \bullet \left(1 - N_{REM,j}\right) \right]$$

Where:

$N_{EFFLUENT,DOM}$ = total nitrogen in the wastewater effluent discharged to aquatic environments in inventory year, kg N/yr

TN_{DOM} = total nitrogen in domestic wastewater in inventory year, kg N/yr. See new Equation 6.10.

T_j = degree of utilisation of treatment system *j* in inventory year ($\sum_i T_{ij}$). See Table 6.5

j = each wastewater treatment type used in inventory year

N_{REM} = fraction of total wastewater nitrogen removed during wastewater treatment per treatment type j. See new Table 6.10c. Pathways for N removal include transfer to sludge and nitrification–denitrification with concomitant N loss to the atmosphere.

Tier 1 Calculation

	Parameter	Value	Unit
TN_{DOM}	Total nitrogen in domestic wastewater in inventory year	778,203,405.41	kg N/yr
T_j	Degree of utilisation of treatment system j in inventory year	0.07	
j	Each wastewater treatment type used in inventory year	Secondary (biological)	
$N_{REM,j}$	Fraction of total wastewater nitrogen removed during wastewater treatment per treatment type j	0.4	

EQUATION 6.8 (UPDATED)
TOTAL NITROGEN IN DOMESTIC WASTEWATER EFFLUENT

$$N_{EFFLUENT,DOM} = \sum_j \left[(TN_{DOM} \bullet T_j) \bullet \left(1 - N_{REM,j}\right) \right]$$

TN_{DOM}	=	778,203,405.41	kg N/yr
T_j	=	0.07	
j	=	Secondary (biological)	
$N_{REM,j}$	=	0.4	
$N_{EFFLUENT,DOM}$	=	$\sum_j [(721{,}606{,}794.11 \times 0.07) \times (1 - 0.4)] + [n] \ldots$. kg N/yr	
	=	$\sum_j [30{,}307{,}485.35] + [n] \ldots$. kg N/yr	
	=	32,684,543.03	kg N/yr

Derived from previous equation

From Table 6.5 (India – under Asian region, Urban High income, "Other" treatment or discharge pathway), as country specific values are not available

IPCC default values

TABLE 6.10C (NEW)
WASTEWATER TREATMENT NITROGEN REMOVAL FRACTIONS (N_{REM}) ACCORDING TO TREATMENT TYPE

Treatment Type	Default	Range
No treatment	0[1–3]	0[1–3]
Primary (mechanical)	0.10[1–3]	0.05 – 0.20[1–3]
Secondary (biological)	0.40[1–3]	0.35 – 0.55[1–3]
Tertiary (advanced biological)	0.80[1–4]	0.45 – 0.85[1–4]
Septic tank	0.15[1–3]	0.10 – 0.25[1–3]
Septic tank + land dispersal field	0.68[5]	0.62 – 0.73[5]
Latrine	0.12[6]	0.07 – 0.21[6]

Tier 1 Calculation

EQUATION 6.8 (UPDATED)
TOTAL NITROGEN IN DOMESTIC WASTEWATER EFFLUENT

$$N_{EFFLUENT,DOM} = \sum_j \left[(TN_{DOM} \bullet T_j) \bullet \left(1 - N_{REM,j}\right) \right]$$

TN_{DOM}	=	778,203,405.41	kg N/yr
T_j	=	0.07	
j	=	Secondary (biological)	
$N_{REM,j}$	=	0.4	
$N_{EFFLUENT,DOM}$	=	$\sum_j [(721{,}606{,}794.11 \times 0.07) \times (1 - 0.4)] + [n] \ldots$.	kg N/yr
	=	$\sum_j [30{,}307{,}485.35] + [n] \ldots$.	kg N/yr
	=	32,684,543.03	kg N/yr

Derived from previous equation

From Table 6.5 (India – under Asian region, Urban High income, "Other" treatment or discharge pathway), as country specific values are not available

IPCC default values

TABLE 6.10C (NEW)
WASTEWATER TREATMENT NITROGEN REMOVAL FRACTIONS (N_{REM}) ACCORDING TO TREATMENT TYPE

Treatment Type	Default	Range
No treatment	0[1-3]	0[1-3]
Primary (mechanical)	0.1[1-3]	0.05 – 0.20[1-3]
Secondary (biological)	0.40[1-3]	0.35 – 0.55[1-3]
Tertiary (advanced biological)	0.80[1-4]	0.45 – 0.85[1-4]
Septic tank	0.15[1-3]	0.10 – 0.25[1-3]
Septic tank + land dispersal field	0.68[5]	0.62 – 0.73[5]
Latrine	0.12[6]	0.07 – 0.21[6]

Taken from default range as country specific values are not available

Tier 2 Calculation

EQUATION 6.8 (UPDATED)
TOTAL NITROGEN IN DOMESTIC WASTEWATER EFFLUENT

$$N_{EFFLUENT,DOM} = \sum_j \left[(TN_{DOM} \bullet T_j) \bullet \left(1 - N_{REM,j}\right) \right]$$

TN_{DOM}	=	999,283,918.31	kg N/yr
T_j	=	0.07	
j	=	Secondary (biological)	
$N_{REM,j}$	=	0.55	
$N_{EFFLUENT,DOM}$	=	$\sum_j [(721{,}606{,}794.11 \times 0.07) \times (1 - 0.55)] + [n] \ldots$.	kg N/yr
	=	$\sum_j [30{,}307{,}485.35] + [n] \ldots$.	kg N/yr
	=	31,477,443.43	kg N/yr

4.D.1 –Domestic Wastewater Treatment and Discharge CONT…

Step 06: Estimate emissions from effluent, accounting for losses of nitrogen that occur within the wastewater treatment process including sludge removal and sum the results for each pathway/system.

Derived from previous equation

Default values are given in Table 6.8a

EQUATION 6.7 (UPDATED)
N_2O EMISSIONS FROM DOMESTIC WASTEWATER EFFLUENT

$$N_2O_{EFFLUENT,DOM} = N_{EFFLUENT,DOM} \bullet EF_{EFFLUENT} \bullet \frac{44}{28}$$

Where:

$N_2O_{EFFLUENT,DOM}$	= N_2O emissions from domestic wastewater effluent in inventory year, kg N_2O/yr
$N_{EFFLUENT,DOM}$	= nitrogen in the effluent discharged to aquatic environments, kg N/yr. See updated Equation 6.8.
$EF_{EFFLUENT}$	= emission factor for N_2O emissions from wastewater discharged to aquatic systems, kg N_2O-N/kg N

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

Tier 1 Calculation

	Parameter	Value	Unit
$N_{EFFLUENT,DOM}$	N2O emissions from domestic wastewater effluent in inventory year	32,684,543.03	kg N/yr
$EF_{EFFLUENT}$	Nitrogen in the effluent discharged to aquatic environments	0.005	kg N2O-N/kg N

EQUATION 6.7 (UPDATED)
N_2O EMISSIONS FROM DOMESTIC WASTEWATER EFFLUENT

$$N_2O_{EFFLUENT,DOM} = N_{EFFLUENT,DOM} \bullet EF_{EFFLUENT} \bullet \frac{44}{28}$$

$N_{EFFLUENT,DOM}$	=	32,684,543.03	kg N/yr
$EF_{EFFLUENT}$	=	0.005	kg N2O-N/kg N
$N_2O_{EFFLUENT,DOM}$	=	30,307,485.35*0.005*(44/28)	kg N2O/yr
	=	256,807.12	kg N2O/yr

Derived from previous equation

IPCC default

TABLE 6.8A (NEW)
DEFAULT EF VALUES FOR DOMESTIC AND INDUSTRIAL WASTEWATER

Type of treatment and discharge pathway or system	Comments	EF[1] (kg N_2O-N/kg N)	Range
Discharge from treated or untreated system, $EF_{EFFLUENT}$			
Freshwater, estuarine, and marine discharge (Tier 1)	Based on limited field data and on specific assumptions regarding the occurrence of nitrification and denitrification in rivers and in estuaries	0.005[2]	0.0005 – 0.075
Nutrient-impacted and/or hypoxic freshwater, estuarine, and marine environments (Tier 3, if needed)	Higher emissions are associated with nutrient-impacted/hypoxic water such as eutrophic lakes, estuaries and rivers, or locations where stagnant conditions occur. See section 6.3.1.2 for more information.	0.019[2]	0.0041 – 0.091
Discharge to soil	Emissions reported in Volume 4		

Tier 1 Calculation

EQUATION 6.7 (UPDATED)
N_2O EMISSIONS FROM DOMESTIC WASTEWATER EFFLUENT

$$N_2O_{EFFLUENT,DOM} = N_{EFFLUENT,DOM} \bullet EF_{EFFLUENT} \bullet \frac{44}{28}$$

$N_{EFFLUENT,DOM}$	=	32,684,543.03	kg N/yr
$EF_{EFFLUENT}$	=	0.005	kg N2O-N/kg N
$N_2O_{EFFLUENT,DOM}$	=	30,307,485.35*0.005*(44/28)	kg N2O/yr
	=	256,807.12	kg N2O/yr

Derived from previous equation

IPCC default

TABLE 6.8A (NEW)
DEFAULT EF VALUES FOR DOMESTIC AND INDUSTRIAL WASTEWATER

Type of treatment and discharge pathway or system	Comments	EF[1] (kg N_2O-N/kg N)	Range
Discharge from treated or untreated system, $EF_{EFFLUENT}$			
Freshwater, estuarine, and marine discharge (Tier 1)	Based on limited field data and on specific assumptions regarding the occurrence of nitrification and denitrification in rivers and in estuaries	0.005[2]	0.0005 – 0.075
Nutrient-impacted and/or hypoxic freshwater, estuarine, and marine environments (Tier 3, if needed)	Higher emissions are associated with nutrient-impacted/hypoxic water such as eutrophic lakes, estuaries and rivers, or locations where stagnant conditions occur. See section 6.3.1.2 for more information.	0.019[2]	0.0041 – 0.091
Discharge to soil	Emissions reported in Volume 4		

Tier 2 Calculation

EQUATION 6.7 (UPDATED)
N_2O EMISSIONS FROM DOMESTIC WASTEWATER EFFLUENT

$$N_2O_{EFFLUENT,DOM} = N_{EFFLUENT,DOM} \bullet EF_{EFFLUENT} \bullet \frac{44}{28}$$

$N_{EFFLUENT,DOM}$	=	31,477,443.43	kg N/yr
$EF_{EFFLUENT}$	=	0.025	kg N2O-N/kg N
$N_2O_{EFFLUENT,DOM}$	=	30,307,485.35*0.005*(	kg N2O/yr
	=	1,236,613.85	kg N2O/yr

Taken from default range as country specific values are not available

Tier 1 Calculation

	Parameter	Value	Unit
P	Country population in inventory year, (person)	118,569,422	persons
BOD	Country-specific per capita BOD in inventory year, g/person/day	40	g/person/day
I	Correction factor for additional industrial BOD discharged into sewers	1	

EQUATION 6.3
TOTAL ORGANICALLY DEGRADABLE MATERIAL IN DOMESTIC WASTEWATER

$$TOW = P \bullet BOD \bullet 0.001 \bullet I \bullet 365$$

P	=	118,569,422	persons
BOD	=	40	g/person/day
I	=	1	
TOW	=	118569422*40*0.001*1*365	kg BOD/yr
	=	1,731,113,561.20	kg BOD/yr

Default

TABLE 6.4
ESTIMATED BOD_5 VALUES IN DOMESTIC WASTEWATER FOR SELECTED REGIONS AND COUNTRIES

Country/Region	BOD_5 (g/person/day)	Range	Reference
Africa	37	35 – 45	1
Egypt	34	27 – 41	1
Asia, Middle East, Latin America	40	35 – 45	1
India	34	27 – 41	1
West Bank and Gaza Strip (Palestine)	50	32 – 68	1

Tier 1 Calculation

EQUATION 6.3
TOTAL ORGANICALLY DEGRADABLE MATERIAL IN DOMESTIC WASTEWATER

$$TOW = P \bullet BOD \bullet 0.001 \bullet I \bullet 365$$

P	=	118,569,422	persons
BOD	=	40	g/person/day
I	=	1	
TOW	=	118569422*40*0.001*1*365	kg BOD/yr
	=	1,731,113,561.20	kg BOD/yr

Default

TABLE 6.4
ESTIMATED BOD_5 VALUES IN DOMESTIC WASTEWATER FOR SELECTED REGIONS AND COUNTRIES

Country/Region	BOD_5 (g/person/day)	Range	Reference
Africa	37	35 – 45	1
Egypt	34	27 – 41	1
Asia, Middle East, Latin America	40	35 – 45	1
India	34	27 – 41	1
West Bank and Gaza Strip (Palestine)	50	32 – 68	1

Tier 2 Calculation

EQUATION 6.3
TOTAL ORGANICALLY DEGRADABLE MATERIAL IN DOMESTIC WASTEWATER

$$TOW = P \bullet BOD \bullet 0.001 \bullet I \bullet 365$$

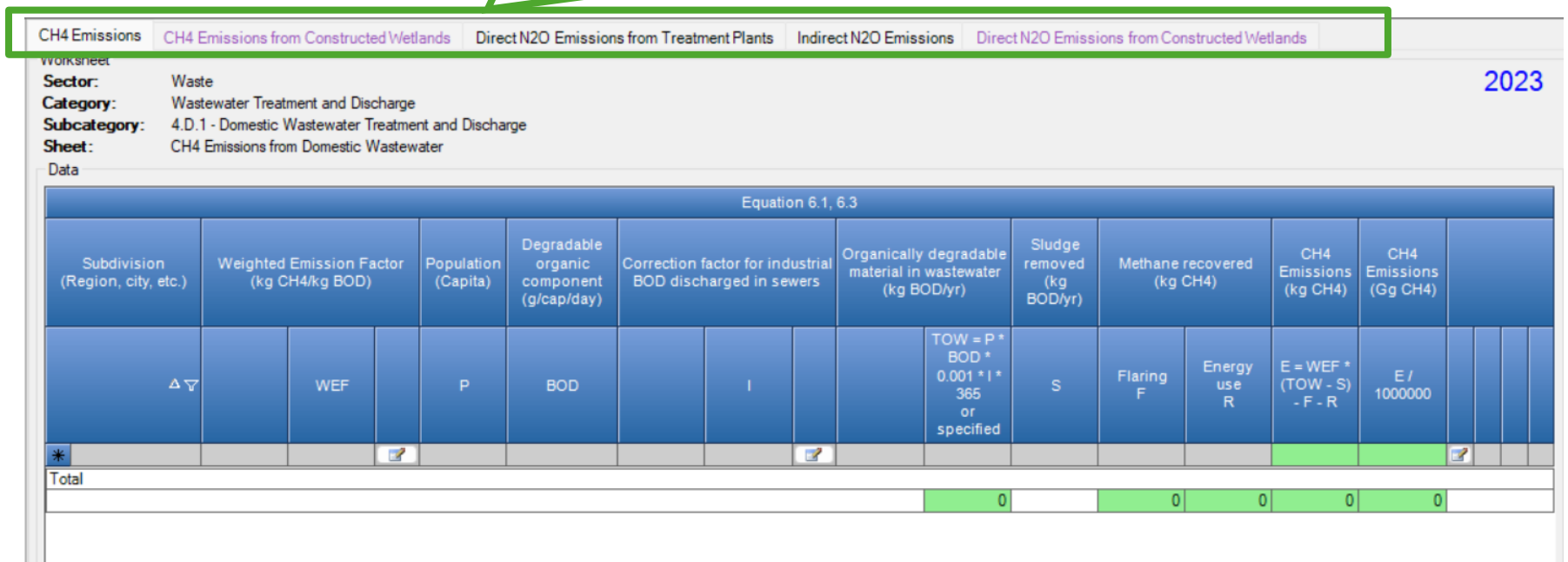
P	=	118,569,422	persons
BOD	=	42	g/person/day
I	=	1.25	
TOW	=	118569422*42*0.001*1.25*365	kg BOD/yr
	=	2,272,086,549.08	kg BOD/yr

As country's wastewater BOD level is not available, value from the value range need to be used

4.D.1 –Domestic Wastewater Treatment and Discharge

There are 5 worksheets within the Domestic Wastewater Treatment and Discharge

1. CH4 Emissions
2. CH4 Emissions from Constructed Wetlands
3. Direct N2O Emissions from Treatment Plants
4. Indirect N2O Emissions
5. Direct N2O Emissions from constructed wetlands



CH4 Emissions | CH4 Emissions from Constructed Wetlands | Direct N2O Emissions from Treatment Plants | Indirect N2O Emissions | Direct N2O Emissions from Constructed Wetlands

Worksheet

Sector: Waste

Category: Wastewater Treatment and Discharge

Subcategory: 4.D.1 - Domestic Wastewater Treatment and Discharge

Sheet: CH4 Emissions from Domestic Wastewater

2023

Data

Equation 6.1, 6.3																
Subdivision (Region, city, etc.)	Weighted Emission Factor (kg CH4/kg BOD)			Population (Capita)	Degradable organic component (g/cap/day)	Correction factor for industrial BOD discharged in sewers			Organically degradable material in wastewater (kg BOD/yr)		Sludge removed (kg BOD/yr)	Methane recovered (kg CH4)		CH4 Emissions (kg CH4)	CH4 Emissions (Gg CH4)	
		WEF		P	BOD		I			TOW = P * BOD * 0.001 * I * 365 or specified	S	Flaring F	Energy use R	E = WEF * (TOW - S) - F - R	E / 1000000	
Total										0		0	0	0	0	

1. CH4 Emissions

Enter BOD manually or use default factor.

Default Value	Range	references
40	35 - 45	Doorn and Liles (1999).

Enter the subdivision .

Enter WEF manually.

Enter population manually.

Enter Correction factor for industrial BOD discharged in sewers manually.

Enter sludge removed, Flaring, and Energy use manually.

Data

Equation 6.1, 6.3																		
Subdivision (Region, city, etc.)	Weighted Emission Factor (kg CH4/kg BOD)			Population (Capita)	Degradable organic component (g/cap/day)	Correction factor for industrial BOD discharged in sewers			Organically degradable material in wastewater (kg BOD/yr)		Sludge removed (kg BOD/yr)	Methane recovered (kg CH4)		CH4 Emissions (kg CH4)	CH4 Emissions (Gg CH4)			
		WEF		P	BOD		I			TOW = P * BOD * 0.001 * I * 365 or specified	S	Flaring F	Energy use R	E = WEF * (TOW - S) - F - R	E / 1000000			
Sub A	Calculated	0.01206		118569422	40	Specified	1		Calculated	17311135...	100	0	0	20877228....	20.87723			
Total																		
										173111356...		0	0	20877228....	20.87723			

2. CH4 Emissions from constructed wetlands

Type of Constructed Wetlands	Methane Correction Factor (Fraction)	Range	Remark
Horizontal Subsurface Flow	0.1	0.07 - 0.13	
Hybrid type			
Semi-natural Treatment Wetlands	0.4		Page 6.13 (WS)
Surface Flow	0.4	0.08 - 0.7	
Vertical Subsurface Flow	0.01	0.004 - 0.016	
Unspecified	0.4		If the type of CW cannot be recognized, the MCF for surface flow can be used as a conservative value.

Enter the subdivision .

Enter manually

Enter manually or use default value .

Enter manually

Equation for this calculation is not in the IPCC 2006 guideline

Data

Equation 6.1, 6.2, 6.3 WS												
Subdivision	Type of Constructed Wetlands	Population served by CWj (Capita)	Degradable organic component (g/cap/day)	Correction factor for industrial BOD discharged in sewers	Total Organic Degradable Material treated in CWj (kg BOD/yr)		Maximum methane producing capacity (kg CH4 / kg BOD)	Methane Correction Factor (Fraction)	Emission Factor (kg CH4 / kg BOD)		CH4 Emissions (kg CH4)	CH4 Emissions (Gg CH4)
	j	Pj	BOD	I		TOWj = Pj * BOD * 0.001 * I * 365 or specified	Bo	MCFj		EFj = Bo * MCFj or specified	E = TOWj * EFj	E / 1000000
Facility 01	Horizontal Subsu...	5000	40	1.25	Calculated	91250	10	0.1	Calculated	1	91250	0.09125
Total						91250					91250	0.09125

3. Direct N2O Emissions from Treatment Plants

Enter the subdivision .

Enter manually.

Enter manually or accept default values.

Click save button

Data

Equation 6.9										
Subdivision (Region, city, etc.)	Population (P) (people)	Degree of utilization of modern, centralized wastewater treatment plants (Tplant) (%)	Fraction of industrial and commercial co-discharged protein (Find-com) (-)	Emission Factor (EFplant) (kg N2O/person/Year)	N2O Emissions (kg N2O/yr)	N2O Emissions (Gg N2O/yr)				
	A	B	C	D	E = A * B * C * D	F = E / 10^6				
Sub A	118569422	90	1.25	0.016	2134249.596	2.13425				
Total										
					2134249.596	2.13425				

4. Indirect N2O Emissions

Enter manually or select the default values .

Enter manually .

Enter the subdivision .

Enter manually or use the default factor

Data

Equation 6.7, 6.8																
Subdivision (Region, city, etc.)	Population (P) (people)	Per capita protein consumption (Protein) (kg/person/Year)	Fraction of nitrogen in protein (Fnpr) (kg N/kg Protein)	Fraction of non-consumption protein (Fnon-con) (-)	Fraction of industrial and commercial co-discharged protein (Find-com)	Nitrogen removed with sludge (Nsludge) (kg)	Total nitrogen in effluent (Neffluent) (kg N/yr)	Nitrogen from Wastewater plants (kg N/yr)	Emission Factor (kg N2O-N/kg N)	N2O Emissions (kg N2O/yr)	N2O Emissions (Gg N2O/yr)					
	A	B	C	D	E	F	G = (A*B*C*D*E) -F)	H	I	J = (G - H) * I * 44/28	K = J / 10^6					
Sub A	1185694...	31.39	0.16	1.1	1.25	0	818816714.4476	1358158.833...	0.005	6422888.65125	6.42289					
Total																
							818816714.4476			6422888.65125	6.42289					

5. Direct N2O Emissions from constructed wetlands

Select type of constructed wetland from the dropdown menu.

Enter manually

Enter manually or accept the default values

Manually enter the emission factor

Enter the subdivision

Equation for this calculation is not in the IPCC 2006 guideline

Data

Equation 6.5 WS, 6.6 WS												
Subdivision (Region, city, etc.)	Type of Constructed Wetlands	Population (P) (people)	Per capita protein consumption (Protein) (kg/person/Year)	Fraction of nitrogen in protein (Fnpr) (kg N/kg Protein)	Fraction of non-consumption protein (Fnon-con) (-)	Fraction of industrial and commercial co-discharged protein (Find-com)	Nitrogen removed with sludge (Nsludge) (kg)	Total nitrogen in effluent (Neffluent) (kg N/yr)	Emission Factor (kg N2O-N/kg N)	N2O Emissions (kg N2O/yr)	N2O Emissions (Gg N2O/yr)	
		A	B	C	D	E	F	G = (A*B*C*D*E)-F	H	I = G * H * 44/28	J = I / 10^6	
facility 01	Horizontal Subsurf...	20000	20	0.16	1.4	1.25	1	111999	0.0079	1390.38759	0.00139	
Total												
								111999		1390.38759	0.00139	

4.D – Wastewater treatment and discharge

- 4.D.2 – Industrial Wastewater Treatment and Discharge

4.D.2 –Industrial Wastewater Treatment and Discharge

Emission calculation - CH_4

Step 01: Estimate total organically degradable carbon in wastewater (TOW) for industrial sector i

Average COD level of wastewater in relevant industry sector

Can be
- pulp and paper manufacture
- meat and poultry processing (slaughterhouses)
- alcohol, beer, starch production
- organic chemicals production
- other food and drink processing etc.

Total production in the inventory year

Wastewater generated from the industry per tonne of production

Average of COD test results of wastewater samples

EQUATION 6.6
ORGANICALLY DEGRADABLE MATERIAL IN INDUSTRIAL WASTEWATER

$$TOW_i = P_i \bullet W_i \bullet COD_i$$

Where:

TOW_i	=	total organically degradable material in wastewater for industry *i*, kg COD/yr
i	=	industrial sector
P_i	=	total industrial product for industrial sector *i*, t/yr
W_i	=	wastewater generated, $m^3/t_{product}$
COD_i	=	chemical oxygen demand (industrial degradable organic component in wastewater), kg COD/m^3

Tier 1 Calculation

	Parameter	Value	Unit
i	Industrial sector	Meat & Poultry	
Pi	Total industrial product for industrial sector i	1000	t/yr
Wi	Wastewater generated	13	m3/t product
CODi	Chemical oxygen demand (industrial degradable organic component in wastewater),	4.1	kg COD/m3

EQUATION 6.6
ORGANICALLY DEGRADABLE MATERIAL IN INDUSTRIAL WASTEWATER

$$TOW_i = P_i \bullet W_i \bullet COD_i$$

i	=	Meat & Poultry
Pi	=	1000 t/yr
Wi	=	13 m3/t product
CODi	=	4.1 kg COD/m3
TOWi	=	1000* 13* 4.1
	=	53300 kg COD/yr

IPCC Default values

TABLE 6.9
EXAMPLES OF INDUSTRIAL WASTEWATER DATA

Industry Type	Wastewater Generation W (m^3/ton)	Range for W (m^3/ton)	COD (kg/m^3)	COD Range (kg/m^3)
Alcohol Refining	24	16 – 32	11	5 – 22
Beer & Malt	6.3	5.0 – 9.0	2.9	2 – 7
Coffee	NA	NA –	9	3 – 15
Dairy Products	7	3 – 10	2.7	1.5 – 5.2
Fish Processing	NA	8 – 18	2.5	
Meat & Poultry	13	8 – 18	4.1	2 – 7

Tier 1 Calculation

EQUATION 6.6
ORGANICALLY DEGRADABLE MATERIAL IN INDUSTRIAL WASTEWATER

$$TOW_i = P_i \bullet W_i \bullet COD_i$$

i	=	Meat & Poultry
Pi	=	1000 t/yr
Wi	=	13 m3/t product
CODi	=	4.1 kg COD/m3
TOWi	=	1000* 13* 4.1
	=	53300 kg COD/yr

IPCC Default values

TABLE 6.9
EXAMPLES OF INDUSTRIAL WASTEWATER DATA

Industry Type	Wastewater Generation W (m^3/ton)	Range for W (m^3/ton)	COD (kg/m^3)	COD Range (kg/m^3)
Alcohol Refining	24	16 – 32	11	5 – 22
Beer & Malt	6.3	5.0 – 9.0	2.9	2 – 7
Coffee	NA	NA –	9	3 – 15
Dairy Products	7	3 – 10	2.7	1.5 – 5.2
Fish Processing	NA	8 – 18	2.5	
Meat & Poultry	13	8 – 18	4.1	2 – 7

Tier 2 Calculation

EQUATION 6.6
ORGANICALLY DEGRADABLE MATERIAL IN INDUSTRIAL WASTEWATER

$$TOW_i = P_i \bullet W_i \bullet COD_i$$

i	=	Meat & Poultry
Pi	=	1000 t/yr
Wi	=	10 m3/t product
CODi	=	2 kg COD/m3
TOWi	=	1000* 10* 2
	=	20000 kg COD/yr

10 m3/ t product is just an example used here as country specific value could not find

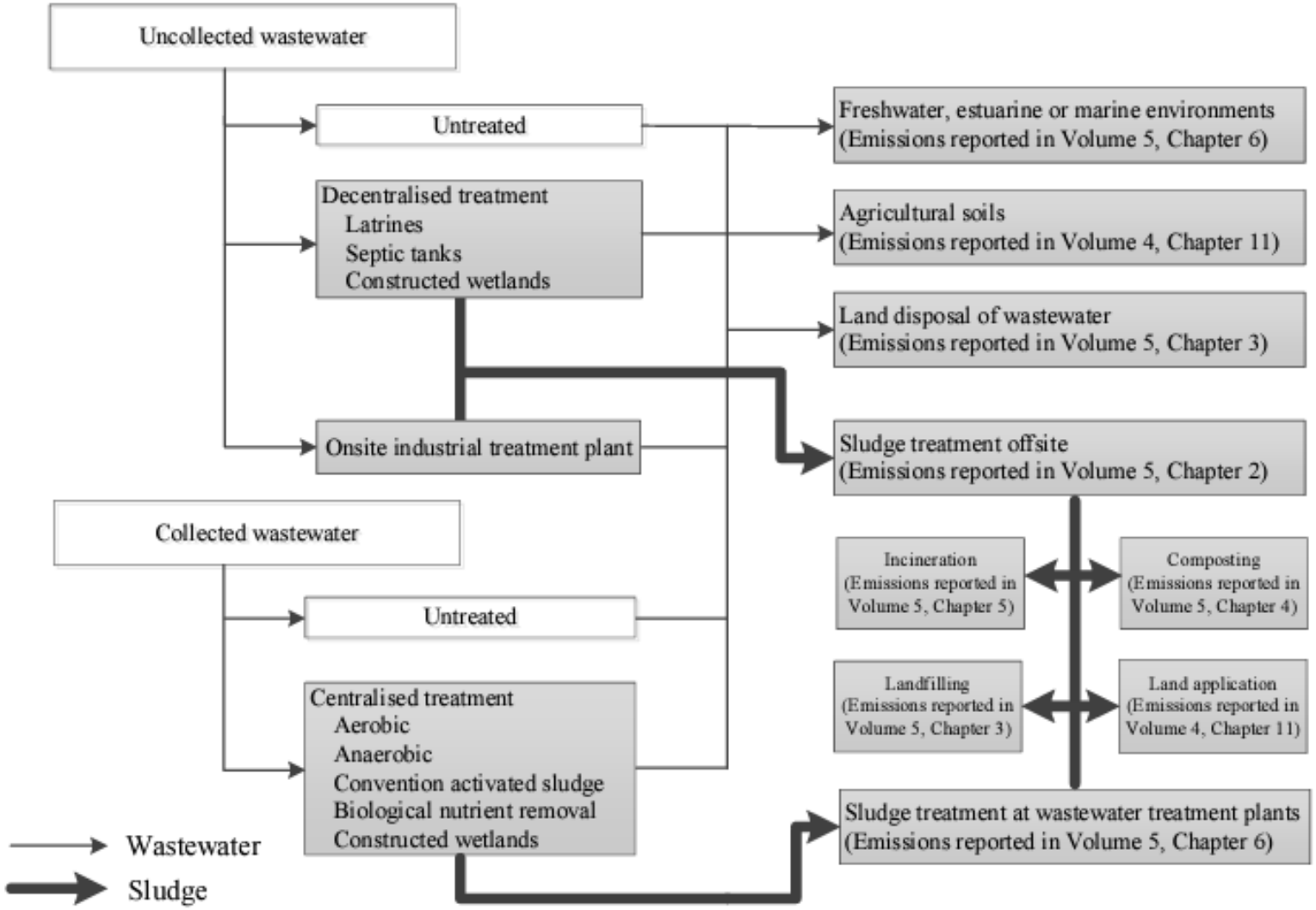
Indicative Values of Wastewater Quality in Selected Industries in the Philippines*

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

Source: Situation of Industrial Wastewater Regulation in the Philippines, (DENR), 2020

4.D.2 –Industrial Wastewater Treatment and Discharge CONT…

Step 02: Select the pathway and systems according to country activity data.



Updated figure in the 2019 refinement

4.D.2 –Industrial Wastewater Treatment and Discharge CONT...

Step 03: For each industrial sector estimate the emission factor using maximum methane producing capacity and the average industry-specific methane correction factor (Country specific **OR** use IPCC default values)

IPCC COD-default factor for B_o (0.25 kg CH4/kg COD)

IPCC Defaults for MCF

TABLE 6.8
DEFAULT MCF VALUES FOR INDUSTRIAL WASTEWATER

Type of treatment and discharge pathway or system	Comments	MCF [1]	Range
Untreated			
Sea, river and lake discharge	Rivers with high organics loadings may turn anaerobic, however this is not considered here.	0.1	0 – 0.2
Treated			
Aerobic treatment plant	Must be well managed. Some CH_4 can be emitted from settling basins and other pockets.	0	0 – 0.1
Aerobic treatment plant	Not well managed. Overloaded	0.3	0.2 – 0.4
Anaerobic digester for sludge	CH_4 recovery not considered here	0.8	0.8 – 1.0
Anaerobic reactor (e.g., UASB, Fixed Film Reactor)	CH_4 recovery not considered here	0.8	0.8 – 1.0
Anaerobic shallow lagoon	Depth less than 2 metres, use expert judgment	0.2	0 – 0.3
Anaerobic deep lagoon	Depth more than 2 metres	0.8	0.8 – 1.0

[1] Based on expert judgment by lead authors of this section

EQUATION 6.5
CH_4 EMISSION FACTOR FOR INDUSTRIAL WASTEWATER

$$EF_j = B_o \bullet MCF_j$$

Where:

EF_j = emission factor for each treatment/discharge pathway or system, kg CH_4/kg COD, (See Table 6.8.)

j = each treatment/discharge pathway or system

B_o = maximum CH_4 producing capacity, kg CH_4/kg COD

MCF_j = methane correction factor (fraction) (See Table 6.8.)

See the previous slide

Tier 1 Calculation

	Parameter	Value	Unit
B_0	Maximum CH4 producing capacity	0.25	kg CH4/kg COD
j	Each treatment/discharge pathway or system	Aerobic treatment plant, Not well managed overloaded	
MCFj	Methane correction factor (fraction)	0.3	

EQUATION 6.5
CH_4 EMISSION FACTOR FOR INDUSTRIAL WASTEWATER

$$EF_j = B_o \bullet MCF_j$$

B_0	=	0.25 kg CH4/kg COD
j	=	Aerobic treatment plant, Not well managed overloaded
MCFj	=	0.3
EFj	=	0.25*0.3
	=	0.075 kg CH4/kg COD

IPCC Default values

TABLE 6.8
DEFAULT MCF VALUES FOR INDUSTRIAL WASTEWATER

Type of treatment and discharge pathway or system	Comments	MCF [1]	Range
Untreated			
Sea, river and lake discharge	Rivers with high organics loadings may turn anaerobic, however this is not considered here.	0.1	0 – 0.2
Treated			
Aerobic treatment plant	Must be well managed. Some CH_4 can be emitted from settling basins and other pockets.	0	0 – 0.1
Aerobic treatment plant	Not well managed. Overloaded	0.3	0.2 – 0.4
Anaerobic digester for sludge	CH_4 recovery not considered here	0.8	0.8 – 1.0
Anaerobic reactor (e.g., UASB, Fixed Film Reactor)	CH_4 recovery not considered here	0.8	0.8 – 1.0
Anaerobic shallow lagoon	Depth less than 2 metres, use expert judgment	0.2	0 – 0.3
Anaerobic deep lagoon	Depth more than 2 metres	0.8	0.8 – 1.0

[1] Based on expert judgment by lead authors of this section

Tier 1 Calculation

EQUATION 6.5
CH_4 EMISSION FACTOR FOR INDUSTRIAL WASTEWATER

$$EF_j = B_o \bullet MCF_j$$

B_0	=	0.25 kg CH4/kg COD
j	=	Aerobic treatment plant, Not well managed overloaded
MCFj	=	0.3
EFj	=	0.25*0.3
	=	0.075 kg CH4/kg COD

IPCC Default values

TABLE 6.8
DEFAULT MCF VALUES FOR INDUSTRIAL WASTEWATER

Type of treatment and discharge pathway or system	Comments	MCF [1]	Range
Untreated			
Sea, river and lake discharge	Rivers with high organics loadings may turn anaerobic, however this is not considered here.	0.1	0 – 0.2
Treated			
Aerobic treatment plant	Must be well managed. Some CH_4 can be emitted from settling basins and other pockets	0	0 – 0.1
Aerobic treatment plant	Not well managed. Overloaded	0.3	0.2 – 0.4
Anaerobic digester for sludge	CH_4 recovery not considered here	0.8	0.8 – 1.0
Anaerobic reactor (e.g., UASB, Fixed Film Reactor)	CH_4 recovery not considered here	0.8	0.8 – 1.0
Anaerobic shallow lagoon	Depth less than 2 metres, use expert judgment	0.2	0 – 0.3
Anaerobic deep lagoon	Depth more than 2 metres	0.8	0.8 – 1.0

[1] Based on expert judgment by lead authors of this section

Tier 2 Calculation

EQUATION 6.5
CH_4 EMISSION FACTOR FOR INDUSTRIAL WASTEWATER

$$EF_j = B_o \bullet MCF_j$$

B_0	=	0.4 kg CH4/kg COD
j	=	Aerobic treatment plant, Not well managed overloaded
MCFj	=	0.25
EFj	=	0.4*0.25
	=	0.1 kg CH4/kg COD

Just examples used here as country specific values are not available

4.D.2 –Industrial Wastewater Treatment and Discharge CONT…

Step 04: Estimate emissions, adjust for possible sludge removal and or CH4 recovery and sum the results

The general equation to estimate CH_4 emissions from industrial wastewater is as follows:

EQUATION 6.4
TOTAL CH_4 EMISSIONS FROM INDUSTRIAL WASTEWATER

$$CH_4 \ Emissions = \sum_i [(TOW_i - S_i) EF_i - R_i]$$

Where:

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

TOW_i = total organically degradable material in wastewater from industry *i* in inventory year, kg COD/yr

i = industrial sector

S_i = organic component removed as sludge in inventory year, kg COD/yr

EF_i = emission factor for industry *i*, kg CH_4/kg COD for treatment/discharge pathway or system(s) used in inventory year

If more than one treatment practice is used in an industry this factor would need to be a weighted average.

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

Calculated previously

Only a few countries may have sludge removal data and CH_4 recovery data

The amount of CH_4 that is flared or recovered for energy use should be subtracted from total emissions through the use of a separate CH_4 recovery parameter.

Calculated previously

Tier 1 Calculation

	Parameter	Value	Unit
i	Industrial sector	Meat & Poultry	
TOWi	Total organically degradable material in wastewater from industry i in inventory year	53300	kg COD/yr
Si	Organic component removed as sludge in inventory year	100	kg COD/yr
EFi	Emission factor for industry i	0.075	kg CH4/kg COD
Ri	Amount of CH4 recovered in inventory year	0	kg CH4/yr

EQUATION 6.4
TOTAL CH_4 EMISSIONS FROM INDUSTRIAL WASTEWATER

$$CH_4\ Emissions = \sum_i [(TOW_i - S_i) EF_i - R_i]$$

i	=	Meat & Poultry	
TOWi	=	53300	kg COD/yr
Si	=	100	kg COD/yr
Efi	=	0.075	kg CH4/kg COD
Ri	=	0	kg CH4/yr
CH_4 Emissions	=	$\sum_i$[(53300-100)*0.075-0] + [n] + ...	
		$\sum_i$[3990] + [n] + ...	kg CH4/yr

From previous Tier 01 calculations

CH4 recovery should be included only if there are facility-specific data. The default for CH4 recovery is zero

Tier 1 Calculation

EQUATION 6.4
TOTAL CH_4 EMISSIONS FROM INDUSTRIAL WASTEWATER

$$CH_4\ Emissions = \sum_i [(TOW_i - S_i)EF_i - R_i]$$

i	=	Meat & Poultry	
TOWi	=	53300	kg COD/yr
Si	=	100	kg COD/yr
Efi	=	0.075	kg CH4/kg COD
Ri	=	0	kg CH4/yr
CH_4 Emissions	=	$\sum_i$[(53300-100)*0.075-0] + [n] + ...	
		$\sum_i$[3990] + [n] + ...	kg CH4/yr

From previous Tier 01 calculations

CH4 recovery should be included only if there are facility-specific data. The default for CH4 recovery is zero

Tier 2 Calculation

EQUATION 6.4
TOTAL CH_4 EMISSIONS FROM INDUSTRIAL WASTEWATER

$$CH_4\ Emissions = \sum_i [(TOW_i - S_i)EF_i - R_i]$$

i	=	Meat & Poultry	
TOWi	=	20000	kg COD/yr
Si	=	100	kg COD/yr
Efi	=	0.1	kg CH4/kg COD
Ri	=	12	kg CH4/yr
CH_4 Emissions	=	$\sum_i$[(20000-100)*0.1-12] + [n] + ...	
		$\sum_i$[1978] + [n] + ...	kg CH4/yr

From previous Tier 02 calculations

This is just an example, as country specific data are not available.
If a country selects to report CH4 recovery, it is good practice to distinguish between flaring and CH4 recovery for energy generation, which should be reported in the Energy Sector taking into account the avoidance of double counting emissions from flaring and energy used.

4.D.2 –Industrial Wastewater Treatment and Discharge CONT...

Emission calculation N_2O

From IPCC 2019 Refinement

Identify the industrial sectors that generate wastewater with large quantities of N, by evaluating total industrial product, N in the wastewater, and wastewater produced

Step 01: Estimate total nitrogen in wastewater entering treatment

Industrial production data and wastewater generation rates may be obtained from national statistics, regulatory agencies, wastewater treatment associations or industry associations.

There should be industry, process, and country specific values

EQUATION 6.13 (NEW)
TOTAL NITROGEN IN INDUSTRIAL WASTEWATER

$$TN_{IND_i} = P_i \bullet W_i \bullet TN_i$$

Where:

TN_{INDi}	= total nitrogen in wastewater entering treatment for industry *i*, kg TN/yr
i	= industrial sector
P_i	= total industrial product for industrial sector *i*, t/yr
W_i	= wastewater generated for industrial sector *i*, $m^3/t_{product}$
TN_i	= total nitrogen in untreated wastewater for industrial sector *i*, kg TN/m^3

Tier 1 Calculation

Philippines - Total production of meat

2,907,638

(tonnes)

in 2022

Source: World data atlas

IPCC Default values

TABLE 6.12 (NEW)
EXAMPLES OF INDUSTRIAL WASTEWATER DATA

Industry Type	Wastewater Generation W (m^3/tonne)	Range for W (m^3/tonne)	Total Nitrogen (TN) (kg/m^3)	TN Range (kg/m^3)
Alcohol refining	24[2]	16 – 32[2]	2.4[2]	0.94 – 3.86[2]
Beer & malt	6.3[2]	5.0 – 9.0[2]	0.055[3]	0.025 – 0.08[3]
Fish processing	5[2]	2 – 8[2]	0.60[2]	0.21 – 0.98[2]
Iron and steel manufacturing	5[1]	0.004 – 10.4[4]	0.25[1]	0.0004 – 0.524[4]
Meat & poultry	13[2]	8 – 18[2]	0.19[2]	0.17 – 0.20[2]

EQUATION 6.13 (NEW)
TOTAL NITROGEN IN INDUSTRIAL WASTEWATER

$$TN_{IND_i} = P_i \bullet W_i \bullet TN_i$$

i	=	Meet & Poultry	
P_i	=	2,907,638	t/yr
W_i	=	13	m3/tonne
TN_i	=	0.19	kg/m3
TN_{INDi}	=	2907638*13*0.19	kg TN/yr
		7,181,866	kg TN/yr

Tier 1 Calculation

IPCC Default values

TABLE 6.12 (NEW)
EXAMPLES OF INDUSTRIAL WASTEWATER DATA

Industry Type	Wastewater Generation W (m^3/tonne)	Range for W (m^3/tonne)	Total Nitrogen (TN) (kg/m^3)	TN Range (kg/m^3)
Alcohol refining	24[2]	16 – 32[2]	2.4[2]	0.94 – 3.86[2]
Beer & malt	6.3[2]	5.0 – 9.0[2]	0.055[3]	0.025 – 0.08[3]
Fish processing	5[2]	2 – 8[2]	0.60[2]	0.21 – 0.98[2]
Iron and steel manufacturing	5[1]	0.004 – 10.4[4]	0.25[1]	0.0004 – 0.524[4]
Meat & poultry	13[2]	8 – 18[2]	0.19[2]	0.17 – 0.20[2]

EQUATION 6.13 (NEW)
TOTAL NITROGEN IN INDUSTRIAL WASTEWATER

$$TN_{IND_i} = P_i \bullet W_i \bullet TN_i$$

i	=	Meet & Poultry	
P_i	=	2,907,638	t/yr
W_i	=	13	m3/tonne
TN_i	=	0.19	kg/m3
TN_{INDi}	=	2907638*13*0.19	kg TN/yr
		7,181,866	kg TN/yr

Tier 2 Calculation

Industry	Wastewater volume from industrial use ('process wastewater') (m3/day)
Poultry processing plant	1,750
Meat and meat products	75-380

=((1750+380)*365)/2,907,638)
=0.27

Source: Situation of Industrial Wastewater Regulation in the Philippines, (DENR), 2020

EQUATION 6.13 (NEW)
TOTAL NITROGEN IN INDUSTRIAL WASTEWATER

$$TN_{IND_i} = P_i \bullet W_i \bullet TN_i$$

i	=	Meet & Poultry	
P_i	=	2,907,638	t/yr
W_i	=	0.27	m3/tonne
TN_i	=	0.7	kg/m3
TN_{INDi}	=	2907638*0.27*0.7	kg TN/yr
		544,215	kg TN/yr

Philippines - Total production of meat

2,907,638

(tonnes)

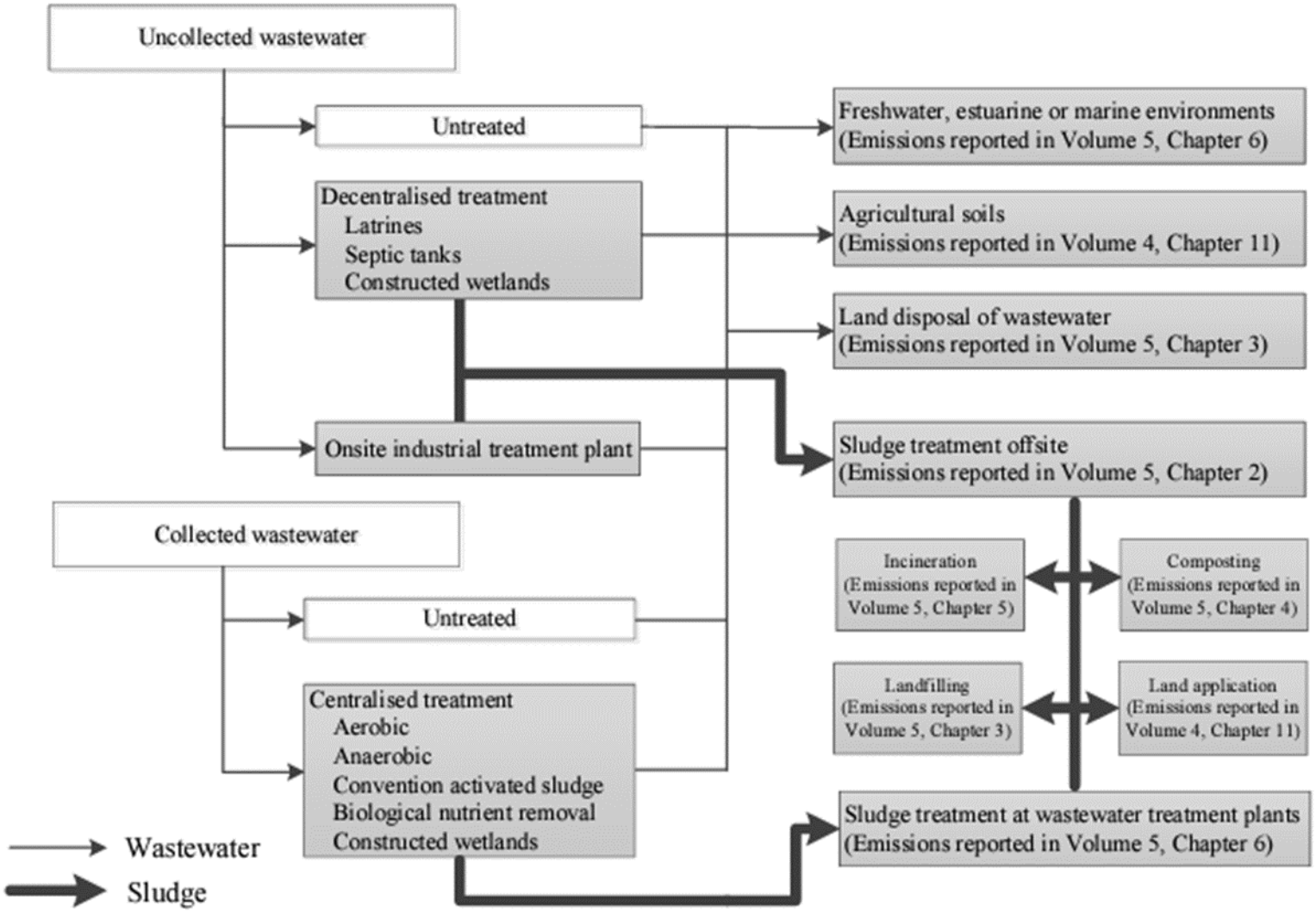
in 2022

Source: World data atlas

This is just an assumption as country specific values are not available

4.D.2 –Industrial Wastewater Treatment and Discharge CONT…

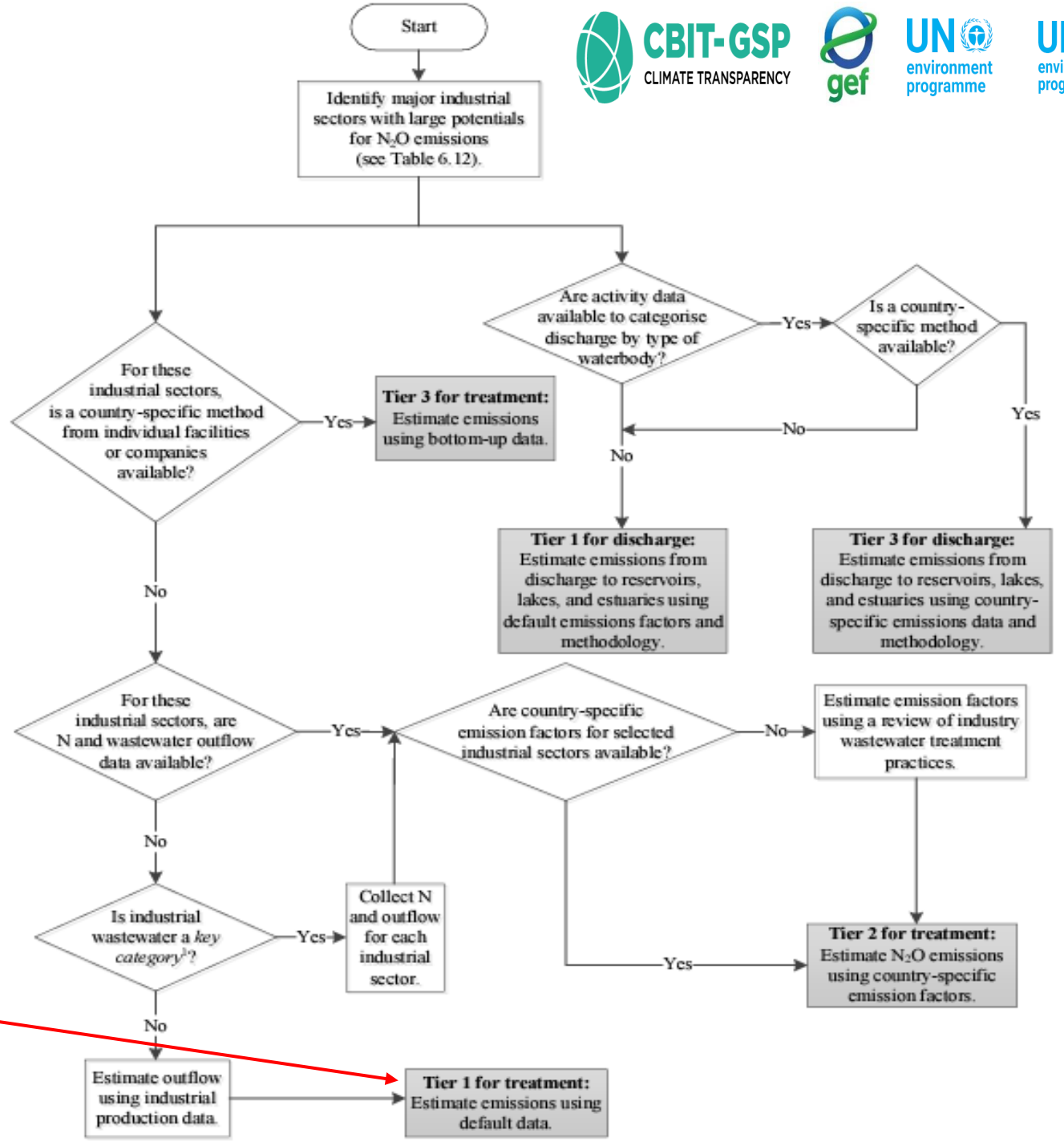
Step 02: Select the pathway and systems according to country activity data.



Updated figure in the 2019 refinement

4.D.2 –Industrial Wastewater Treatment and Discharge CONT...

Step 03: Choice of method for each industrial wastewater treatment/ discharge pathway or system



Refer Table 6.8A of the 2019 IPCC Refinement for default values

4.D.2 –Industrial Wastewater Treatment and Discharge CONT...

Step 04: Estimate the emissions from wastewater treatment and sum the results for each pathway/system

Calculated through previous equation

Refer Table 6.5 of the 2019 IPCC Refinement for default values

Use country specific EFs or Refer Table 6.8A of the 2019 IPCC Refinement for default values

Industry Type
Alcohol refining
Beer & malt
Fish processing
Iron and steel manufacturing
Meat & poultry
Nitrogen fertiliser
Plastics & resins
Starch production

EQUATION 6.11 (NEW)
N_2O EMISSIONS FROM INDUSTRIAL WASTEWATER TREATMENT PLANTS

$$N_2O\ Plants_{IND} = \left[\sum_i (T_{i,j} \bullet EF_j \bullet TN_{IND_i})\right] \bullet \frac{44}{28}$$

Where:

$N_2O\ Plants_{IND}$ = N_2O emissions from industrial wastewater treatment plants in inventory year, kg N_2O/yr

TN_{INDi} = total nitrogen in wastewater from industry *i* in inventory year, kg N/yr. See new Equation 6.13.

$T_{i,j}$ = degree of utilisation of treatment/discharge pathway or system *j*, for each industry *i* in inventory year

i = industry

j = each treatment/discharge pathway or system

EF_j = emission factor for treatment/discharge pathway or system *j*, kg N_2O-N/kg N. See Table 6.8a (New).

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

Tier 1 Calculation

EQUATION 6.11 (NEW)
N_2O EMISSIONS FROM INDUSTRIAL WASTEWATER TREATMENT PLANTS

$$N_2O\ Plants_{IND} = \left[\sum_i (T_{i,j} \bullet EF_j \bullet TN_{IND_i})\right] \bullet \frac{44}{28}$$

TN_{INDi}	=	7,181,866	kg N/yr
$T_{i,j}$	=	0.07	
i	=	Meet & Poultry	
j	=	Centralised, aerobic treatment plant	
EF_j	=	0.016	kg N2O-N/kg N
$N_2O\ Plants_{IND}$	=	$[\sum_i (0.07 \times 0.016 \times 7{,}181{,}866) + (n) \ldots .] \times \frac{44}{28}$	kg N2O/yr
	=	$\sum_i [(8{,}043.69) + (n) + ...] \times \frac{44}{28}$	kg N2O/yr
		Considering only the sample emission	
	=	12,640.08	kg N2O/yr

From previous Tier 01 calculations

From Table 6.5 (India, Urban High income, other)

From Table 6.8A (Centralized, aerobic treatment plant default EF)

Tier 2 Calculation

EQUATION 6.11 (NEW)
N_2O EMISSIONS FROM INDUSTRIAL WASTEWATER TREATMENT PLANTS

$$N_2O\ Plants_{IND} = \left[\sum_i (T_{i,j} \bullet EF_j \bullet TN_{IND_i})\right] \bullet \frac{44}{28}$$

TN_{INDi}	=	544,215	kg N/yr
$T_{i,j}$	=	0.07	
i	=	Meet & Poultry	
j	=	Centralised, aerobic treatment plant	
EF_j	=	0.07	kg N2O-N/kg N
$N_2O\ Plants_{IND}$	=	$[\sum_i (0.07 \times 0.07 \times 544{,}25) + (n) \ldots .] \times \frac{44}{28}$	kg N2O/yr
	=	$\sum_i [(2{,}666.65) + (n) + ...] \times \frac{44}{28}$	kg N2O/yr
		Considering only the sample emission	
	=	4190.45	kg N2O/yr

From previous Tier 02 calculations

From Table 6.8A (Centralized, aerobic treatment plant – selected a value from EF range as country specific value is not available)

4.D.2 –Industrial Wastewater Treatment and Discharge CONT...

Step 05: Estimate the total nitrogen in the industrial wastewater effluent

Derived from step 01 equation

If country specific value is not available, regional value can be taken from Table 6.5 of IPCC 2019 refinement

EQUATION 6.14 (NEW)
TOTAL NITROGEN IN INDUSTRIAL WASTEWATER EFFLUENT

$$N_{EFFLUENT,IND} = \sum_j \left[TN_{IND_i} \bullet T_j \bullet \left(1 - N_{REM,j}\right) \right]$$

Where:

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

TN_{INDi} = total nitrogen in wastewater entering treatment for industry *i*, kg TN/yr

T_j = degree of utilisation of treatment system *j* in inventory year ($\sum_i T_{ij}$). See Table 6.5.

j = each wastewater treatment type used in inventory year

$N_{REM,j}$ = fraction of total wastewater nitrogen removed during wastewater treatment per treatment type j. See new Table 6.10c.

TABLE 6.10C (NEW)
WASTEWATER TREATMENT NITROGEN REMOVAL FRACTIONS (N_{REM}) ACCORDING TO TREATMENT TYPE

Treatment Type	Default	Range
No treatment	0[1–3]	0[1–3]
Primary (mechanical)	0.10[1–3]	0.05 – 0.20[1–3]
Secondary (biological)	0.40[1–3]	0.35 – 0.55[1–3]
Tertiary (advanced biological)	0.80[1–4]	0.45 – 0.85[1–4]
Septic tank	0.15[1–3]	0.10 – 0.25[1–3]
Septic tank + land dispersal field	0.68[5]	0.62 – 0.73[5]
Latrine	0.12[6]	0.07 – 0.21[6]

Tier 1 Calculation

EQUATION 6.14 (NEW)
TOTAL NITROGEN IN INDUSTRIAL WASTEWATER EFFLUENT

$$N_{EFFLUENT,IND} = \sum_j \left[TN_{IND_i} \bullet T_j \bullet \left(1 - N_{REM,j}\right) \right]$$

TN_{INDi}	=	7,181,866	kg TN/yr
T_j	=	0.07	
j	=	Secondary (biological)	
$N_{REM,j}$	=	0.4	
$N_{EFFLUENT, IND}$	=	$\sum_j [(7{,}181{,}866 \times 0.07 \times (1 - 0.4)] + (n) \ldots .]$	kg N/yr
	=	$\sum_j [(301{,}638.37)] + (n) \ldots .]$	kg N/yr
		Considering only the sample emission	
	=	301,638.37	kg N/yr

From previous Tier 01 calculations

From Table 6.5 (India, Urban High income, other)

TABLE 6.10C (NEW)
WASTEWATER TREATMENT NITROGEN REMOVAL FRACTIONS (N_{REM}) ACCORDING TO TREATMENT TYPE

Treatment Type	Default	Range
No treatment	0^{1-3}	0^{1-3}
Primary (mechanical)	0.10^{1-3}	$0.05 - 0.20^{1-3}$
Secondary (biological)	0.40^{1-3}	$0.35 - 0.55^{1-3}$
Tertiary (advanced biological)	0.80^{1-4}	$0.45 - 0.85^{1-4}$

Tire 2 Calculation

EQUATION 6.14 (NEW)
TOTAL NITROGEN IN INDUSTRIAL WASTEWATER EFFLUENT

$$N_{EFFLUENT,IND} = \sum_j \left[TN_{IND_i} \bullet T_j \bullet \left(1 - N_{REM,j}\right) \right]$$

From previous Tier 02 calculations

From Table 6.5 (India, Urban High income, other)

From Table 6.10C (Secondary (biological) – selected a value from range as country specific value is not available)

TN_{INDi}	=	544,215	kg TN/yr
T_j	=	0.07	
j	=	Secondary (biological)	
$N_{REM,j}$	=	0.55	
$N_{EFFLUENT, IND}$	=	$\sum_j [(544{,}215 \times 0.07 \times (1 - 0.55)] + (n) \ldots .]$	kg N/yr
	=	$\sum_j [(17{,}142.77)] + (n) \ldots .]$	kg N/yr
		Considering only the sample emission	
	=	17,142.77	kg N/yr

4.D.2 –Industrial Wastewater Treatment and Discharge CONT…

Step 06: Estimate emissions from effluent, accounting for losses of nitrogen that occur within the wastewater treatment process, including sludge removal, and sum the results for each pathway/system.

Can be derived from equation under step 05

Use country specific EFs or Refer Table 6.8A of the 2019 IPCC Refinement for default values

EQUATION 6.12 (NEW)
N_2O EMISSIONS FROM INDUSTRIAL WASTEWATER EFFLUENT

$$N_2OEffluent_{IND} = N_{EFFLUENT,IND} \bullet EF_{EFFLUENT} \bullet \frac{44}{28}$$

Where:

$N_2OEffluent_{IND}$ = N_2O emissions from industrial wastewater effluent in inventory year, kg N_2O/yr

$N_{EFFLUENT, IND}$ = nitrogen in the industrial wastewater effluent discharged to aquatic environments, kg N/yr. See new Equation 6.14.

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

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

Tire 1 Calculation

EQUATION 6.12 (NEW)
N_2O EMISSIONS FROM INDUSTRIAL WASTEWATER EFFLUENT

$$N_2O Effluent_{IND} = N_{EFFLUENT,IND} \bullet EF_{EFFLUENT} \bullet \frac{44}{28}$$

From previous calculations

$N_{EFFLUENT, IND}$	=	301,638.37	kg N/yr
$EF_{EFFLUENT}$	=	0.016	kg N2O-N/kg N
N_2O $Effluent_{IND}$	=	301.638.37*0.016*(44/28)	kg N2O/yr
	=	7,584.05	kg N2O/yr

Wastewater treatment system, EF_{plants}			
Centralised, aerobic treatment plant	N_2O is variable and can be significant	0.016[1]	0.00016 – 0.045
Anaerobic reactor	N_2O is not significant	0	0 – 0.001
Anaerobic lagoons	N_2O is not significant	0	0 – 0.001
Constructed wetlands	See *2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*: Wetlands (IPCC 2014)		

Tire 2 Calculation

EQUATION 6.12 (NEW)
N_2O EMISSIONS FROM INDUSTRIAL WASTEWATER EFFLUENT

$$N_2O Effluent_{IND} = N_{EFFLUENT,IND} \bullet EF_{EFFLUENT} \bullet \frac{44}{28}$$

$N_{EFFLUENT, IND}$	=	17,142.77	kg N/yr
$EF_{EFFLUENT}$	=	0.02	kg N2O-N/kg N
N_2O $Effluent_{IND}$	=	17,142.77*0.02*(44/28)	kg N2O/yr
	=	538.77	kg N2O/yr

4.D.2 –Industrial Wastewater Treatment and Discharge

There are 6 worksheets within the Industrial wastewater treatment and discharge

1. CH4 Emissions
2. CH4 Emissions from Constructed Wetlands
3. Direct N2O Emissions from constructed wetlands
4. N in wastewater
5. Direct N2O Emissions from treatment plants
6. N2O emissions from effluent wastewater

CH4 Emissions | CH4 Emissions from Constructed Wetlands | Direct N2O Emissions from Constructed Wetlands | N in Wastewater | Direct N2O Emissions from Treatment Plants | N2O Emissions from Effluent wastewater

Worksheet

Sector: Waste
Category: Wastewater Treatment and Discharge
Subcategory: 4.D.2 - Industrial Wastewater Treatment and Discharge
Sheet: CH4 Emissions from Industrial Wastewater

2023

Data

Equation 6.4, 6.6																
Subdivision (Region, city, etc.)	Industry sector	Total industry product (t/yr)	Wastewater generated (m3/t)	Chemical Oxygen Demand (kg COD/m3)	Total organic degradable material in wastewater for each industry sector (kg COD/yr)		Sludge removed in each industry sector (kg COD/yr	Weighted Emission Factor (kg CH4/kg COD)			Methane recovered (kg CH4)		CH4 Emissions (kg CH4)	CH4 Emissions (Gg CH4)		
	i	Pi	Wi	CODi		TOWi = Pi * Wi * CODi or specified	Si		WEFi		Flaring Fi	Energy use Ri	Ei = (TOWi - Si) * WEFi - Fi - Ri	Ei / 1000000		
Total						0					0	0	0	0		

Worksheet 1: CH_4 Emissions

Select the industry sector by the drop-down

Industry Type	Wastewater Generation W (m3/t)	Range for W (m3/t)	COD (kg/m3)	COD Range (kg/m3)
Alcohol Refining	24	16 - 32	11	5 - 22
Beer & Malt	6.3	5.0 - 9.0	2.9	2 - 7
Coffee			9	3 - 15
Dairy Products	7	3 - 10	2.7	1.5 - 5.2
Fish Processing		8 - 18	2.5	
Meat & Poultry	13	8 - 18	4.1	2 - 7
Organic Chemicals	67	0 - 400	3	0.8 - 5
Petroleum Refineries	0.6	0.3 - 1.2	1	0.4 - 1.6

User-defined parameter

Default or User-defined parameters

Select as "calculated" from the dropdown

Default or User-defined parameters

User-defined parameter

According to IPCC, consider as "zero" due to unavailability of data

Subdivision's Column allows to report at regional/ city level as well as to further disaggregate estimates

2006 IPCC Categories

- 4 - Waste
  - 4.D - Wastewater Treatment and Discharge
    - 4.D.1 - Domestic Wastewater Treatment and D

CH4 Emissions | Direct N2O Emissions from Constructed Wetlands | N in Wastewater | Direct N2O Emissions from Treatment Plants | N2O Emissions from Effluent wastewater

Worksheet

Sector: W

Category: Was ...tment and Discharge

Subcategory: 4.D.2 ...Wastewater Treatment and Discharge

Sheet: CH4 Em... ...m Industrial Wastewater

Data

2000

Equation 6.4, 6.6

Subdivision (Region, city, etc.)	Industry sector	Total industry product (t/yr)	Wastewater generated (m3/t)	Chemical Oxygen Demand (kg COD/m3)	Total organic degradable material in wastewater for each industry sector (kg COD/yr)	Sludge removed in each industry sector (kg COD/yr)	Weighted Emission Factor (kg CH4/kg COD)		Methane recovered (kg CH4)		CH4 Emissions (kg CH4)	CH4 Emissions (Gg CH4)
	i	Pi	Wi	CODi	TOWi = Pi * Wi * CODi or specified	Si		WEFi	Flaring Fi	Energy use Ri	Ei = (TOWi - Si) * WEFi - Fi - Ri	Ei / 1000000
Sub A	Meat & Poultry	1000	13	4.1	Calculated	53300	100	Calculated	0.075	0	0	3990	0.00399
Total					53300					0	0	3990	0.00399

2. CH4 Emissions from Constructed Wetlands

Enter the subdivision.

Select from the dropdown menu

Value will be automatically selected according to industry sector

Enter manually

Enter manually or accept the default value

Equation for this calculation is not in the IPCC 2006 guideline

Data

Equation 6.1, 6.2, 6.4 WS																
Subdivision	Type of Constructed Wetlands	Industry sector	Chemical Oxygen Demand (kg COD/m3)	Daily flow rate of industrial wastewater (m3/day)	Total Organic Degradable Material from industry i treated in CWj (kg COD/yr)		Maximum methane producing capacity (kg CH4/kg COD)	Methane Correction Factor (Fraction)	Emission Factor (kg CH4/kg COD)		CH4 Emissions (kg CH4)	CH4 Emissions (Gg CH4)				
	j	i	CODi	Wij		TOWi,j = CODi * Wi,j * 365 or specified	Bo	MCFj		EFj = Bo * MCFj or specified	Ej = TOWi,j * EFj	Ej / 1000000				
constructed wetla...	Surface Flow	Coffee	9	350	Calculated	1149750	0.25	0.4	Calculated	0.1	114975	0.11498				
Total																
						1149750					114975	0.11498				

3. Direct N2O Emissions from constructed wetlands

Enter the subdivision.

Select from the dropdown menu

Value will be automatically selected according to industry sector

Enter manually

Equation for this calculation is not in the IPCC 2006 guideline

Data

Equation 6.5 WS, 6.7 WS															
Subdivision	Type of Constructed Wetlands	Industry sector	Total N concentration in industrial wastewater i treated by constructed wetlands j (kg N/m3)	Yearly flow rate of industrial wastewater treated by constructed wetlands j (m3/yr)				Nitrogen removed with sludge (kg N)	Total nitrogen in effluent (kg N/yr)	Emission Factor (kg N2O-N/kg N)	N2O Emissions (kg N2O)	N2O Emissions (Gg N2O)			
	j	i	TNij		Total industry product i (t/yr) Pij	Wastewater generated (m3/t) WWij	Wij = Pij * WWij or specified	S	Nij = TNij * Wij - S	EFj	E = Nij * EFj * 44/28	E / 10^6			
constructed wetla...	Surface Flow	Fish Processing	0.6	Calculated	500	10	5000	0	3000	0.0013	6.12857	0.00001			
Total									3000		6.12857	0.00001			

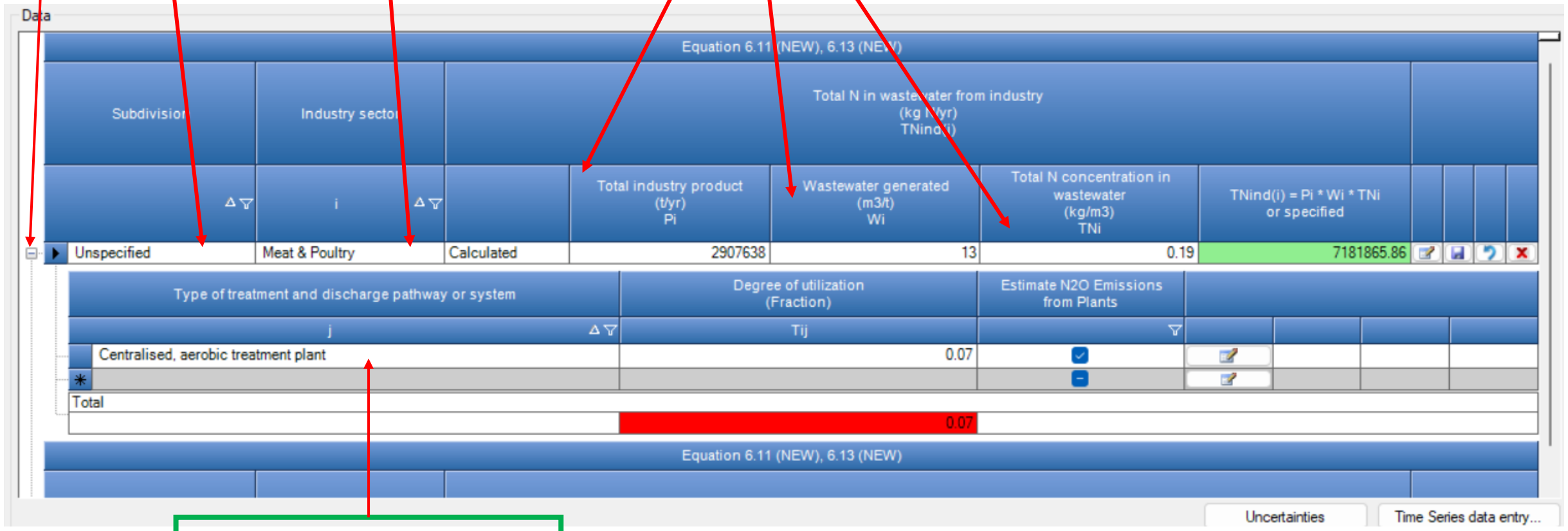
4. N in wastewater

Enter the subdivision.

Select the industry sector from the dropdown menu

User can enter these values manually

Click here to expand



Select from the dropdown

5. Direct N2O Emissions from treatment plants

User can enter these parameters manually

Click here to expand

Data

Equation 6.11 (NEW), 6.13 (NEW)

Subdivision	Industry sector	Total N in wastewater from industry (kg N/yr)	N2O Emissions (kg N2O)	N2O Emissions (Gg N2O)
	i	TNind(i)	Ei = ∑Eij	Ei / 10^6
Unspecified	Meat & Poultry	7181865.86	12640.08391	0.01264

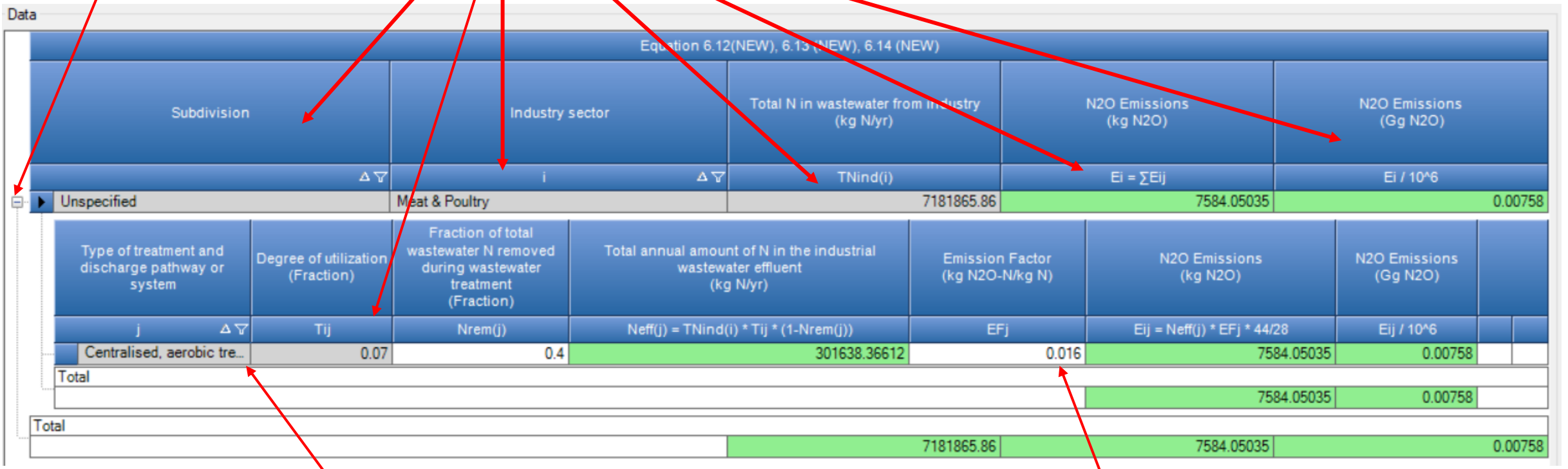
Type of treatment and discharge pathway or system	Degree of utilization (Fraction)	Emission Factor (kg N2O-N/kg N)	N2O Emissions (kg N2O)	N2O Emissions (Gg N2O)
j	Tij	EFj	Eij = TNind(i) * Tij * EFj * 44/28	Eij / 10^6
Centralised, aerobic treatment plant	0.07	0.016	12640.08391	0.01264
Total				
			12640.08391	0.01264
Total				
		7181865.86	12640.08391	0.01264

Select from the dropdown

6. N2O emissions from effluent wastewater

Click here to expand

User can enter these parameters manually



Select from the dropdown

Default value

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Let’s do an exercise with the IPCC GHGI tool!

Exercise for Domestic Wastewater Treatment and Discharge

Activity 01

Step 01: Open the worksheets for 4.D.1 – Domestic Wastewater Treatment and Discharge

Step 02: In the first worksheet, CH4 Emissions, enter the following data accordingly

Input parameter	Entry	Note
Subdivision	Philippine	
WEF	0.5	
Population	20000000	
BOD	40	Use the default value
I	0.85	
S	0	
Flaring F	0	
Energy use	0	
**the activity data used in this activity are not real. Just examples only for this activity.*		

Exercise for Domestic Wastewater Treatment and Discharge

Activity 02

Step 01: Open the worksheets for 4.D.1 – Domestic Wastewater Treatment and Discharge

Step 02: In the second worksheet, CH4 Emissions from constructed wetlands, enter the following data accordingly

Input parameter	Entry	Note
Subdivision	Facility 01	
Type of constructed wetlands	Horizontal subsurface flow	
Population served by cwj (capita)	2000	
Degradable Organic Component (g/cap/day)	40 (g/cap/day)	Used the default value
Correction factor for industrial BOD discharged in sewers	1.25	
Maximum methane producing capacity	10 (kg/BOD/Yr)	
Methane correction factor	0.2	
Emission Factor	2	
**the activity data used in this activity are not real. Just examples only for this activity.*		

Exercise for Domestic Wastewater Treatment and Discharge

Activity 03

Step 01: Open the worksheets for 4.D.1 – Domestic Wastewater Treatment and Discharge

Step 02: In the third worksheet, direct N2O emissions from treatment plants, enter the following data accordingly

Input parameter	Entry	Note
Subdivision	Facility 01	
Population	20000	
Degree of utilization of modern, centralized wastewater treatment plants (%)	10	
Fraction of industrial and commercial co-discharged protein	1.25	
Emission Factor (EF plant)	0.0032 (kg N2O/person/Yr)	

**the activity data used in this activity are not real. Just examples only for this activity.*

Activity 04

Step 01: Open the worksheets for 4.D.1 – Domestic Wastewater Treatment and Discharge

Step 02: In the fourth worksheet, indirect N2O emissions, enter the following data accordingly

Input parameter	Entry	Note
Subdivision	Facility 01	
Population	10000000	
Per capita protein consumption	20	
Fraction of nitrogen in protein	0.16	Default value
Fraction of non-consumption protein	1.1	Default value
Fraction of industrial and commercial co-discharged protein	1.25	Default value
Nitrogen from wastewater plants	5.09091	
Emission factor	0.005	
**the activity data used in this activity are not real. Just examples only for this activity.*		

Activity 05

Step 01: Open the worksheets for 4.D.1 – Domestic Wastewater Treatment and Discharge

Step 02: In the fifth worksheet, direct N2O emissions from constructed wetlands, enter the following data

Input parameter	Entry	Note
Subdivision	Facility 01	
Type of constructed wetland	Horizontal Surface flow	
Population	4000	
Per capita protein consumption	5	
Fraction of nitrogen in protein	0.16	Default value
Fraction of non-consumption protein	1.4	Default value
Fraction of industrial and commercial co-discharged protein	1.25	Default value
Nitrogen removed with sludge	1	
Emission factor	0.0079	
**the activity data used in this activity are not real. Just examples only for this activity.*		

Activity 01

CH4 Emissions

Data

Equation 6.1, 6.3																			
Subdivision (Region, city, etc.)	Weighted Emission Factor (kg CH4/kg BOD)			Population (Capita)	Degradable organic component (g/cap/day)	Correction factor for industrial BOD discharged in sewers			Organically degradable material in wastewater (kg BOD/yr)		Sludge removed (kg BOD/yr)	Methane recovered (kg CH4)		CH4 Emissions (kg CH4)	CH4 Emissions (Gg CH4)				
		WEF		P	BOD		I			TOW = P * BOD * 0.001 * I * 365 or specified	S	Flaring F	Energy use R	E = WEF * (TOW - S) - F - R	E / 1000000				
Philippine-Urban	Specified	0.5		20000000	40	Specified	0.85		Calculated	2482000...	0	0	0	124100000	124.1				
Total																			
										248200000		0	0	124100000	124.1				

Activity 02

CH4 Emissions from constructed wetlands

Data

Equation 6.1, 6.2, 6.3 WS															
Subdivision	Type of Constructed Wetlands	Population served by CWj (Capita)	Degradable organic component (g/cap/day)	Correction factor for industrial BOD discharged in sewers	Total Organic Degradable Material treated in CWj (kg BOD/yr)		Maximum methane producing capacity (kg CH4 / kg BOD)	Methane Correction Factor (Fraction)	Emission Factor (kg CH4 / kg BOD)		CH4 Emissions (kg CH4)	CH4 Emissions (Gg CH4)				
	j	Pj	BOD	I		TOWj = Pj * BOD * 0.001 * I * 365 or specified	Bo	MCFj		EFj = Bo * MCFj or specified	E = TOWj * EFj	E / 1000000				
Facility 01	Horizontal Subsu...	2000	40	1.25	Calculated	36500	10	0.2	Calculated	2	73000	0.073				
Total																
						36500					73000	0.073				

Activity 03

Direct N2O emissions from treatment plants

Data

Equation 6.9											
Subdivision (Region, city, etc.)	Population (P) (people)	Degree of utilization of modern, centralized wastewater treatment plants (Tplant) (%)	Fraction of industrial and commercial co-discharged protein (Find-com) (-)	Emission Factor (EFplant) (kg N2O/person/Year)	N2O Emissions (kg N2O/yr)	N2O Emissions (Gg N2O/yr)					
	A	B	C	D	E = A * B * C * D	F = E / 10^6					
facility 01	20000	10	1.25	0.0032	8	0.00001					
Total											
					8	0.00001					

Activity 04

Indirect N2O emissions

Data

Equation 6.7, 6.8															
Subdivision (Region, city, etc.)	Population (P) (people)	Per capita protein consumption (Protein) (kg/person/Year)	Fraction of nitrogen in protein (Fnpr) (kg N/kg Protein)	Fraction of non-consumption protein (Fnon-con) (-)	Fraction of industrial and commercial co-discharged protein (Find-com)	Nitrogen removed with sludge (Nsludge) (kg)	Total nitrogen in effluent (Neffluent) (kg N/yr)	Nitrogen from Wastewater plants (kg N/yr)	Emission Factor (kg N2O-N/kg N)	N2O Emissions (kg N2O/yr)	N2O Emissions (Gg N2O/yr)				
	A	B	C	D	E	F	G = (A*B*C*D*E)-F)	H	I	J = (G - H) * I * 44/28	K = J / 10^6				
Facility 01	100000...	20	0.16	1.1	1.25	!	44000000		0.005	345714.285...	0.34571				
Total															
							44000000			345714.285...	0.34571				

Activity 05

Direct N2O emissions from constructed wetlands

Data

Equation 6.5 WS, 6.6 WS															
Subdivision (Region, city, etc.)	Type of Constructed Wetlands	Population (P) (people)	Per capita protein consumption (Protein) (kg/person/Year)	Fraction of nitrogen in protein (Fnpr) (kg N/kg Protein)	Fraction of non-consumption protein (Fnon-con) (-)	Fraction of industrial and commercial co-discharged protein (Find-com)	Nitrogen removed with sludge (Nsludge) (kg)	Total nitrogen in effluent (Neffluent) (kg N/yr)	Emission Factor (kg N2O-N/kg N)	N2O Emissions (kg N2O/yr)	N2O Emissions (Gg N2O/yr)				
		A	B	C	D	E	F	G = (A*B*C*D*E)-F)	H	I = G * H * 44/28	J = I / 10^6				
facility 01	Horizontal Subsurf...	40000	5	0.16	1.4	1.25	1	55999	0.0079	695.18759	0.0007				
Total															
								55999		695.18759	0.0007				

Exercise

Let’s do an exercise with the inventory tool!

Exercise

Step 01: Open the Worksheet 1: CH4 Emissions.

Step 02: Enter following data accordingly

Input parameter	Entry	Note
Subdivision	Sub A	
Industry sector	Meat & Poultry	
Total industry product (t/yr)	5000	
Wastewater generated (m3/t)	13	Default
COD (kg COD/m3)	4.1	Default
Sludge removed.. (kg COD/yr)	12	
Weighted EF	0.25	Default
Methane recovered (Flaring)	0	According to IPCC, consider as "zero" due to unavailability of data
Methane recovered (Energy use)	0	

**the activity data used in this activity are not real. Just examples only for this activity.*

Step 03: Save entered data

Exercise CONT…

Step 04: Open the Worksheet 2: CH4 Emissions from constructed wetlands

Step 05: Enter following data accordingly

Input parameter	Entry	Note
Subdivision	Con. Wetland 1	
Type of constructed wetland	Surface flow	
Industry sector	Dairy Products	
COD (kg COD/ m3)	2.7	Default
Daily flow rate of industrial WW (m3/day)	500	
Total organic degradable…	Select “calculated”	
Maximum methane producing capacity	0.25	Default
Methane correction factor	0.4	Default
Emission factor	Select “calculated”	

**the activity data used in this activity are not real. Just examples only for this activity.*

Step 06: Save entered data

Exercise CONT…

Step 07: Open the Worksheet 3: Direct N_2O Emissions from constructed wetlands

Step 08: Enter following data accordingly

Input parameter	Entry	Note
Subdivision	Con. Wetland 1	
Type of constructed wetland	Surface flow	
Industry sector	Beer & Meet	
COD (kg COD/ m3)	0.055	Default
Yearly flow rate of industrial WW…. (m3/day)	Select "calculated"	
Total industry product	1000	
Wastewater generated (m3/t)	6.3	Default
N removed with sludge	0	Default
Emission factor	0.0013	Default

**the activity data used in this activity are not real. Just examples only for this activity.*

Step 09: Save entered data

Exercise CONT…

Step 10: Open the Worksheet 4: N in wastewater

Step 11: Enter following data accordingly

Input parameter	Entry	Note
Subdivision	Sub A	
Industry sector	Beer & Meet	
Total N in wastewater from industry (kg N/yr)	Select “calculated”	
Total industry product	1500	
Wastewater generated (m3/t)	6.3	Default
Total N concentration in wastewater (kg/m3)	0.055	Default
Type of treatment or discharge pathway or system	Centralised aerobic treatment plant	
Degree of utilisation	0.07	

**the activity data used in this activity are not real. Just examples only for this activity.*

Step 12: Save entered data

CBIT-GSP CLIMATE TRANSPARENCY · gef · UN environment programme · UN environment programme · copenhagen climate centre

Results of Worksheet 1: CH4 Emissions

CH4 Emissions | CH4 Emissions from Constructed Wetlands | Direct N2O Emissions from Constructed Wetlands | N in Wastewater | Direct N2O Emissions from Treatment Plants | N2O Emissions from Effluent wastewater

Worksheet

Sector: Waste
Category: Wastewater Treatment and Discharge
Subcategory: 4.D.2 - Industrial Wastewater Treatment and Discharge
Sheet: CH4 Emissions from Industrial Wastewater

2010

Data

Equation 6.4, 6.6																		
Subdivision (Region, city, etc.)	Industry sector	Total industry product (t/yr)	Wastewater generated (m3/t)	Chemical Oxygen Demand (kg COD/m3)	Total organic degradable material in wastewater for each industry sector (kg COD/yr)		Sludge removed in each industry sector (kg COD/yr	Weighted Emission Factor (kg CH4/kg COD)			Methane recovered (kg CH4)		CH4 Emissions (kg CH4)	CH4 Emissions (Gg CH4)				
	i	Pi	Wi	CODi		TOWi = Pi * Wi * CODi or specified	Si		WEFi		Flaring Fi	Energy use Ri	Ei = (TOWi - Si) * WEFi - Fi - Ri	Ei / 1000000				
Sub A	Meat & Poultry	5000	13	4.1	Calculated	266500	12	Specified	0.25		0	0	66622	0.06662				
Total																		
						266500					0	0	66622	0.06662				

Results of Worksheet 2: CH4 Emissions from constructed wetlands

CH4 Emissions | CH4 Emissions from Constructed Wetlands | Direct N2O Emissions from Constructed Wetlands | N in Wastewater | Direct N2O Emissions from Treatment Plants | N2O Emissions from Effluent wastewater

Worksheet

Sector: Waste

Category: Wastewater Treatment and Discharge

Subcategory: 4.D.2 - Industrial Wastewater Treatment and Discharge

Sheet: CH4 Emissions from Industrial Wastewater in Constructed Wetlands

2010

Data

Equation 6.1, 6.2, 6.4 WS													
Subdivision	Type of Constructed Wetlands	Industry sector	Chemical Oxygen Demand (kg COD/m3)	Daily flow rate of industrial wastewater (m3/day)	Total Organic Degradable Material from industry i treated in CWj (kg COD/yr)		Maximum methane producing capacity (kg CH4/kg COD)	Methane Correction Factor (Fraction)	Emission Factor (kg CH4/kg COD)		CH4 Emissions (kg CH4)	CH4 Emissions (Gg CH4)	
	j	i	CODi	Wi,j		TOWi,j = CODi * Wi,j * 365 or specified	Bo	MCFj		EFj = Bo * MCFj or specified	Ej = TOWi,j * EFj	Ej / 1000000	
Con. Wetland 1	Surface Flow	Dairy Products	2.7	500	Calculated	492750	0.25	0.4	Calculated	0.1	49275	0.04928	
Total													
						492750					49275	0.04928	

Results of Worksheet 3: Direct N2O Emissions from constructed wetlands

CH4 Emissions | CH4 Emissions from Constructed Wetlands | Direct N2O Emissions from Constructed Wetlands | N in Wastewater | Direct N2O Emissions from Treatment Plants | N2O Emissions from Effluent wastewater

Worksheet

Sector: Waste

Category: Wastewater Treatment and Discharge

Subcategory: 4.D.2 - Industrial Wastewater Treatment and Discharge

Sheet: Direct N2O Emissions from Industrial Wastewater Treated in Constructed Wetlands

2010

Data

Equation 6.5 WS, 6.7 WS															
Subdivision	Type of Constructed Wetlands	Industry sector	Total N concentration in industrial wastewater i treated by constructed wetlands j (kg N/m3)	Yearly flow rate of industrial wastewater treated by constructed wetlands j (m3/yr)				Nitrogen removed with sludge (kg N)	Total nitrogen in effluent (kg N/yr)	Emission Factor (kg N2O-N/kg N)	N2O Emissions (kg N2O)	N2O Emissions (Gg N2O)				
	j	i	TNij		Total industry product i (t/yr) Pij	Wastewater generated (m3/t) WWij	Wij = Pij * WWij or specified	S	Nij = TNij * Wij - S	EFj	E = Nij * EFj * 44/28	E / 10^6				
Con. Wetland 1	Surface Flow	Beer & Malt	0.055	Calculated	1000	6.3	6300	0	346.5	0.0013	0.70785	0				
Total																
									346.5		0.70785	0				

Results of Worksheet 4: N in wastewater

CH4 Emissions | CH4 Emissions from Constructed Wetlands | Direct N2O Emissions from Constructed Wetlands | N in Wastewater | Direct N2O Emissions from Treatment Plants | N2O Emissions from Effluent wastewater

Worksheet

Sector: Waste

Category: Wastewater Treatment and Discharge

Subcategory: 4.D.2 - Industrial Wastewater Treatment and Discharge

Sheet: N in Wastewater

2010

Data

Equation 6.11 (NEW), 6.13 (NEW)

Subdivision	Industry sector	Total N in wastewater from industry (kg N/yr) TNind(i)								
	i		Total industry product (t/yr) Pi	Wastewater generated (m3/t) Wi	Total N concentration in wastewater (kg/m3) TNi	TNind(i) = Pi * Wi * TNi or specified				
Sub A	Beer & Malt	Calculated	1500	6.3	0.055	519.75				
Total										
						519.75				