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GHG Emission Estimation in Waste Sector

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1. Methodology

- The Revised 1996 IPCC Guidelines and the UNFCCC software for use in calculating and estimating emissions (Version 1.3.2, 28 January 2007), the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, etc., were applied.

- Estimation of GHG emissions from waste covers:
  - Solid waste disposal sites and wastewater handling (CH_4), and
  - Human sewage (N_2O)

2. Methane Emission from SWDS (1)

Step 1: Estimate Total Municipal Solid Waste Generated and Disposed of in Solid Waste Disposal Sites.

- Cambodia's total urban population was assumed to be the population whose Waste goes to SWDSs.
- The urban population was 1,067,022 in the year 2000 (CIPS 2004)
- The default value of solid waste generation of 0.27 tonnes/capita/yr, and a default value of 0.59 for the fraction of MSW disposed to SWDSs (The revised 1996 IPCC Guidelines).

➢ The MSW disposed to SWDSs was estimated at 170 Gg in 2000.

2. Methane Emission from SWDS (2)

Step 2: Determine Methane Correction Factors

No national data. The IPCC Guidelines all waste is assumed to be disposed to unmanaged sites, and the IPCC default value for the Methane Correction Factors is 0.6.

Step 3: Estimate Methane Production Rate per Unit of Waste

The IPCC Guidelines default values were used for the following variables:

- The default values of MSW composition were applied.
- The Fraction of Degradable Organic Carbon (DOC) is 0.77
- The Fraction of Carbon Released as Methane is 0.5

2. Methane Emission from SWDS (3)

Step 4: Estimate Total Net Annual Methane Emissions

- The amount of Recovered Methane per Year is zero
- The default value for One Minus the Methane Oxidation Correction Factor (1-0=1) was applied.

➢ Net Annual Methane Emission from SWDS was estimated at 9.69 Gg

3. Methane Emissions from Wastewater Handling (1)

Step 1: Estimate Total Organic Wastewater and Sludge

Following the IPCC Guidelines, *only the urban population is used for the inventory year*.

Since precise national data was not available, the IPCC Guidelines default values were applied :

- 14,600 kg/1000 persons/yr for BOD5
- 0 for the Fraction of Degradable Organic Component Removed as Sludge

Step 2: Estimate of Emission Factors for Domestic/Commercial Wastewater and Sludge Handling Systems

- The IPCC Guidelines (2006) report the following default values for untreated systems:
- 0.1 for sea, river and lake discharge
- 0.3 centralised aerobic treatment plant (not well managed, overloaded)

3. Methane Emissions from Wastewater Handling (2)

Step 3: Estimate Emission Factors for Domestic / Commercial Sludge Handling Systems

– IPCC Guidelines, the Fraction of Degradable Organic Component Removed as Sludge is assumed to be 0.

Step 4: Estimate Methane Emissions from Domestic/ Commercial Wastewater and Sludge

➢ Net CH4 Emissions from domestic/commercial wastewater and sludge is estimated at 0.46 Gg.

4. Methane from Industrial Wastewater and Sludge Streams (1)

Step 1: Estimate Total Organic Wastewater and Sludge

The following IPCC GPG default values were applied:

- Degradable Organic Component: beer (2.9 kg COD/m^3 wastewater), soft drinks (2.0 kg COD/m^3 wastewater), starch (18 kg COD/m^3 wastewater)
- Wastewater Produced per unit product: beer (9 m^3/tonne), soft drinks (2 m^3/tonne), starch (10 m^3/tonne)
- Fraction of Degradable of Degradable Organic Component Removed as Sludge (0)

4. Methane from Industrial Wastewater and Sludge Streams (2)

Step 2: Estimate Emission Factors for Industrial Wastewater Handling Systems

- The industrial wastewater handling system in use in Cambodia consists of Aerobic Shallow Lagoons. The IPCC Guidelines, 80% of industrial wastewater was assumed to be treated, while 20% was left untreated.
- For Methane Conversion Factors, the IPCC 2006 default values 0.1 was applied for untreated discharge, and 0.2 for Anaerobic shallow lagoons. The 1996 IPCC Guidelines default value for the Maximum Methane Producing Capacity for the wastewater of 0.25 kg CH4/kg BOD is inputted.

4. Methane from Industrial Wastewater and Sludge Streams (3)

Step 3: Estimate Emission Factors for Industrial Sludge Handling Systems

- Following the IPCC Guidelines, in the absence of readily available data, the default assumption is that the amount of total emissions from sludge is zero.

Step 4: Estimate Methane Emissions from Industrial Wastewater and Sludge

- There was no methane recovery or flaring facility in Cambodia in the year 2000. Thus, the amount of methane recovered/flared from the industrial wastewater was zero.

➢ Net methane emissions from the selected industrial wastewater were negligible and amounted 0.03 Gg in the year 2000.

5. Nitrous Oxide from Human Sewage

- The protein consumption in Cambodia was estimated about 18.6 kg/capita/year over the period 2001-2003 (FAOSTAT),
- The country population in the year 2000 is provided by the NIS,
- The IPCC default values were applied for the following variables:
  - 0.16 kg N/kg protein for the Fraction of Nitrogen in Protein (FracNPR),
  - 0.01 kg N_2O-N/kg sewage-N produced (EF6),

- As result, the Nitrous Oxide from human sewage was about 0.05 Gg

6. Result

GHG SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O
Total Waste		**10.18**	**0.05**
A Solid Waste Disposal on Land		**9.69**	**0.00**
B Wastewater Handling		**0.49**	**0.05**
1 Domestic & Commercial WW		0.46	0.05
2 Industrial WW		0.03	
3 Other (please specify)			
C Waste Incineration			
D Other (please specify)			

7. Conclusion and Recommendation

Conclusion

- The uncertainty level of waste sector was in medium to high as no regular data collection, lack activity data, no local emission factors,
- An assessment based on urban population estimates and primary data of factory production,

Recommendation

- Establishing and improving waste data base management system,
- Need to have a well define of urban/rural areas,
- Enhancing on desk research activity, institutional arrangement and networking with local, national and international agencies,
- Search for other opportunities s to improve waste inventory.

Thank you!