JICA Climate-FIT
Version 7.0

Appendicies

Table 1 Net Caloric Value of Fuels

TABLE 1.2
DEFAULT NET CALORIFIC VALUES (NCVS) AND LOWER AND UPPER LIMITS OF THE 95% CONFIDENCE INTERVALS [1]

Fuel type English description		Net calorific value (TJ/Gg)	Lower	Upper
Crude Oil		42.3	40.1	44.8
Orimulsion		27.5	27.5	28.3
Natural Gas Liquids		44.2	40.9	46.9
Gasoline	Motor Gasoline	44.3	42.5	44.8
	Aviation Gasoline	44.3	42.5	44.8
	Jet Gasoline	44.3	42.5	44.8
Jet Kerosene		44.1	42.0	45.0
Other Kerosene		43.8	42.4	45.2
Shale Oil		38.1	32.1	45.2
Gas/Diesel Oil		43.0	41.4	43.3
Residual Fuel Oil		40.4	39.8	41.7
Liquefied Petroleum Gases		47.3	44.8	52.2
Ethane		46.4	44.9	48.8
Naphtha		44.5	41.8	46.5
Bitumen		40.2	33.5	41.2
Lubricants		40.2	33.5	42.3
Petroleum Coke		32.5	29.7	41.9
Refinery Feedstocks		43.0	36.3	46.4
Other Oil	Refinery Gas [2]	49.5	47.5	50.6
	Paraffin Waxes	40.2	33.7	48.2
	White Spirit and SBP	40.2	33.7	48.2
	Other Petroleum Products	40.2	33.7	48.2
Anthracite		26.7	21.6	32.2
Coking Coal		28.2	24.0	31.0
Other Bituminous Coal		25.8	19.9	30.5
Sub-Bituminous Coal		18.9	11.5	26.0
Lignite		11.9	5.50	21.6
Oil Shale and Tar Sands		8.9	7.1	11.1
Brown Coal Briquettes		20.7	15.1	32.0
Patent Fuel		20.7	15.1	32.0
Coke	Coke Oven Coke and Lignite Coke	28.2	25.1	30.2
	Gas Coke	28.2	25.1	30.2
Coal Tar [3]		28.0	14.1	55.0
Derived Gases	Gas Works Gas [4]	38.7	19.6	77.0
	Coke Oven Gas [5]	38.7	19.6	77.0
	Blast Furnace Gas [6]	2.47	1.20	5.00
	Oxygen Steel Furnace Gas [7]	7.06	3.80	15.0
Natural Gas		48.0	46.5	50.4
Municipal Wastes (non-biomass fraction)		10	7	18
Industrial Wastes		NA	NA	NA
Waste Oil [8]		40.2	20.3	80.0
Peat		9.76	7.80	12.5

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, IPCC, Volume 2: Energy, Chapter 1: Introduction, Table 1.2

TABLE 1.2 (CONTINUED)
DEFAULT NET CALORIFIC VALUES (NCVS) AND LOWER AND UPPER LIMITS OF THE 95% CONFIDENCE INTERVALS [1]

Fuel type English description		Net calorific value (TJ/Gg)	Lower	Upper
Solid Biofuels	Wood/Wood Waste [9]	15.6	7.90	31.0
	Sulphite lyes (black liquor) [10]	11.8	5.90	23.0
	Other Primary Solid Biomass [11]	11.6	5.90	23.0
	Charcoal [12]	29.5	14.9	58.0
Liquid Biofuels	Biogasoline [13]	27.0	13.6	54.0
	Biodiesels [14]	27.0	13.6	54.0
	Other Liquid Biofuels [15]	27.4	13.8	54.0
Gas Biomass	Landfill Gas [16]	50.4	25.4	100
	Sludge Gas [17]	50.4	25.4	100
	Other Biogas [18]	50.4	25.4	100
Other non-fossil fuels	Municipal Wastes (biomass fraction)	11.6	6.80	18.0

Notes:

[1] The lower and upper limits of the 95 percent confidence intervals, assuming lognormal distributions, fitted to a dataset, based on national inventory reports, IEA data and available national data. A more detailed description is given in section 1.5.

[2] Japanese data; uncertainty range: expert judgement

[3] EFDB; uncertainty range: expert judgement

[4] Coke Oven Gas; uncertainty range: expert judgement

[5-7] Japan and UK small number data; uncertainty range: expert judgement

[8] For waste oils the values of "Lubricants" are taken

[9] EFDB; uncertainty range: expert judgement

[10] Japanese data ; uncertainty range: expert judgement

[11] Solid Biomass; uncertainty range: expert judgement

[12] EFDB; uncertainty range: expert judgement

[13-14] Ethanol theoretical number; uncertainty range: expert judgement;

[15] Liquid Biomass; uncertainty range: expert judgement

[16-18] Methane theoretical number uncertainty range: expert judgement;

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, IPCC, Volume 2: Energy, Chapter 1: Introduction, Table 1.2

Table 2 CO_2 Emission Factors of Fuels

TABLE 1.4
DEFAULT CO_2 EMISSION FACTORS FOR COMBUSTION [1]

Fuel type English description		Default carbon content (kg/GJ)	Default carbon oxidation factor	Effective CO_2 emission factor (kg/TJ) [2]		
				Default value [3]	95% confidence interval	
		A	B	C=A*B*44/12*1000	Lower	Upper
Crude Oil		20.0	1	73 300	71 100	75 500
Orimulsion		21.0	1	77 000	69 300	85 400
Natural Gas Liquids		17.5	1	64 200	58 300	70 400
Gasoline	Motor Gasoline	18.9	1	69 300	67 500	73 000
Gasoline	Aviation Gasoline	19.1	1	70 000	67 500	73 000
Gasoline	Jet Gasoline	19.1	1	70 000	67 500	73 000
Jet Kerosene		19.5	1	71 500	69 700	74 400
Other Kerosene		19.6	1	71 900	70 800	73 700
Shale Oil		20.0	1	73 300	67 800	79 200
Gas/Diesel Oil		20.2	1	74 100	72 600	74 800
Residual Fuel Oil		21.1	1	77 400	75 500	78 800
Liquefied Petroleum Gases		17.2	1	63 100	61 600	65 600
Ethane		16.8	1	61 600	56 500	68 600
Naphtha		20.0	1	73 300	69 300	76 300
Bitumen		22.0	1	80 700	73 000	89 900
Lubricants		20.0	1	73 300	71 900	75 200
Petroleum Coke		26.6	1	97 500	82 900	115 000
Refinery Feedstocks		20.0	1	73 300	68 900	76 600
Other Oil	Refinery Gas	15.7	1	57 600	48 200	69 000
Other Oil	Paraffin Waxes	20.0	1	73 300	72 200	74 400
Other Oil	White Spirit & SBP	20.0	1	73 300	72 200	74 400
Other Petroleum Products		20.0	1	73 300	72 200	74 400
Anthracite		26.8	1	98 300	94 600	101 000
Coking Coal		25.8	1	94 600	87 300	101 000
Other Bituminous Coal		25.8	1	94 600	89 500	99 700
Sub-Bituminous Coal		26.2	1	96 100	92 800	100 000
Lignite		27.6	1	101 000	90 900	115 000
Oil Shale and Tar Sands		29.1	1	107 000	90 200	125 000
Brown Coal Briquettes		26.6	1	97 500	87 300	109 000
Patent Fuel		26.6	1	97 500	87 300	109 000
Coke	Coke oven coke and lignite Coke	29.2	1	107 000	95 700	119 000
Coke	Gas Coke	29.2	1	107 000	95 700	119 000
Coal Tar		22.0	1	80 700	68 200	95 300
Derived Gases	Gas Works Gas	12.1	1	44 400	37 300	54 100
Derived Gases	Coke Oven Gas	12.1	1	44 400	37 300	54 100
Derived Gases	Blast Furnace Gas [4]	70.8	1	260 000	219 000	308 000
Derived Gases	Oxygen Steel Furnace Gas [5]	49.6	1	182 000	145 000	202 000

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, IPCC, Volume 2: Energy, Chapter 1: Introduction, Table 1.4

TABLE 1.4 (CONTINUED)
DEFAULT CO_2 EMISSION FACTORS FOR COMBUSTION [1]

Fuel type English description		Default carbon content (kg/GJ)	Default carbon oxidation Factor	Effective CO_2 emission factor (kg/TJ) [2]		
				Default value	95% confidence interval	
		A	B	C=A*B*44/12*1000	Lower	Upper
Natural Gas		15.3	1	56 100	54 300	58 300
Municipal Wastes (non-biomass fraction)		25.0	1	91 700	73 300	121 000
Industrial Wastes		39.0	1	143 000	110 000	183 000
Waste Oil		20.0	1	73 300	72 200	74 400
Peat		28.9	1	106 000	100 000	108 000
Solid Biofuels	Wood/Wood Waste	30.5	1	112 000	95 000	132 000
	Sulphite lyes (black liquor)[5]	26.0	1	95 300	80 700	110 000
	Other Primary Solid Biomass	27.3	1	100 000	84 700	117 000
	Charcoal	30.5	1	112 000	95 000	132 000
Liquid Biofuels	Biogasoline	19.3	1	70 800	59 800	84 300
	Biodiesels	19.3	1	70 800	59 800	84 300
	Other Liquid Biofuels	21.7	1	79 600	67 100	95 300
Gas biomass	Landfill Gas	14.9	1	54 600	46 200	66 000
	Sludge Gas	14.9	1	54 600	46 200	66 000
	Other Biogas	14.9	1	54 600	46 200	66 000
Other non-fossil fuels	Municipal Wastes (biomass fraction)	27.3	1	100 000	84 700	117 000

Notes:

[1] The lower and upper limits of the 95 percent confidence intervals, assuming lognormal distributions, fitted to a dataset, based on national inventory reports, IEA data and available national data. A more detailed description is given in section 1.5

[2] TJ = 1000GJ

[3] The emission factor values for BFG includes carbon dioxide originally contained in this gas as well as that formed due to combustion of this gas.

[4] The emission factor values for OSF includes carbon dioxide originally contained in this gas as well as that formed due to combustion of this gas

[5] Includes the biomass-derived CO_2 emitted from the black liquor combustion unit and the biomass-derived CO_2 emitted from the kraft mill lime kiln.

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, IPCC, Volume 2: Energy, Chapter 1: Introduction, Table 1.4

Table 3 Grid Emission Factors

Choose appropriate value of the target country taking into account types of the project such as firm energy (hydro, geothermal etc.), intermittent energy (solar, wind, tidal, etc.), energy efficiency and electricity consumption. In case the updated version of emission factors is provided by IFI TWG (The Technical Working Group of the International Financial Institutions), apply these values.

($t\text{-}CO_2/MWh$)

	Combined Margin Grid Emission Factor				Operating Margin Grid Emission Factor (including for use in PCAF GHG accounting)
	Firm Energy (e.g., Hydro, Geothermal)	Intermittent Energy (e.g., Solar, Wind, Tidal)	Energy Efficiency	Electricity Consumption	
Country / Territory / Island					
Afghanistan	0.193	0.331	0.193	0.193	0.414
Albania	0.000	0.000	0.000	0.000	0.000
Algeria	0.397	0.479	0.397	0.397	0.528
American Samoa (U.S.)	0.516	0.664	0.516	0.516	0.753
Andorra	0.070	0.144	0.070	0.070	0.188
Angola	0.748	1.203	0.748	0.748	1.476
Anguilla (U.K.)	0.472	0.647	0.472	0.472	0.753
Antigua and Barbuda	0.489	0.654	0.489	0.489	0.753
Argentina	0.288	0.407	0.288	0.288	0.478
Armenia	0.205	0.321	0.205	0.205	0.390
Aruba	0.421	0.628	0.421	0.421	0.753
Australia	0.421	0.663	0.421	0.421	0.808
Austria	0.113	0.194	0.113	0.113	0.242
Azerbaijan	0.384	0.478	0.384	0.384	0.534
Azores (Portugal)	0.384	0.614	0.384	0.384	0.753
Bahamas	0.441	0.636	0.441	0.441	0.753
Bahrain	0.454	0.624	0.454	0.454	0.726
Bangladesh	0.412	0.484	0.412	0.412	0.528
Barbados	0.484	0.650	0.484	0.484	0.749
Belarus	0.292	0.359	0.292	0.292	0.400
Belgium	0.124	0.204	0.124	0.124	0.252
Belize	0.183	0.320	0.183	0.183	0.403
Benin	0.576	0.682	0.576	0.576	0.745
Bermuda (U.K.)	0.342	0.598	0.342	0.342	0.753
Bhutan	0.000	0.000	0.000	0.000	0.000
Bolivia, Plurinational State of	0.393	0.525	0.393	0.393	0.604
Bonaire (Netherland)	0.400	0.620	0.400	0.400	0.753
Bosnia and Herzegovina	0.739	1.025	0.739	0.739	1.197
Botswana	1.070	1.330	1.070	1.070	1.486
Brazil	0.150	0.234	0.150	0.150	0.284
British Virgin Islands (U.K.)	0.420	0.628	0.420	0.420	0.753
Brunei Darussalam	0.407	0.578	0.407	0.407	0.681
Bulgaria	0.495	0.755	0.495	0.495	0.911
Burkina Faso	0.539	0.672	0.539	0.539	0.753
Burundi	0.197	0.333	0.197	0.197	0.414
Cambodia	0.588	0.874	0.588	0.588	1.046
Cameroon	0.354	0.545	0.354	0.354	0.659
Canada	0.213	0.312	0.213	0.213	0.372
Canary Islands (Spain)	0.435	0.633	0.435	0.435	0.753
Cape Verde	0.505	0.660	0.505	0.505	0.753
Cayman Islands	0.373	0.610	0.373	0.373	0.753
Central African Republic	0.077	0.146	0.077	0.077	0.188
Chad	0.581	0.688	0.581	0.581	0.753
Channel Islands (U.K)	0.389	0.616	0.389	0.389	0.753
Chile	0.235	0.499	0.235	0.235	0.657
China (PRC and Hong Kong)	0.485	0.744	0.485	0.485	0.899
Colombia	0.208	0.334	0.208	0.208	0.410
Comoros	0.589	0.691	0.589	0.589	0.753
Congo, Democratic Republic of	0.000	0.000	0.000	0.000	0.000
Congo, Republic of	0.405	0.564	0.405	0.405	0.659

	Combined Margin Grid Emission Factor				Operating Margin Grid Emission Factor (including for use in PCAF GHG accounting)
	Firm Energy (e.g., Hydro, Geothermal)	Intermittent Energy (e.g., Solar, Wind, Tidal)	Energy Efficiency	Electricity Consumption	
Cook Islands	0.422	0.628	0.422	0.422	0.753
Costa Rica	0.039	0.082	0.039	0.039	0.108
Côte d'Ivoire	0.314	0.409	0.314	0.314	0.466
Croatia	0.168	0.247	0.168	0.168	0.294
Cuba	0.391	0.496	0.391	0.391	0.559
Curacao/Netherlands Antilles	0.506	0.737	0.506	0.506	0.876
Cyprus	0.438	0.633	0.438	0.438	0.751
Czech Republic	0.461	0.736	0.461	0.461	0.902
Denmark	0.155	0.284	0.155	0.155	0.362
Djibouti	0.575	0.686	0.575	0.575	0.753
Dominica	0.433	0.633	0.433	0.433	0.753
Dominican Republic	0.426	0.536	0.426	0.426	0.601
Ecuador	0.280	0.455	0.280	0.280	0.560
Egypt	0.406	0.498	0.406	0.406	0.554
El Salvador	0.275	0.445	0.275	0.275	0.547
Equatorial Guinea	0.361	0.531	0.361	0.361	0.632
Eritrea	0.704	0.836	0.704	0.704	0.915
Estonia	0.625	0.895	0.625	0.625	1.057
Eswatini	0.000	0.000	0.000	0.000	0.000
Ethiopia	0.000	0.000	0.000	0.000	0.000
Falkland Islands (U.K.)	0.316	0.589	0.316	0.316	0.753
Faroe Islands (Denmark)	0.320	0.590	0.320	0.320	0.753
Fiji	0.334	0.525	0.334	0.334	0.640
Finland	0.114	0.209	0.114	0.114	0.267
France	0.068	0.124	0.068	0.068	0.158
French Guiana	0.200	0.340	0.200	0.200	0.423
French Polynesia	0.412	0.625	0.412	0.412	0.753
Gabon	0.533	0.791	0.533	0.533	0.946
Gambia	0.591	0.692	0.591	0.591	0.753
Georgia	0.135	0.231	0.135	0.135	0.289
Germany	0.313	0.523	0.313	0.313	0.650
Ghana	0.276	0.413	0.276	0.276	0.495
Gibraltar (U.K.)	0.369	0.625	0.369	0.369	0.779
Greece	0.346	0.447	0.346	0.346	0.507
Greenland	0.105	0.204	0.105	0.105	0.264
Grenada	0.523	0.666	0.523	0.523	0.753
Guadeloupe (France)	0.433	0.633	0.433	0.433	0.753
Guam	0.428	0.631	0.428	0.428	0.753
Guatemala	0.427	0.659	0.427	0.427	0.798
Guinea	0.460	0.643	0.460	0.460	0.753
Guinea-Bissau	0.577	0.687	0.577	0.577	0.753
Guyana	0.616	0.760	0.616	0.616	0.847
Haiti	0.765	0.942	0.765	0.765	1.048
Honduras	0.359	0.548	0.359	0.359	0.662
Hungary	0.191	0.257	0.191	0.191	0.296
Iceland	0.000	0.000	0.000	0.000	0.000
India	0.608	0.822	0.608	0.608	0.951
Indonesia	0.675	0.743	0.675	0.675	0.783
Iran, Islamic Republic of	0.421	0.528	0.421	0.421	0.592
Iraq	0.788	0.971	0.788	0.788	1.080
Ireland	0.189	0.309	0.189	0.189	0.380
Isle of Man (U.K.)	0.204	0.349	0.204	0.204	0.436
Israel	0.258	0.343	0.258	0.258	0.394
Italy	0.224	0.343	0.224	0.224	0.414
Jamaica	0.498	0.631	0.498	0.498	0.711
Japan	0.408	0.448	0.408	0.408	0.471
Jordan	0.382	0.474	0.382	0.382	0.529

	Combined Margin Grid Emission Factor				Operating Margin Grid Emission Factor (including for use in PCAF GHG accounting)
	Firm Energy (e.g., Hydro, Geothermal)	Intermittent Energy (e.g., Solar, Wind, Tidal)	Energy Efficiency	Electricity Consumption	
Kazakhstan	0.532	0.698	0.532	0.532	0.797
Kenya	0.274	0.462	0.274	0.274	0.574
Kiribati	0.530	0.669	0.530	0.530	0.753
Korea (North), Democratic People's Republic of	0.359	0.606	0.359	0.359	0.754
Korea (South), Republic of	0.335	0.473	0.335	0.335	0.555
Kosovo	0.843	1.032	0.843	0.843	1.145
Kuwait	0.400	0.572	0.400	0.400	0.675
Kyrgyzstan	0.098	0.172	0.098	0.098	0.217
Lao People's Democratic Republic	0.555	0.876	0.555	0.555	1.069
Latvia	0.117	0.194	0.117	0.117	0.240
Lebanon	0.567	0.709	0.567	0.567	0.794
Lesotho	0.000	0.000	0.000	0.000	0.000
Liberia	0.374	0.564	0.374	0.374	0.677
Libya	0.493	0.602	0.493	0.493	0.668
Liechtenstein	0.052	0.114	0.052	0.052	0.151
Lithuania	0.102	0.170	0.102	0.102	0.211
Luxembourg	0.095	0.173	0.095	0.095	0.220
Madagascar	0.567	0.760	0.567	0.567	0.876
Madeira (Portugal)	0.369	0.552	0.369	0.369	0.663
Malawi	0.243	0.397	0.243	0.243	0.489
Malaysia	0.436	0.508	0.436	0.436	0.551
Maldives	0.524	0.667	0.524	0.524	0.753
Mali	0.623	0.906	0.623	0.623	1.076
Malta	0.295	0.435	0.295	0.295	0.520
Marshall Islands	0.561	0.681	0.561	0.561	0.753
Martinique (France)	0.406	0.623	0.406	0.406	0.753
Mauritania	0.513	0.663	0.513	0.513	0.753
Mauritius	0.543	0.641	0.543	0.543	0.700
Mayotte (France)	0.512	0.662	0.512	0.512	0.753
Mexico	0.359	0.467	0.359	0.359	0.531
Micronesia	0.557	0.679	0.557	0.557	0.753
Moldova, Republic of	0.399	0.488	0.399	0.399	0.541
Monaco	0.068	0.124	0.068	0.068	0.158
Mongolia	1.002	1.230	1.002	1.002	1.366
Montenegro	0.471	0.739	0.471	0.471	0.899
Montserrat	0.517	0.664	0.517	0.517	0.753
Morocco	0.547	0.660	0.547	0.547	0.729
Mozambique	0.111	0.188	0.111	0.111	0.234
Myanmar	0.407	0.602	0.407	0.407	0.719
Namibia	0.139	0.274	0.139	0.139	0.355
Nauru	0.521	0.666	0.521	0.521	0.753
Nepal	0.000	0.000	0.000	0.000	0.000
Netherlands	0.203	0.280	0.203	0.203	0.326
New Caledonia (France)	0.445	0.654	0.445	0.445	0.779
New Zealand	0.108	0.194	0.108	0.108	0.246
Nicaragua	0.372	0.562	0.372	0.372	0.675
Niger	0.718	0.752	0.718	0.718	0.772
Nigeria	0.358	0.463	0.358	0.358	0.526
Niue	0.459	0.642	0.459	0.459	0.753
North Macedonia, Republic of	0.563	0.743	0.563	0.563	0.851
Northern Mariana Islands (U.S.)	0.416	0.626	0.416	0.416	0.753
Norway	0.017	0.036	0.017	0.017	0.047
Oman	0.320	0.419	0.320	0.320	0.479
Pakistan	0.386	0.515	0.386	0.386	0.592
Palau	0.497	0.657	0.497	0.497	0.753
Palestinian Authority	0.517	0.643	0.517	0.517	0.719

	Combined Margin Grid Emission Factor				Operating Margin Grid Emission Factor (including for use in PCAF GHG accounting)
	Firm Energy (e.g., Hydro, Geothermal)	Intermittent Energy (e.g., Solar, Wind, Tidal)	Energy Efficiency	Electricity Consumption	
Panama	0.230	0.385	0.230	0.230	0.477
Papua New Guinea	0.315	0.491	0.315	0.315	0.597
Paraguay	0.000	0.000	0.000	0.000	0.000
Peru	0.252	0.390	0.252	0.252	0.473
Philippines	0.525	0.617	0.525	0.525	0.672
Poland	0.532	0.717	0.532	0.532	0.828
Portugal	0.228	0.329	0.228	0.228	0.389
Puerto Rico (U.S.)	0.362	0.508	0.362	0.362	0.596
Qatar	0.258	0.411	0.258	0.258	0.503
Reunion (France)	0.421	0.641	0.421	0.421	0.772
Romania	0.289	0.414	0.289	0.289	0.489
Russian Federation	0.360	0.432	0.360	0.360	0.476
Rwanda	0.416	0.601	0.416	0.416	0.712
Saint Helena (U.K.)	0.456	0.641	0.456	0.456	0.753
Saint Kitts and Nevis	0.477	0.649	0.477	0.477	0.753
Saint Lucia	0.521	0.666	0.521	0.521	0.753
Saint Martin (France)	0.484	0.652	0.484	0.484	0.753
Saint Pierre and Miquelon (France)	0.415	0.626	0.415	0.415	0.753
Saint Vincent and Grenadines	0.499	0.658	0.499	0.499	0.753
Samoa	0.434	0.633	0.434	0.434	0.753
San Marino	0.224	0.343	0.224	0.224	0.414
Sao Tomé & Principe	0.565	0.682	0.565	0.565	0.753
Saudi Arabia	0.374	0.510	0.374	0.374	0.592
Senegal	0.656	0.790	0.656	0.656	0.870
Serbia	0.678	0.933	0.678	0.678	1.086
Seychelles	0.479	0.650	0.479	0.479	0.753
Sierra Leone	0.246	0.398	0.246	0.246	0.489
Singapore	0.200	0.311	0.200	0.200	0.379
Sint Martin (Netherlands)	0.463	0.644	0.463	0.463	0.753
Slovak Republic	0.164	0.269	0.164	0.164	0.332
Slovenia	0.285	0.494	0.285	0.285	0.620
Solomon Islands	0.563	0.681	0.563	0.563	0.753
Somalia	0.582	0.689	0.582	0.582	0.753
South Africa	0.786	0.964	0.786	0.786	1.070
South Sudan	0.704	0.820	0.704	0.704	0.890
Spain	0.209	0.329	0.209	0.209	0.402
Sri Lanka	0.506	0.646	0.506	0.506	0.731
Sudan	0.398	0.609	0.398	0.398	0.736
Suriname	0.565	0.855	0.565	0.565	1.029
Sweden	0.025	0.052	0.025	0.025	0.068
Switzerland	0.020	0.038	0.020	0.020	0.048
Syrian Arab Republic	0.546	0.650	0.546	0.546	0.713
Taiwan (Chinese Taipei)	0.331	0.427	0.331	0.331	0.484
Tajikistan	0.106	0.199	0.106	0.106	0.255
Tanzania, United Republic of	0.336	0.458	0.336	0.336	0.531
Thailand	0.351	0.413	0.351	0.351	0.450
Timor-Leste	0.589	0.691	0.589	0.589	0.753
Togo	0.597	0.761	0.597	0.597	0.859
Tonga	0.533	0.670	0.533	0.533	0.753
Trinidad and Tobago	0.370	0.488	0.370	0.370	0.559
Tunisia	0.348	0.423	0.348	0.348	0.468
Turkey	0.309	0.351	0.309	0.309	0.376
Turkmenistan	0.676	0.833	0.676	0.676	0.927
Turks and Caicos Islands (U.K.)	0.451	0.639	0.451	0.451	0.753
Tuvalu	0.497	0.657	0.497	0.497	0.753
Uganda	0.116	0.218	0.116	0.116	0.279
Ukraine	0.435	0.643	0.435	0.435	0.768

	Combined Margin Grid Emission Factor				Operating Margin Grid Emission Factor (including for use in PCAF GHG accounting)
	Firm Energy (e.g., Hydro, Geothermal)	Intermittent Energy (e.g., Solar, Wind, Tidal)	Energy Efficiency	Electricity Consumption	
United Arab Emirates	0.310	0.464	0.310	0.310	0.556
United Kingdom	0.219	0.320	0.219	0.219	0.380
United States	0.246	0.352	0.246	0.246	0.416
Uruguay	0.065	0.133	0.065	0.065	0.174
Uzbekistan	0.467	0.558	0.467	0.467	0.612
Vanatu	0.504	0.659	0.504	0.504	0.753
Venezuela, Bolivarian Republic of	0.368	0.582	0.368	0.368	0.711
Viet Nam	0.381	0.493	0.381	0.381	0.560
Virgin Islands (U.S.)	0.373	0.546	0.373	0.373	0.650
Yemen	0.615	0.735	0.615	0.615	0.807
Zambia	0.197	0.334	0.197	0.197	0.416
Zimbabwe	0.880	1.315	0.880	0.880	1.575
Note 1: For methodology and sources used to derive the default emission factors, please refer to the document "AHG-001: Methodological Approach for the Common Default Grid Emission Factor Dataset". Note 2: Partnership for Carbon Accounting Financials (PCAF) is a global partnership of financial institutions that work together to develop and implement a harmonized approach to assess and disclose the GHG emissions associated with their loans and investments. https://carbonaccountingfinancials.com/					

Source: Harmonized IFI Default Grid Factors 2022 v3.2. IFI TWG (The Technical Working Group of the International Financial Institutions).
https://unfccc.int/climate-action/sectoral-engagement/ifis-harmonization-of-standards-for-ghg-accounting/ifi-twg-list-of-methodologies

Table 4 CO_2 Emission Factors for Standalone Power Generation

Table 2. Emission factors for diesel generator systems (in kg CO2e/kWh[(a)]) for three different levels of load factors[(b)]

Cases	Mini-grid with 24 hour service	(a) Mini-grid with temporary service (4-6 hr/day); (b) Productive applications; (c) Water pumps	Mini-grid with storage
Load factors [%]	**25%**	**50%**	**100%**
<15 kW	2.4	1.4	1.2
>=15 <35 kW	1.9	1.3	1.1
>=35 <135 kW	1.3	1.0	1.0
>=135<200 kW	0.9	0.8	0.8
> 200 kW[(c)]	0.8	0.8	0.8

(a) A conversion factor of 3.2 kg CO_2 per kg of diesel has been used (following revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories);

(b) Values derived from figures reported in RETScreen International's PV 2000 model retrieved from: <http://retscreen.net/>;

(c) Default values.

Source: Small Scale CDM Methodology: AMS I.F. ver.3

Table 5 Default Values of Boiler Efficiencies

Table 1: Default baseline efficiency for different technologies

Technology of the energy generation system	Default efficiency
New natural gas fired boiler (w/o condenser)	92%
New oil fired boiler	90%
Old natural gas fired boiler (w/o condenser)	87%
New coal fired boiler	85%
Old oil fired boiler	85%
Old coal fired boiler	80%

Source: CDM Tool to determine the baseline efficiency of thermal or electric energy generation systems, ver.1

Table 6 CO_2 Emission Factors for Different Transport Modes

CO_2 emission factors per km (g-CO_2/km)

Vehicle Type	Emission Factors
Car	304.1
2-Wheeler	45.9
3-Wheeler	125.2
Taxi	290.6
Bus	1337.9
Jeepney/RTV	420.5

Source: Manual for Calculating Greenhouse Gas Benefits of Global Environment Facility Transportation Projects (GEF, 2012)

CO_2 emission factors per passenger km (g-CO_2/passenger-km)

Vehicle Type	Emission Factors
Passenger car	130
Aviation	98
Bus	57
Railway	17
Motorbike	50

Source: MLIT Ministry of Land, Infrastructure, Transport and Tourism, Japan (FY2019). Sustainable Transport : A Sourcebook for Policy-makers in Developing Cities (GTZ, 2007)

Table 7 CO_2 Emission Factors in g-CO_2/t-km for Different Transport Modes

Vehicle Type		Emission Factors
Road	Commercial standard sized vehicles	173
	Commercial small size vehicles	808
	Commercial small mini vehicles	1,951
	Private standard sized vehicles	394
	Private small size vehicles	3,443
Railway		22
Domestic vessels		39
Domestic airway		1,490

Source: CO_2 Emission Estimation Guideline for Logistics, Version 3.1, METI and MLIT, Japan

Type of cargo transported	**Emission factor (g CO_2/tonne.km)**
Agricultural products and live animals	83
Beverage	61
Groceries	76
Perishable and semi-perishable foodstuff and canned food	94
Other food products and fodder	74
Solid mineral fuels and petroleum products	76
Ores and metal waste	90
Metal products	80
Mineral products	57
Other crude and manufactured minerals and building materials	70
Fertilizers	76
Chemicals	70
Transport equipment	100
Machinery and metal products	119
Glass and ceramic and porcelain products	84
Grouped goods	94
Other manufactured articles	113

Source: Approved baseline and monitoring methodology AM0090: Modal shift in transportation of cargo from road transportation to water or rail transportation.

Table 8 (1) Fraction of degradable organic carbon by waste type (DOC_j)

Waste type *j*	**DOC_j (% wet waste)**
Wood and wood products	43
Pulp, paper and cardboard (other than sludge)	40
Food, food waste, beverages and tobacco (other than sludge)	15
Textiles	24
Garden, yard and park waste	20
Glass, plastic, metal, other inert waste	0

Source: CDM Methodological Tool: Emissions from solid waste disposal sites [version 8.1] (original source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, IPCC, Volume 5, Table 2.4 and 2.5)

Table 8 (2) Fraction of degradable organic carbon which decomposes by waste type ($DOC_{f,j}$)

TABLE 3.0 (NEW)
FRACTION OF DEGRADABLE ORGANIC CARBON WHICH DECOMPOSES (DOC_F) FOR DIFFERENT WASTE TYPES

Type of Waste	**Recommended Default DOC_f Values**	**Remark**
Less decomposable wastes e.g. wood, engineered wood products, tree branches (wood)	0.1	An average value of 0.088 was derived from DOC_f values for engineered wood products, sawn woods, tree branches reported in 3 references[1-3]
Moderately decomposable wastes e.g. paper, textile, nappies	0.5	An average value of 0.523 was derived from DOC_f values for paper products, textile and nappies reported in 4 references[4-7].
Highly decomposable wastes, e.g. food wastes, grasses (garden and park waste excluding tree branches)	0.7	An average value of 0.706 was derived from DOC_f values for food wastes and grasses reported in 3 references[4-6]
Bulk waste*	0.5	

[1] Wang *et al.* (2011); [2]Wang and Barlaz (2016); [3] Ximenes *et al.* (2018); [4]Eleazer *et al.* (1997); [5]Bayard *et al.* (2017); [6]Jeong (2016); [7]Wang *et al.* (2015)

* It is used when the fractions of less, moderately and highly decomposable wastes in MSW are not known.

Source: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5, Table 3.0 (New)

Table 9(1) Methane Correction Factor (for SWDS)

TABLE 3.1 (UPDATED)
SWDS CLASSIFICATION AND METHANE CORRECTION FACTORS (MCF)

Type of Site	Methane Correction Factor (MCF) Default Values	Remarks
Managed – anaerobic	1.0[a]	These must have controlled placement of waste (i.e., waste directed to specific deposition areas, a degree of control of scavenging and a degree of control of fires) and will include at least one of the following: (i) cover material; (ii) mechanical compacting; or (iii) levelling of the waste.
Managed well – semi-aerobic	0.5[b]	When semi-aerobic managed SWDS type is managed under one of the following condition, it is regarded as well magement ; (i) permeable cover material; (ii) leachate drainage system without sunk; (iii) regulating pondage; and (iv) gas ventilation system without cap, (v) connection of leachate drainage system and gas ventilation system.
Managed poorly – semi-aerobic	0.7[c]	When semi-aerobic managed SWDS type is managed under one of the following condition, it is regarded as poor management; (i) condition of sunk of leachate drainage system; (ii) closing of valve of drainage or atmosphere-unopening of drainage exit; (iii) capping of gas ventilation exit.
Managed well – active-aeration	0.4[d,e,f]	Active aeration of managed landfills includes the technology of in-situ low pressure aeration, air sparging, bioventing, passive ventilation with extraction (suction). These must have controlled placement of waste and will include leachate drainage system to avoid the blockage of air penetration, and (i) cover material; (ii) air injection or gas extraction system without drying of waste.
Managed poorly – active-aeration	0.7[f,g,h]	When SWDS, that is equipped as well as active aeration of managed SWDS, is managed under one of the following condition, it is judged as poor management; (i) blockage of aeration system due to failure of drainage; (ii) lack of available moisture for microorganisms due to high- pressure aeration.
Unmanaged – deep (>5 m waste) and /or high water table	0.8 [a]	All SWDS not meeting the criteria of managed SWDS and which have depths of greater than or equal to 5 metres and/or high water table at near ground level. Latter situation corresponds to filling inland water, such as pond, river or wetland, by waste.
Unmanaged – shallow (<5 m waste)	0.4 [a]	All SWDS not meeting the criteria of managed SWDS and which have depths of less than 5 metres.
Uncategorised SWDS	0.6 [a]	Only if countries cannot categorise their SWDS into above four categories of managed and unmanaged SWDS, the MCF for this category can be used.

Sources: [a]IPCC (2000); [b]Matsufuji *et al*. (1996); [c]Yamada *et al*. (2013); [d]Hrad *et al*. (2013); [e]Ishigaki *et al*. (2003); [f]Ritzkowski & Stegmann (2013); [g]Raga & Cossu (2014); [h]Ritzkowski *et al*. (2016)

Source: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5, Table 3.1 (Updated)

Table 9(2) Methane Correction Factor (for wastewater)

Type of wastewater treatment and discharge pathway or system	***MCF* value**
Discharge of wastewater to sea, river or lake	0.1
Land application	0.1
Aerobic treatment, well managed	0.0
Aerobic treatment, poorly managed or overloaded	0.3
Anaerobic digester for sludge without methane recovery	0.8
Anaerobic reactor without methane recovery	0.8
Anaerobic shallow lagoon (depth less than 2 metres)	0.2
Anaerobic deep lagoon (depth more than 2 metres)	0.8
Septic system	0.5
Land application[(a)]	0.1

(a) Please refer SSC_664, "Clarification on methane correction factors for treated water used for irrigation under AMS-III.H ver. 16".

Source: CDM Methodology: AMS-III.H. Methane recovery in wastewater treatment [Version 19.0]

Table 10 Decay Rates of Wastes

Waste type *j*		**Boreal and Temperate (MAT≤20°C)**		**Tropical (MAT>20°C)**	
		Dry (MAP/PET <1)	Wet (MAP/PET >1)	Dry (MAP< 1000mm)	Wet (MAP> 1000mm)
Slowly degrading	Pulp, paper, cardboard (other than sludge), textiles	0.04	0.06	0.045	0.07
	Wood, wood products and straw	0.02	0.03	0.025	0.035
Moderately degrading	Other (non-food) organic putrescible garden and park waste	0.05	0.10	0.065	0.17
Rapidly degrading	Food, food waste, sewage sludge, beverages and tobacco	0.06	0.185	0.085	0.40

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, IPCC, Volume 5, Table 3.3

Table 11 Degradable Organic Content of the Untretaed Sludge

Sludge type		Default DOC(-)	
		Wet matter	Dry matter
Domestic sludge		0.05	0.50
Industrial sludge	Rough default	0.09	0.35
	Pulp and paper industry	-	0.27
	Food industry	-	0.30
	Chemical industry	-	0.52

Source: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 5: Waste, p.2.13

Table 12 Default Quantity of Waste Disposed in the SWDS (W_y)

TABLE 2.1
MSW GENERATION AND TREATMENT DATA - REGIONAL DEFAULTS

Region	MSW Generation Rate[1, 2, 3] (tonnes/cap/yr)	Fraction of MSW disposed to SWDS	Fraction of MSW incinerated	Fraction of MSW composted	Fraction of other MSW management, unspecified[4]
Asia					
Eastern Asia	0.37	0.55	0.26	0.01	0.18
South-Central Asia	0.21	0.74	-	0.05	0.21
South-East Asia	0.27	0.59	0.09	0.05	0.27
Africa[5]	0.29	0.69	-	-	0.31
Europe					
Eastern Europe	0.38	0.90	0.04	0.01	0.02
Northern Europe	0.64	0.47	0.24	0.08	0.20
Southern Europe	0.52	0.85	0.05	0.05	0.05
Western Europe	0.56	0.47	0.22	0.15	0.15
America					
Caribbean	0.49	0.83	0.02	-	0.15
Central America	0.21	0.50	-	-	0.50
South America	0.26	0.54	0.01	0.003	0.46
North America	0.65	0.58	0.06	0.06	0.29
Oceania[6]	0.69	0.85	-	-	0.15

[1] Data are based on weight of wet waste.

[2] To obtain the total waste generation in the country, the per-capita values should be multiplied with the population whose waste is collected. In many countries, especially developing countries, this encompasses only urban population.

[3] The data are default data for the year 2000, although for some countries the year for which the data are applicable was not given in the reference, or data for the year 2000 were not available. The year for which the data are collected, where available, is given in the Annex 2A.1.

[4] Other, unspecified, includes data on recycling for some countries.

[5] A regional average is given for the whole of Africa as data are not available for more detailed regions within Africa.

[6] Data for Oceania are based only on data from Australia and New Zealand.

Source:2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 5 Waste Table2.1

Table 13 Global Warming Potential (GWP) of Major Greenhouse Gases

Name	Chemical formula	GWP-100
Carbon dioxide	CO_2	1
Methane	CH_4	27.9
Nitrous oxide	N_2O	273
Sulfur hexafluoride	SF_6	24,300

Note: For the GWP of GHGs other than those listed above, refer to Table 7.SM.7 in the source below.
Source : The Earth's Energy Budget, Climate Feedbacks, and Climate Sensitivity Supplementary Material. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

Table 14 CH_4 emission factor for sewage treatment

Facility type	Emission factor (tCH_4/ m^3)
Sewage Treatment Plant (Final Treatment Plant)	0.00000088

* For emission factors for facility categories/technologies other than those listed above, refer to resources such as the "List of calculation methods and emission factors under the Calculation, Reporting and Disclosure System (https://policies.env.go.jp/earth/ghg-santeikohyo/calc.html)".

Table 15 N_2O emission factor for sewage treatment

Facility type	Emission factor (tN_2O/ m^3)
Sewage Treatment Plant (Final Treatment Plant)	-
Standard activated sludge process	0.00000014
Anaerobic-aerobic activated sludge process	0.000000030
Anaerobic-anoxic-oxic process and recycled nitrification; denitrification process	0.000000012
Recycled nitrification-denitrification membrane bioreactor	0.0000000011

* For emission factors for facility categories/technologies other than those listed above, refer to resources such as the "List of calculation methods and emission factors under the Calculation, Reporting and Disclosure System (https://policies.env.go.jp/earth/ghg-santeikohyo/calc.html)".

Table 16 Emission factors for direct N_2O emissions from managed soils

TABLE 11.1 (UPDATED)
DEFAULT EMISSION FACTORS TO ESTIMATE DIRECT N_2O EMISSIONS FROM MANAGED SOILS

Emission factor	Aggregated		Disaggregated		
	Default value	Uncertainty range	Disaggregation[4]	Default value	Uncertainty range
EF_1 for N additions from synthetic fertilisers, organic amendments and crop residues, and N mineralised from mineral soil as a result of loss of soil carbon[1] [kg N_2O–N (kg $N)^{-1}$]	0.010	0.001 – 0.018	Synthetic fertiliser inputs[5] in wet climates	0.016	0.013 – 0.019
			Other N inputs[6] in wet climates	0.006	0.001 – 0.011
			All N inputs in dry climates	0.005	0.000 – 0.011

Source: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Uses, p.11.12

Table 17 Emission factors for indirect N_2O emissions from managed soils

TABLE 11.3 (UPDATED)
DEFAULT EMISSION, VOLATILISATION AND LEACHING FACTORS FOR INDIRECT SOIL N_2O EMISSIONS

Emission factor	Aggregated		Disaggregated		
	Default value	Uncertainty range	Disaggregation	Default value	Uncertainty range
EF_4 [N volatilisation and re-deposition][1], kg N_2O–N (kg NH_3–N + NO_X–N volatilised)$^{-1}$	0.010	0.002 - 0.018	Wet climate	0.014	0.011 – 0.017
			Dry climate	0.005	0.000 – 0.011
EF_5 [leaching/runoff][2], kg N_2O–N (kg N leaching/runoff)$^{-1}$	0.011	0.000 - 0.020	-	-	-
$Frac_{GASF}$ [Volatilisation from synthetic fertiliser][3], (kg NH_3–N + NOx–N) (kg N applied)$^{-1}$	0.11	0.02 - 0.33	Urea	0.15	0.03 – 0.43
			Ammonium-based	0.08	0.02 – 0.30
			Nitrate-based	0.01	0.00 – 0.02
			Ammonium-nitrate-based	0.05	0.00 – 0.20
$Frac_{GASM}$ [Volatilisation from all organic N fertilisers applied, and dung and urine deposited by grazing animals][4], (kg NH_3–N + NOx–N) (kg N applied or deposited)$^{-1}$	0.21	0.00 - 0.31	-	-	-
$Frac_{LEACH-(H)}$ [N losses by leaching/runoff in wet climates][5], kg N (kg N additions or deposition by grazing animals)$^{-1}$	0.24	0.01 – 0.73	-	-	-

Source: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Uses, p.11.26

Table 18 CH_4 emission factor for continuously flooded fields without organic amendments ($kgCH_4$/ha/day)

TABLE 5.11 (UPDATED)
DEFAULT CH_4 BASELINE EMISSION FACTOR ASSUMING NO FLOODING FOR LESS THAN 180 DAYS PRIOR TO RICE CULTIVATION, AND CONTINUOUSLY FLOODED DURING RICE CULTIVATION WITHOUT ORGANIC AMENDMENTS

World		Regional		
Emission factor (kg CH_4 ha^{-1} d^{-1})	Error range (kg CH_4 ha^{-1} d^{-1})	Region	Emission factor (kg CH_4 ha^{-1} d^{-1})	Error range (kg CH_4 ha^{-1} d^{-1})
1.19	0.80 – 1.76	Africa [1]	1.19	0.80 – 1.76
		East Asia	1.32	0.89 – 1.96
		Southeast Asia	1.22	0.83 – 1.81
		South Asia	0.85	0.58 – 1.26
		Europe	1.56	1.06 – 2.31
		North America	0.65	0.44 – 0.96
		South America	1.27	0.86 – 1.88

Note: Emission factors and error ranges were estimated based on 95% confidence interval, using statistical model with updated database; See Annex 5A.2 for more information.

[1] For Africa, the global estimate is used due to lack of data.

Source: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Uses, p.5.53

Table 19 Scaling factor to account for differences in water regime during the cultivation period

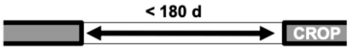
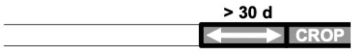
TABLE 5.12 (UPDATED)
DEFAULT CH_4 EMISSION SCALING FACTORS FOR WATER REGIMES DURING THE CULTIVATION PERIOD RELATIVE TO CONTINUOUSLY FLOODED FIELDS

Water regime		Aggregated case		Disaggregated case	
		Scaling factor)SFw(	Error range	Scaling factor)SFw(	Error range
Upland [a]		0	-	0	–
Irrigated [b]	Continuously flooded	0.60	0.44 – 0.78	1.00	0.73 – 1.27
	Single drainage period			0.71	0.53 – 0.94
	Multiple drainage periods			0.55	0.41 – 0.72
Rainfed and deep water [c]	Regular rainfed	0.45	0.32 – 0.62	0.54	0.39 – 0.74
	Drought prone			0.16	0.11 – 0.24
	Deep water	0.06	0.03 – 0.12	0.06	0.03 – 0.12

Source: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Uses, p.5.54

Table 20 Scaling factor to account for differences in water regime in the pre-season before the cultivation period

TABLE 5.13 (UPDATED)
DEFAULT CH_4 EMISSION SCALING FACTORS FOR WATER REGIMES BEFORE THE CULTIVATION PERIOD

<table>
<tr><th colspan="2" rowspan="2">Water regime prior to rice cultivation (schematic presentation showing flooded periods as shaded)</th><th colspan="2">Aggregated case</th><th colspan="2">Disaggregated case</th></tr>
<tr><th>Scaling factor (SF_p)</th><th>Error range</th><th>Scaling factor (SF_p)</th><th>Error range</th></tr>
<tr><td>Non flooded pre-season <180 d</td><td></td><td rowspan="4">1.22</td><td rowspan="4">1.08 – 1.37</td><td>1.00</td><td>0.88 – 1.12</td></tr>
<tr><td>Non flooded pre-season >180 d</td><td></td><td>0.89</td><td>0.80 – 0.99</td></tr>
<tr><td>Flooded pre-season (>30 d)[a,b]</td><td></td><td>2.41</td><td>2.13 – 2.73</td></tr>
<tr><td>Non-flooded pre-season >365 d [c]</td><td></td><td>0.59</td><td>0.41 – 0.84</td></tr>
</table>

Source: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Uses, p.5.55

Table 21 Conversion factor for organic amendment

TABLE 5.14 (UPDATED)
DEFAULT CONVERSION FACTORS FOR DIFFERENT TYPES OF ORGANIC AMENDMENTS

Organic amendment	Conversion factor (CFOA)	Error range
Straw incorporated shortly (<30 days) before cultivation[a]	1.00	0.85 – 1.17
Straw incorporated long (>30 days) before cultivation[a]	0.19	0.11 – 0.28
Compost	0.17	0.09 – 0.29
Farm yard manure	0.21	0.15 – 0.28
Green manure	0.45	0.36 – 0.57

Source: Conversion factors and error ranges (based on 95% confidential interval) were determined using statistical model and updated database; see Annex 5A.2 for more information.

[a] Straw application means that straws are incorporated into the soil. It does not include cases where straws are just placed on soil surface, and straws that were burnt on the field.

Source: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Uses, p.5.56

Table 22 Management practices of manure

TABLE 10.18 (UPDATED)
DEFINITIONS OF MANURE MANAGEMENT SYSTEMS[3]

System		Definition
Pasture/Range/Paddock (PRP)		The manure from pasture and range grazing animals is allowed to lie as deposited, and is not managed.
Daily spread		Manure is routinely removed from a confinement facility and is applied to cropland or pasture within 24 hours of excretion.
Solid storage		The storage of manure, typically for a period of several months, in unconfined piles or stacks. Manure is able to be stacked due to the presence of a sufficient amount of bedding material or loss of moisture by evaporation. Solid stores can be covered or compacted. In some cases, bulking agent or additives are added .
Solid storage-Covered/compacted		Similar to solid storage, but the manure pile is a) covered with a plastic sheet to reduce the surface of manure exposed to air and/or b) compacted to increase the density and reduce the free air space within the material.
Solid storage - Bulking agent addition		Specific materials (bulking agents) are mixed with the manure to provide structural support. This allows the natural aeration of the pile, thus enhancing decomposition. (e.g. sawdust, straw, coffee husks, maize stover)
Solid storage - Additives		The addition of specific substances to the pile in order to reduce gaseous emissions. Addition of certain compounds such as attapulgite, dicyandiamide or mature compost have shown to reduce N_2O emissions; while phosphogypsum reduce CH_4 emissions
Dry lot		A paved or unpaved open confinement area without any significant vegetative cover. Dry lots do not require the addition of bedding to control moisture. Manure may be removed periodically and spread on fields.
Liquid/Slurry [1]		Manure is stored as excreted or with some minimal addition of water or bedding material in tanks or ponds outside the animal housing. Manure is removed and spread on fields once or more in a calendar year. Manure is agitated before removal from the tank/ponds to ensure that most of the VS are removed from the tank..
Uncovered anaerobic lagoon		A type of liquid storage system designed and operated to combine waste stabilization and storage. Lagoons have a lower depth and a much larger surface compared to liquid slurry stores. Anaerobic lagoons are designed with varying lengths of storage (up to a year or greater), depending on the climate region, the volatile solids loading rate, and other operational factors. The supernatant water from the lagoon may be recycled as flush water or used to irrigate and fertilise fields.
Pit storage below animal confinements		Collection and storage of manure usually with little or no added water typically below a slatted floor in an enclosed animal confinement facility, usually for periods less than one year. Manure may be pumped out of the storage to a secondary storage tank multiple times in one year, or stored and applied directly to fields. It is assumed that VS removal rates on tank emptying are >90%.
Anaerobic digester	Digesters of high quality and low leakage	Animal manure with and without straw are collected and anaerobically digested in a containment vessel. Co-digestion with other waste or energy crops may occur. Digesters are designed, constructed and operated according to industrial technology standard for waste stabilization by the microbial reduction of complex organic compounds to CO_2 and CH_4. Biogas is captured and used as a fuel. Digestate is stored either in open storage, in covered storage with no leakage control, or in gas tight storage with gas recovery or flaring.
	Digesters with high leakage	Animal manure with and without straw are collected and anaerobically digested in covered lagoon. Digesters are used for waste stabilization by the microbial reduction of complex organic compounds to CO_2 and CH_4 Biogas is captured and flared or used as a fuel. After anaerobic digestion, digestate is stored either openly, covered, or gas tightly.
Burned for fuel		The dung and urine are excreted on fields. The sun dried dung cakes are burned for fuel.

TABLE 10.18 (UPDATED) (CONTINUED) DEFINITIONS OF MANURE MANAGEMENT SYSTEMS		
System		**Definition**
Deep bedding		As manure accumulates, bedding is continually added to absorb moisture over a production cycle and possibly for as long as 6 to 12 months. This manure management system also is known as a bedded pack manure management system and may be combined with a dry lot or pasture. Manure may undergo periods where animals are present and are actively mixing the manure, or periods in which the pack is undisturbed.
Composting	In-vessel[2]	Composting, typically in an enclosed channel, with forced aeration and continuous mixing.
	Static pile	Composting in piles with forced aeration but no mixing, with runoff/leaching containment.
		Composting in piles with forced aeration but no mixing, without runoff/leaching containment.
	Intensive windrow[2]	Composting in windrows with regular (at least daily) turning for mixing and aeration, runoff/leaching containment
		Composting in windrows with regular (at least daily) turning for mixing and aeration, no runoff/leaching containment
	Composting - Passive windrow[2]	Composting in windrows with infrequent turning for mixing and aeration, with runoff/leaching.
		Composting in windrows with infrequent turning for mixing and aeration, no runoff/leaching.
Poultry manure with litter		Similar to cattle and swine deep bedding except usually not combined with a dry lot or pasture. Typically used for all poultry breeder flocks, for alternative systems for layers and for the production of meat type chickens (broilers) and other fowl. Litter and manure are left in place with added bedding during the poultry production cycle and cleaned between poultry cycles, typically 5 to 9 weeks in productive systems and greater in lower productivity systems.
Poultry manure without litter		May be similar to open pits in enclosed animal confinement facilities or may be designed and operated to dry the manure as it accumulates. The latter is known as a high-rise manure management system and is a form of passive windrow composting when designed and operated properly. Some intensive poultry farms installed the manure belt under the cage, where the manure is dried inside housing.
Aerobic treatment		The biological oxidation of manure collected as a liquid with either forced or natural aeration. Natural aeration is limited to aerobic and facultative ponds and wetland systems and is due primarily to photosynthesis. Hence, these systems typically become anoxic during periods without sunlight.

[1] Covers on manure management systems can impact emissions of direct N_2O, CH_4 and NH_3. With N_2O and CH_4 emission, the effect of the cover depends upon character of the cover material .

[2] Composting is the biological oxidation of a solid waste including manure usually with bedding or another organic carbon source typically at thermophilic temperatures produced by microbial heat production.

[3] Comparative definitions with the EMEP/EEA Air Pollutant Emission Inventory 2016 Guidebook can be found in Annex Table 10A.10

Source: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Uses, p.10.72

Table 23 Maximum CH4 producing capacity (B_0)

TABLE 10.16 (UPDATED)
DEFAULT VALUES FOR MAXIMUM METHANE PRODUCING CAPACITY (B_0) (M^3 CH_4 KG^{-1} VS)

Category of animal [2]	Region					
	North America	Western Europe	Eastern Europe	Oceania	Other Regions[1]	
					High productivity systems	Low productivity systems
Dairy cattle	0.24				0.24	0.13
Non dairy cattle	0.19	0.18	0.17	0.17	0.18	0.13
Buffalo	0.10				0.10	0.10
Swine	0.48	0.45	0.45	0.45	0.45	0.29
Chicken-Layer	0.39				0.39	0.24
Chicken-Broilers	0.36				0.36	0.24
Sheep	0.19				0.19	0.13
Goats	0.18				0.18	0.13
Horses	0.30				0.30	0.26
Mules/ Asses	0.33				0.33	0.26
Camels	0.26				0.26	0.21
All Animals PRP	0.19					

Sources: All values are consistent with IPCC 2006 values from Annex 10A.2 with the exception of PRP, taken from the analysis described in Annex 10B.6.

[1] For other regions, low productivity is considered the default value for Tier 1 if not using the Tier 1a.

[2] Only presenting values for manure, compilers are recommended to consult scientific literature or develop country-specific B_0 values for the different codigestates that may be used in anaerobic digesters.

Uncertainty values are ±15 percent

Source: Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Uses, p.10.66

Definition of High / Low Productivity Systems

Dairy Cattle and milk production:
The dairy cow population is estimated separately from other cattle (see Table 10.1). Dairy cows are defined in this method as mature cows (first lactation and beyond) that are producing milk in commercial quantities for consumption. This definition corresponds to the dairy cow population reported in FAO et al. (2014). Dairy cow population should not be confused with multi-purpose cows that may be used for more than one production purpose milk, meat or draft.
In some countries the dairy cow population is comprised of two well-defined segments:
High-productivity systems are based on high-yielding dairy cows that are concentrated in confinement production systems or grazing on high quality pastures with supplements. The farms are 100-percent market oriented for commercial milk production, for national markets and/or export; Purebred or crossbred cattle are genetically improved through selective breeding for milk production (FAO et al. 2014).
Low productivity systems are based on low-yielding dairy cows, grazing non improved pastures, and using locally produced roughage (e.g. crop residues), and agro-industrial by-products. Local breeds or crossbred cows are bred locally, without intensive selection for milk productivity. Milk production is mostly for local market and local consumption (FAO et al. 2014).
Dairy buffalo may be categorized in a similar manner to dairy cows.
Other cattle:
High-productivity systems are based on animal feeding systems using forage (e.g. high-quality grass) and concentrates in confinement production systems or grazing with supplements or on improved pastures, producing high rates of daily weight gain. Animals can be purebred or crossbred and are genetically improved through selective breeding for improved commercial meat production. Growing cattle may be finished young in "intensive grazing with supplements" or feedlot systems, and meat is produced for national markets and/or export (FAO et al. 2014).
Low productivity systems are based on animal feeding systems where locally produced roughage (e.g. crop residues) or low quality rangelands represent the major source of feed utilized, producing low rates of daily weight

gain. Animals can be represented by local breeds or may be crossbred and can also be used for multiple purposes such as draft, meat and milk for self consumption and markets (FAO et al. 2014).

Other livestock species:

High-productivity systems, which are 100 percent market oriented with high level of capital input requirements and high level of overall herd (flock) performance. Feed is purchased from local or international market or intensively produced on farm. Animals are improved through breeding practices for commercial production. The high-productivity systems are common in swine, poultry, goats and sheep production (MacLeod et al. 2017).

Low productivity systems which are mainly driven by local market or by self-consumption, with low capital input requirements and low level of overall herd (fowl) performance typically using large areas for production or backyards. Locally produced feed represents the major source of feed utilized or animals are kept-free range for major part or all of their production cycle, the yield of the activity being linked to the natural fertility of the land and the seasonal production of the pastures. The low-productivity systems are common in swine, poultry, goats and sheep production (MacLeod et al. 2017).

Source: Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Uses, p.10.13

Table 24 CH_4 conversion factors for manure management systems

TABLE 10.17 (UPDATED)
METHANE CONVERSION FACTORS FOR MANURE MANAGEMENT SYSTEMS

System[4]		MCFs by climate zone									
		Cool				Temperate		Warm			
		Cool Temperate Moist	Cool Temperate Dry	Boreal Moist	Boreal Dry	Warm Temperate Moist	Warm Temperate Dry	Tropical Montane	Tropical Wet	Tropical Moist	Tropical Dry
Uncovered anaerobic lagoon[7]		60%	67%	50%	49%	73%	76%	76%	80%	80%	80%
Liquid/Slurry, and Pit storage below animal confinements[1]	1 Month	6%	8%	4%	4%	13%	15%	25%	38%	36%	42%
	3 Month[8]	12%	16%	8%	8%	24%	28%	43%	61%	57%	62%
	4 Month[9]	15%	19%	9%	9%	29%	32%	50%	67%	64%	68%
	6 Month[9]	21%	26%	14%	14%	37%	41%	59%	76%	73%	74%
	12 Month[9]	31%	42%	21%	20%	55%	64%	73%	80%	80%	80%
Cattle and Swine deep bedding (cont.)[5]	> 1 month[10]	21%	26%	14%	14%	37%	41%	59%	76%	73%	74%
Cattle and Swine deep bedding	< 1 month[11]	2.75%				6.50%		18%			
Solid storage[6,12]		2.00%				4.00%		5.00%			
Solid storage – Covered/compacted[6, 13]		2.00%				4.00%		5.00%			
Solid storage – Bulking agent addition[6, 14]		0.50%				1.00%		1.50%			
Solid storage – Additives[6, 15]		1.00%				2.00%		2.50%			
Dry lot[16]		1.00%				1.50%		2.00%			
Daily spread[17]		0.10%				0.50%		1.00%			

TABLE 10.17 (UPDATED) (CONTINUED)
METHANE CONVERSION FACTORS FOR MANURE MANAGEMENT SYSTEMS

System[4]	MCFs by climate zone									
	Cool				Temperate		Warm			
	Cool Temperate Moist	Cool Tempera te Dry	Boreal Moist	Boreal Dry	Warm Temperate Moist	Warm Temperate Dry	Tropical Montane	Tropical Wet	Tropical Moist	Tropical Dry
Composting - In-vessel[b, 18]	0.50%									
Composting - Static pile (Forced aeration)[b,6, 19]	1.00%				2.00%		2.50%			
Composting - Intensive windrow[b, 20]	0.50%				1.00%		1.5%			
Composting – Passive windrow (Unfrequent turning)[3,6,21]	1.00%				2.00%		2.50%			
Pasture/Range/Paddock[2]	0.47%									
Poultry manure with and without litter[22]	1.50%									
Aerobic treatment[23]	0.00%									
Burned for fuel[24]	10.00%									
Anaerobic Digester[25], Low leakage, High quality gastight storage, best complete industrial technology	1.00%									
Anaerobic Digester[25], Low leakage, High quality industrial technology, low quality gastight storage technology	1.41%									

TABLE 10.17 (UPDATED) (CONTINUED) METHANE CONVERSION FACTORS FOR MANURE MANAGEMENT SYSTEMS										
System[4]	MCFs by climate zone									
	Cool				Temperate		Warm			
Cool Temperate Moist	Cool Temperate Moist	Cool Temperate Dry	Boreal Moist	Boreal Dry	Warm Temperate Moist	Warm Temperate Dry	Tropical Montane	Tropical Wet	Tropical Moist	Tropical Dry
Anaerobic Digester[25], Low leakage, High quality industrial technology, open storage	3.55%				4.38%		4.59%			
Anaerobic Digester[25], High leakage, low quality technology, high quality gastight storage technology	9.59%									
Anaerobic Digester[25], High leakage, low quality technology, low quality gastight storage technology	10.85%									
Anaerobic Digester[25], High leakage, low quality technology, open storage	12.14%				12.97%		13.17%			

Source: Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Uses, p.10.67

Table 25 Volitile solid excretion rate by types of livestock

TABLE 10.13A (NEW) DEFAULT VALUES FOR VOLATILE SOLID EXCRETION RATE (KG VS (1000 KG ANIMAL MASS)-1 DAY-1)																					
Category of animal	Region																				
	North America	Western Europe	Eastern Europe	Oceania[7]	Latin America			Africa[6]			Middle East[6]			Asia			India sub-continent				
					Mean	High PS[1]	Low PS[1]	Mean	High PS	Low PS	Mean	High PS	Low PS	Mean	High PS	Low PS	Mean	High PS	Low PS		
Dairy cattle[4]	9.3	7.5	6.7	6.0	7.9	9.0	7.1	18.2	21.7	15.2	10.7	8.4	11.8	9.0	8.1	9.2	14.1	9.1	16.1		
Other cattle[4]	7.6	5.7	7.6	8.7	8.5	8.1	8.6	12.0	10.2	12.7	14.1	10.5	16.8	9.8	6.8	10.8	12.2	13.5	12.0		
Buffalo[4]	NA	7.7	6.2	NA	11.2	NE		12.9	NE		9.8	NE		13.5	NE			NE			
Swine[3]	3.3	4.5	4.0	4.0	5.0	3.3	8.3	7.2	4.3	8.7	4.3	3.9	7.2	5.8	4.3	7.1	7.7	5.5	8.7		
Finishing	3.9	5.3	4.9	5.6	6.4	4.3	10.0	8.2	5.3	9.4	4.9	4.4	7.8	6.8	5.1	8.1	8.6	6.5	9.5		
Breeding	1.8	2.4	2.0	2.1	2.7	1.7	4.8	4.4	2.4	6.0	2.5	2.3	4.6	3.4	2.3	4.3	4.6	3.0	5.5		
Poultry[3]	14.5	12.3	12.6	15.4	13.5	13.3	15.7	12.6	12.3	13.0	14.2	14.1	16.5	11.2	10.6	14.3	14.9	14.3	15.7		
Hens ±1 yr	9.4	8.6	9.4	8.6	10.1	9.3	14.7	10.2	8.0	11.6	9.0	8.4	15.8	9.3	8.5	12.8	13.2	11.6	14.6		
Pullets	5.9	5.3	5.9	6.2	7.6	5.7	18.5	12.0	5.8	16.5	6.8	5.6	18.5	7.5	5.4	17.7	13.2	6.8	18.9		
Broilers	16.8	16.1	16.0	18.3	15.6	15.5	17.8	15.9	16.0	15.4	17.7	17.7	17.9	15.7	15.6	17.1	17.7	17.6	18.2		
Turkeys[8]	10.3																				
Ducks[8]	7.4																				
Sheep[3]	8.2				8.3																
Goats[5]	9				10.4																
Horses[8]	5.65				7.2																
Mules/ Asses[8]	7.2																				
Camels[8]	11.5																				

Source: Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Uses, p.10.55

Table 26 Weights by types of livestock

TABLE 10A.5 (NEW)
DEFAULT VALUES FOR LIVE WEIGHTS FOR ANIMAL CATEGORIES (KG)

Category of animal	Region																		
	North America	Western Europe	Eastern Europe	Oceania	Latin America			Africa			Middle East			Asia			India sub-continent		
					Mean	High PS[1]	Low PS[1]	Mean	High PS	Low PS	Mean	High PS	Low PS	Mean	High PS	Low PS	Mean	High PS	Low PS
Dairy cattle[2]	650	600	550	488	508	520	500	260	250	270	349	510	270	386	485	355	285	350	265
Other cattle[2]	407	405	389	359	303	329	295	236	302	208	275	362	232	299	310	296	226	167	236
Buffalo[2]	NA	509	467	NA	315			339			381			336			321		
Swine[3]	77	76	77	61	65	81	59	49	72	37	59	70	53	58	69	52	59	68	53
Finishing	61	61	59	41	51	59	47	41	54	33	52	60	48	49	56	44	51	55	48
Breeding	184	190	204	163	143	205	121	100	200	61	118	157	99	122	160	102	121	162	99
Poultry[3]	1.4	1.4	1.3	1.3	1.1	1.3	0.9	0.9	1	0.8	0.9	1.2	0.7	1.2	1.4	1	1.0	1.2	0.8
Hens >/= 1 yr	1.5	1.9	1.9	2	1.4	1.6	1.3	1.4	1.9	1.1	1.2	1.7	1	1.5	1.9	1.3	1.3	1.5	1.1
Pullets	1.2	1.5	1.3	1.4	0.7	1.3	0.5	0.7	1.4	0.5	0.6	1.2	0.4	0.8	1.5	0.6	0.6	1.3	0.4
Broilers	1.4	1.2	1.1	1.2	0.9	1.2	0.7	0.8	0.8	0.7	0.7	1	0.5	0.8	1	0.7	0.8	1	0.6
Turkeys[4]	6.8																		
Ducks[4]	2.7																		
Sheep[3]	40				31														
Goats[5]	41	40	36	33	24														
Horses[4]	377				238														
Mules and asses[4]	130																		
Camels[4]	217																		
Ostrich[5]	120																		
Deer[5]	120																		
Reindeer[5]	120																		

Source: Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Uses, p.10.118

Table 27 Emission factors for direct N_2O emission from manure management systems

TABLE 10.21 (UPDATED)
DEFAULT EMISSION FACTORS FOR DIRECT N_2O EMISSIONS FROM MANURE MANAGEMENT[24]

System	Definition		EF_3 [kg N_2O-N (kg Nitrogen excreted)$^{-1}$]
Pasture/Range/ Paddock	The manure from pasture and range grazing animals is allowed to lie as is, and is not managed.		Direct and indirect N_2O emissions associated with the manure deposited on agricultural soils and pasture, range, paddock systems are treated in Chapter 11, Section 11.2, N_2O emissions from managed soils.
Daily spread[5]	Manure is routinely removed from a confinement facility and is applied to cropland or pasture within 24 hours of excretion. N_2O emissions during storage and treatment are assumed to be zero. N_2O emissions from land application are covered under the Agricultural Soils category.		0
Solid storage[2, 4, 6]	The storage of manure, typically for a period of several months, in unconfined piles or stacks. Manure is able to be stacked due to the presence of a sufficient amount of bedding material or loss of moisture by evaporation.		0.010
Solid storage- Covered/compacted[4, 7]	Similar to solid storage, but the manure pile is a) covered with a plastic sheet to reduce the surface of manure exposed to air and/or b) compacted to increase the density and reduce the free air space within the material.		0.01
Solid storage - Bulking agent addition[4, 8]	Specific materials (bulking agents) are mixed with the manure to provide structural support. This allows the natural aeration of the pile, thus enhancing decomposition. (e.g. sawdust, straw, coffee husks, maize stover)		0.005
Solid storage – Additives[4, 8]	The addition of specific substances to the pile in order to reduce gaseous emissions. Addition of certain compounds such as attapulgite, dicyandiamide or mature compost have shown to reduce N_2O emissions; while phosphogypsum reduce CH_4 emissions		0.005
Dry lot[9]	A paved or unpaved open confinement area without any significant vegetative cover where accumulating manure may be removed periodically. Dry lots are most typically found in dry climates but also are used in humid climates.		0.02
Liquid/Slurry	Manure is stored as excreted or with some minimal addition of water to facilitate handling and is stored in either tanks or earthen ponds.	With [9] natural crust cover	0.005
		Without [10] natural crust cover	0
		Cover[11]	0.005
Uncovered[12] anaerobic lagoon	Anaerobic lagoons are designed and operated to combine waste stabilization and storage. Lagoon supernatant is usually used to remove manure from the associated confinement facilities to the lagoon. Anaerobic lagoons are designed with varying lengths of storage (up to a year or greater), depending on the climate region, the volatile solids loading rate, and other operational factors. The water from the lagoon may be recycled as flush water or used to irrigate and fertilise fields.		0

TABLE 10.21 (UPDATED) (CONTINUED)
DEFAULT EMISSION FACTORS FOR DIRECT N_2O EMISSIONS FROM MANURE MANAGEMENT[24]

System	Definition		EF_3 [kg N_2O-N (kg Nitrogen excreted)$^{-1}$]
Pit storage [13] below animal confinements	Collection and storage of manure usually with little or no added water typically below a slatted floor in an enclosed animal confinement facility.		0.002
Anaerobic [14] digester	Anaerobic digesters are designed and operated for waste stabilization by the microbial reduction of complex organic compounds to CH_4 and CO_2, which is captured and flared or used as a fuel.		0.0006
Burned for fuel or as waste	The dung is excreted on fields. The sun dried dung cakes are burned for fuel.		The emissions associated with the burning of the dung are to be reported under the IPCC category 'Fuel Combustion' if the dung is used as fuel and under the IPCC category 'Waste Incineration' if the dung is burned without energy recovery.
	Urine N deposited on pasture and paddock		Direct and indirect N_2O emissions associated with the urine deposited on agricultural soils and pasture, range, paddock systems are treated in Chapter 11, Section 11.2, N_2O emissions from managed soils.
Cattle and swine deep bedding	As manure accumulates, bedding is continually added to absorb moisture over a production cycle and possibly for as long as 6 to 12 months. This manure management system also is known as a bedded pack manure management system and may be combined with a dry lot or pasture.	No mixing[15]	0.01
		Active mixing [16]	0.07
Composting - In-Vessel [3, 17]	Composting, typically in an enclosed channel, with forced aeration and continuous mixing.		0.006
Composting - Static Pile[3] (Forced aeration) [4, 18]	Composting in piles with forced aeration but no mixing.		0.010
Composting - Intensive Windrow[3, 19] (Frequent turning)	Composting in windrows with regular turning for mixing and aeration.		0.005
Composting- Passive windrow (infrequent turning) [4, 20]	Composting in windrows with infrequent turning for mixing and aeration.		0.005
Poultry manure with litter [21]	Similar to deep bedding systems. Typically used for all poultry breeder flocks and for the production of meat type chickens (broilers) and other fowl.		0.001
Poultry manure without litter[21]	May be similar to open pits in enclosed animal confinement facilities or may be designed and operated to dry the manure as it accumulates. The latter is known as a high-rise manure management system and is a form of passive windrow composting when designed and operated properly.		0.001
Aerobic treatment	The biological oxidation of manure collected as a liquid with either forced or natural aeration. Natural aeration is limited to aerobic and facultative ponds and wetland systems and is due primarily to photosynthesis. Hence, these systems typically become anoxic during periods without sunlight.	Natural aeration systems[22]	0.01
		Forced aeration systems[23]	0.005

Source: Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Uses, p.10.90

Table 28 Nitrogen excretion rate by types of livestock

TABLE 10.19 (UPDATED)
DEFAULT VALUES FOR NITROGEN EXCRETION RATE (KG N (1000 KG ANIMAL MASS)$^{-1}$ DAY^{-1})

Category of animal	Region																		
	North America	Western Europe	Eastern Europe	Oceania	Latin America			Africa			Middle East			Asia			India sub-continent		
					Mean	High PS[1]	Low PS[1]	Mean	High PS	Low PS	Mean	High PS	Low PS	Mean	High PS	Low PS	Mean	High PS	Low PS
Dairy cattle[3]	0.60	0.50	0.42	0.72	0.39	0.60	0.28	0.44	0.41	0.45	0.50	0.49	0.51	0.44	0.55	0.41	0.65	0.51	0.70
Other cattle[3]	0.40	0.42	0.47	0.46	0.31	0.36	0.29	0.44	0.42	0.45	0.55	0.51	0.58	0.38	0.36	0.38	0.44	0.63	0.40
Buffalo[3]	NA	0.45	0.35	NA	0.41			0.41			0.39			0.44			0.57		
Swine[4]	0.39	0.65	0.63	0.54	0.59	0.55	0.67	0.44	0.33	0.49	0.66	0.67	0.56	0.61	0.54	0.67	0.68	0.63	0.71
Finishing	0.46	0.76	0.77	0.72	0.73	0.69	0.80	0.49	0.39	0.54	0.73	0.75	0.60	0.70	0.63	0.76	0.76	0.74	0.76
Breeding	0.24	0.38	0.36	0.31	0.35	0.32	0.43	0.29	0.21	0.35	0.40	0.41	0.37	0.37	0.32	0.43	0.43	0.37	0.47
Poultry[4]	1.45	0.99	0.96	1.42	1.20	1.13	2.14	1.29	1.16	1.44	1.29	1.27	1.79	1.10	1.00	1.62	1.62	1.48	1.83
Hens >/= 1 yr	1.13	0.87	0.81	1.04	1.17	1.02	2.01	1.20	0.99	1.34	1.11	1.06	1.70	1.00	0.89	1.50	1.65	1.60	1.70
Pullets	0.77	0.58	0.58	0.76	0.95	0.68	2.50	1.29	0.70	1.72	0.85	0.74	2.03	0.83	0.60	1.91	1.63	0.98	2.20
Broilers	1.59	1.14	1.12	1.59	1.23	1.21	2.39	1.40	1.34	1.58	1.43	1.42	1.95	1.35	1.31	1.84	1.58	1.47	2.11
Turkeys[12]	0.74																		
Ducks[12]	0.83																		
Sheep[4]	0.35	0.36	0.36	0.43	0.32														
Goats[5]	0.46	0.46	0.44	0.42	0.34														
Horses and mules and asses[12]	0.30	0.26	0.30	0.30	0.46														
Camels[12]	0.38				0.46														
Ostrich[7,11]	0.34																		
Deer[8,11]	0.67																		
Reindeer[9,11]	0.23																		
Mink and Polecat (kg N head^{-1} yr^{-1})[6,11]	4.59																		
Rabbits (kg N head^{-1} yr^{-1})[10,11]	8.10																		
Fox and Racoon (kg N head^{-1} yr^{-1})[6,11]	12.09																		

Source: Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Uses, p.10.83

Table A-1　Default values of biomass conversion and expansion factors（BCEF）

TABLE 4.5
DEFAULT BIOMASS CONVERSION AND EXPANSION FACTORS (BCEF), TONNES BIOMASS (M^3 OF WOOD VOLUME)$^{-1}$

BCEF for expansion of merchantable growing stock volume to above-ground biomass ($BCEF_S$), for conversion of net annual increment ($BCEF_I$) and for conversion of wood and fuelwood removal volume to above-ground biomass removal ($BCEF_R$)

Climatic zone	Forest type	BCEF	Growing stock level (m^3)			
			<20	21-50	51-100	>100
Boreal	pines	$BCEF_S$	**1.2** (0.85-1.3)	**0.68** (0.5-0.72)	**0.57** (0.52-0.65)	**0.5** (0.45-0.58)
		$BCEF_I$	0.47	0.46	0.46	0.463
		$BCEF_R$	1.33	0.75	0.63	0.55
	larch	$BCEF_S$	**1.22** (0.9-1.5)	**0.78** (0.7-0.8)	**0.77** (0.7-0.85)	**0.77** (0.7-0.85)
		$BCEF_I$	0.9	0.75	0.77	0.77
		$BCEF_R$	1.35	0.87	0.85	0.85
	firs and spruces	$BCEF_S$	**1.16** (0.8-1.5)	**0.66** (0.55-0.75)	**0.58** (0.5-0.65)	**0.53** (0.45-0.605)
		$BCEF_I$	0.55	0.47	0.47	0.464
		$BCEF_R$	1.29	0.73	0.64	0.59
	hardwoods	$BCEF_S$	**0.9** (0.7-1.2)	**0.7** (0.6-0.75)	**0.62** (0.53-0.7)	**0.55** (0.5-0.65)
		$BCEF_I$	0.65	0.54	0.52	0.505
		$BCEF_R$	1.0	0.77	0.69	0.61

Climatic zone	Forest type	BCEF	Growing stock level (m^3)				
			<20	21-40	41-100	100 -200	>200
Temperate	hardwoods	$BCEF_S$	**3.0** (0.8-4.5)	**1.7** (0.8-2.6)	**1.4** (0.7-1.9)	**1.05** (0.6-1.4)	**0.8** (0.55-1.1)
		$BCEF_I$	1.5	1.3	0.9	0.6	0.48
		$BCEF_R$	3.33	1.89	1.55	1.17	0.89
	pines	$BCEF_S$	**1.8** (0.6 -2.4)	**1.0** (0.65 -1.5)	**0.75** (0.6-1.0)	**0.7** (0.4-1.0)	**0.7** (0.4-1.0)
		$BCEF_I$	1.5	0.75	0.6	0.67	0.69
		$BCEF_R$	2.0	1.11	0.83	0.77	0.77
	other conifers	$BCEF_S$	**3.0** (0.7-4.0)	**1.4** (0.5-2.5)	**1.0** (0.5-1.4)	**0.75** (0.4-1.2)	**0.7** (0.35-0.9)
		$BCEF_I$	1.0	0.83	0.57	0.53	0.60
		$BCEF_R$	3.33	1.55	1.11	0.83	0.77
Mediterranean, dry tropical, subtropical			<20	21-40	41-80	>80	
	hardwoods	$BCEF_S$	**5.0** (2.0-8.0)	**1.9** (1.0-2.6)	**0.8** (0.6-1.4)	**0.66** (0.4-0.9)	
		$BCEF_I$	1.5	0.5	0.55	0.66	
		$BCEF_R$	5.55	2.11	0.89	0.73	
	conifers	$BCEF_S$	**6.0** (3.0-8.0)	**1.2** (0.5-2.0)	**0.6** (0.4-0.9)	**0.55** (0.4-0.7)	
		$BCEF_I$	1.5	0.4	0.45	0.54	
		$BCEF_R$	6.67	1.33	0.67	0.61	

Climatic zone	Forest type	BCEF	Growing stock level (m^3)							
			<10	11-20	21-40	41-60	61-80	80-120	120-200	>200
Humid tropical	conifers	$BCEF_S$	**4.0** (3.0-6.0)	**1.75** (1.4-2.4)	**1.25** (1.0-1.5)	**1.0** (0.8-1.2)	**0.8** (0.7-1.2)	**0.76** (0.6-1.0)	**0.7** (0.6-0.9)	**0.7** (0.6-0.9)
		$BCEF_I$	2.5	0.95	0.65	0.55	0.53	0.58	0.66	0.70
		$BCEF_R$	4.44	1.94	1.39	1.11	0.89	0.84	0.77	0.77
	natural forests	$BCEF_S$	**9.0** (4.0-12.0)	**4.0** (2.5-4.5)	**2.8** (1.4-3.4)	**2.05** (1.2-2.5)	**1.7** (1.2-2.2)	**1.5** (1.0-1.8)	**1.3**(0.9-1.6)	**0.95** (0.7-1.1)
		$BCEF_I$	4.5	1.6	1.1	0.93	0.9	0.87	0.86	0.85
		$BCEF_R$	10.0	4.44	3.11	2.28	1.89	1.67	1.44	1.05

Note: Lower values of the ranges for $BCEF_S$ apply if growing stock definition includes branches, stem tops and cull trees; upper values apply if branches and tops are not part of growing stock, minimum top diameters in the definition of growing stock are large, inventoried volume falls near the lower category limit or basic wood densities are relatively high. Continuous graphs, functional forms and updates with new studies can be found at the forest- and climate- change website at: http://www.fao.org/forestry/

Average BCEF for inhomogeneous forests should be derived as far as possible as weighted averages. It is good practice to justify the factors chosen. To apply $BCEF_I$, an estimate of the current average growing stock is necessary. It can be derived from FRA 2005 at http://www.fao.org/forestry/

$BCEF_R$ values are derived by dividing $BCEF_S$ by 0.9

Sources: *Boreal forests*: Alexeyev V.A. and R.A. Birdseye, 1998; Fang J. and Z.M. Wang, 2001; *temperate forests*: Fang J. *et al.*, 2001; Fukuda M. *et al.*, 2003; Schroeder P. *et al.*, 1997; Snowdon P. *et.al.*, 2000; Smith J. *et. al.*, 2002; Brown S., 1999; Schoene D. and A. Schulte, 1999; Smith J. *et al.*, 2004; *Mediterranean forests*: Vayreda *et al.*, 2002; Gracia *et al.*, 2002; *tropical forests*: Brown S. *et al.*, 1989; Brown S. and A. Lugo, 1992; Brown S., 2002; Fang J.Y., 2001.

Source：2006 IPCC Guidelines for National Greenhouse Gas Inventories

Table A-2　Carbon fraction of aboveground forest biomass（CF）

TABLE 4.3
CARBON FRACTION OF ABOVEGROUND FOREST BIOMASS

Domain	Part of tree	Carbon fraction, (CF) [tonne C (tonne d.m.)$^{-1}$]	References
Default value	All	0.47	McGroddy *et al.*, 2004
Tropical and Subtropical	All	0.47 (0.44 - 0.49)	Andreae and Merlet, 2001; Chambers *et al.*, 2001; McGroddy *et al.*, 2004; Lasco and Pulhin, 2003
	wood	0.49	Feldpausch *et al.*, 2004
	wood, tree d < 10 cm	0.46	Hughes *et al.*, 2000
	wood, tree d ≥ 10 cm	0.49	Hughes *et al.*, 2000
	foliage	0.47	Feldpausch *et al.*, 2004
	foliage, tree d < 10 cm	0.43	Hughes *et al.*, 2000
	foliage, tree d ≥ 10 cm	0.46	Hughes *et al.*, 2000
Temperate and Boreal	All	0.47 (0.47 - 0.49)	Andreae and Merlet, 2001; Gayoso *et al.*, 2002; Matthews, 1993; McGroddy *et al.*, 2004
	broad-leaved	0.48 (0.46 - 0.50)	Lamlom and Savidge, 2003
	conifers	0.51 (0.47 - 0.55)	Lamlom and Savidge, 2003

Source：2006 IPCC Guidelines for National Greenhouse Gas Inventories

Table A-3 Above-ground net biomass growth in natural forests (t-d.m./ha/year)

TABLE 4.9 (UPDATED)
ABOVE-GROUND NET BIOMASS GROWTH IN NATURAL FORESTS[1,2,3,4] (TONNES D.M. HA^{-1} YR^{-1})

Domain	Ecological Zone[4]	Continent	Status/ Condition	Aboveground biomass growth [tonnes d.m. ha^{-1} yr^{-1}]	Uncertainty	Uncertainty type	References
Tropical	Tropical rainforest	Africa	Primary	1.3	3.5	SD	1, 2
			Secondary> 20 years	3.5	3.3	SD	3-8
			Secondary≤ 20 years	7.6	5.9	SD	3-7, 9
		North and South America	Primary	1.0	2.0	SD	2, 10, 11
			Secondary> 20 years	2.3	1.1	SD	3, 4, 12-15
			Secondary≤ 20 years	5.9	2.5	SD	3, 4, 6, 12-14
		Asia	Primary	0.7	2.2	SD	2, 16
			Secondary> 20 years	2.7	3.1	SD	3, 4, 17
			Secondary≤ 20 years	3.4	3.9	SD	3, 4, 17-19
	Tropical moist deciduous forest	Africa	Primary[6]	0.4	±90%	default	
			Secondary> 20 years	0.9	0.7	SD	20, 21
			Secondary≤ 20 years	2.9	1.0	SD	20, 21
		North and South America	Primary	0.4	2.1	SD	2, 10, 11
			Secondary> 20 years	2.7	1.7	SD	3, 4, 12, 13, 15, 22
			Secondary≤ 20 years	5.2	2.3	SD	3, 4, 12, 13, 22
		Asia	Primary	0.4	±90%	default	7
			Secondary> 20 years	0.9	±90%	default	8
			Secondary≤ 20 years	2.4	0.3	SD	3, 4
	Tropical dry forest	Africa	Primary	-	-	-	
			Secondary> 20 years	1.6	±90%	default	9
			Secondary≤ 20 years	3.9	±90%	default	10
		North and South America	Primary	-	-	-	
			Secondary> 20 years	1.6	1.1	SD	12, 13
			Secondary≤ 20 years	3.9	2.4	SD	12, 13, 23

TABLE 4.9 (UPDATED) (CONTINUED)
ABOVE-GROUND NET BIOMASS GROWTH IN NATURAL FORESTS[1,2,3,4] (TONNES D.M. HA^{-1} YR^{-1})

Domain	Ecological Zone[4]	Continent	Status/ Condition	Aboveground biomass growth [tonnes d.m. ha^{-1} yr^{-1}]	Uncertainty	Uncertainty type	References
Tropical	Tropical dry forest	Asia	Primary	-	-	-	
			Secondary> 20 years	1.6	±90%	default	11
			Secondary≤ 20 years	3.9	±90%	default	12
	Tropical shrublands	Africa	Primary	0.9 (0.2-1.6)*	±90%	default	24
			Secondary> 20 years	0.9 (0.2-1.6)*	±90%	default	24
			Secondary≤ 20 years	0.2-0.7	±90%	default	24
		North and South America	Primary	1.0*	±90%	default	24
			Secondary> 20 years	1.0*	±90%	default	24
			Secondary≤ 20 years	4.0	±90%	default	24
		Asia (Continental)	Primary	1.3 (1.0-2.2)*	±90%	default	24
			Secondary> 20 years	1.3 (1.0-2.2)*	±90%	default	24
			Secondary≤ 20 years	5.0	±90%	default	24
		Asia (insular)	Primary	1.0*	±90%	default	24
			Secondary> 20 years	1.0*	±90%	default	24
			Secondary≤ 20 years	2.0	±90%	default	24
	Tropical mountain system	Africa	Primary	0.5	±90%	default	13
			Secondary> 20 years	1.8	±90%	default	14
			Secondary≤ 20 years	5.5	6.8	SD	25-27
		North and South America	Primary	0.5	1.9	SD	2, 10, 11
			Secondary> 20 years	1.8	0.8	SD	3, 4, 12, 13
			Secondary≤ 20 years	4.4	1.6	SD	3, 4, 12, 13, 22
		Asia	Primary	-0.7	3.1	SD	2, 16
			Secondary> 20 years	1.1	0.4	SD	3, 4, 28, 29
			Secondary≤ 20 years	2.9	0.1	SD	3, 4, 28-30

TABLE 4.9 (UPDATED) (CONTINUED)
ABOVE-GROUND NET BIOMASS GROWTH IN NATURAL FORESTS[1,2,3,4] (TONNES D.M. HA^{-1} YR^{-1})

Domain	Ecological Zone[4]	Continent	Status/ Condition	Aboveground biomass growth [tonnes d.m. ha^{-1} yr^{-1}]	Uncertainty	Uncertainty type	References
Sub-tropical	Subtropical humid forest	Africa	Primary	-	-	-	
			Secondary >20 years	1.0	±90%	default	15
			Secondary ≤20 years	2.5	±90%	default	16
		North and South America	Primary	-	-	-	
			Secondary >20 years	1.0	±90%	default	17
			Secondary ≤20 years	2.5	±90%	default	18
		Asia	Primary	-	-	-	
			Secondary >20 years	1.0	0.9	SD	3, 4, 31
			Secondary ≤20 years	2.5	0.8	SD	3, 4, 31
	Subtropical dry forest	Africa	Primary	1.8 (0.6-3.0)*	±90%	default	24
			Secondary >20 years	1.8 (0.6-3.0)*	±90%	default	24
			Secondary ≤20 years	2.4 (2.3-2.5)	±90%	default	24
		North and South America	Primary	1.0*	±90%	default	24
			Secondary >20 years	1.0*	±90%	default	24
			Secondary ≤20 years	4.0	±90%	default	24
		Asia (continental)	Primary	1.5*	±90%	default	24
			Secondary >20 years	1.5*	±90%	default	24
			Secondary ≤20 years	6.0	±90%	default	24
		Asia (insular)	Primary	2.0*	±90%	default	24
			Secondary >20 years	2.0*	±90%	default	24
			Secondary ≤20 years	7.0	±90%	default	24
	Subtropical steppe	Africa	Primary	0.9 (0.2-1.6)*	±90%	default	24
			Secondary >20 years	0.9 (0.2-1.6)*	±90%	default	24
			Secondary ≤20 years	1.2 (0.8-1.5)	±90%	default	24
		North and South America	Primary	1.0*	±90%	default	24
			Secondary >20 years	1.0*	±90%	default	24
			Secondary ≤20 years	4.0	±90%	default	24

TABLE 4.9 (UPDATED) (CONTINUED)
ABOVE-GROUND NET BIOMASS GROWTH IN NATURAL FORESTS[1,2,3,4] (TONNES D.M. HA^{-1} YR^{-1})

Domain	Ecological Zone[4]	Continent	Status/ Condition	Aboveground biomass growth [tonnes d.m. ha^{-1} yr^{-1}]	Uncertainty	Uncertainty type	References
Subtropical	Subtropical steppe	Asia (continental)	Primary	1.3 (1.0-2.2)*	±90%	default	24
			Secondary >20 years	1.3 (1.0-2.2)*	±90%	default	24
			Secondary ≤20 years	5.0	±90%	default	24
		Asia (insular)	Primary	1.0*	±90%	default	24
			Secondary >20 years	1.0*	±90%	default	24
			Secondary ≤20 years	2.0	±90%	default	24
	Subtropical mountain system	Africa	Primary	-	-	-	
			Secondary >20 years	0.5	±90%	default	19
			Secondary ≤20 years	2.5	±90%	default	20
		North and South America	Primary	-	-	-	
			Secondary >20 years	0.5	±90%	default	21
			Secondary ≤20 years	2.5	±90%	default	22
		Asia	Primary	-	-	-	
			Secondary >20 years	0.5	0.3	SD	3, 4, 32
			Secondary ≤20 years	2.5	0.03	SD	3, 4, 32
Temperate	Oceanic	New Zealand	Primary	0.37	±0.85	95%CI	33
			Secondary >20 years	2.12	±0.82	95%CI	33
			Secondary ≤20 years	3.12	0.83	SE	34
		Europe	All	2.3	-	-	35
		North and South America	Secondary >20 years	9.1	20.2	SD	36
			Secondary ≤20 years	6.3	7.4	SD	36
	Continental	North and South America	Secondary >20 years	3.6	15.0	SD	36
			Secondary ≤20 years	3.3	5.2	SD	36
	Mountain	North and South America	Secondary >20 years	4.4	100.7	SD	36
			Secondary ≤20 years	3.1	3.6	SD	36

TABLE 4.9 (UPDATED) (CONTINUED)
ABOVE-GROUND NET BIOMASS GROWTH IN NATURAL FORESTS[1,2,3,4] (TONNES D.M. HA^{-1} YR^{-1})

Domain	Ecological Zone[4]	Continent	Status/ Condition	Aboveground biomass growth [tonnes d.m. ha^{-1} yr^{-1}]	Uncertainty	Uncertainty type	References
Temperate	Desert	North and South America	Secondary >20 years	0.6	0.9	SD	36
			Secondary ≤20 years	0.5	1.2	SD	36
	Steppe	North and South America	Secondary >20 years	3.5	13.3	SD	36
			Secondary ≤20 years	2.3	3.2	SD	36
Boreal	Coniferous	Asia, Europe, North America	All	0.1-2.1	-	-	35
	Tundra woodland	Asia, Europe, North America	All	0.4	(0.2-0.5)	Range	24
	Mountain	Asia, Europe, North America	Primary or secondary >20 years	1.1-1.5	-	-	24
			Secondary ≤20 years	1.0-1.1	-	-	24

[1] Aboveground net biomass growth is defined as net change in total aboveground biomass over time. In this respect, both forest productivity and mortality are accounted for.

[2] Some categories include sub-strata for primary forests defined as old growth forests that are intact or with no active human intervention, and secondary forests which include all other forests. The table considers a forest definition of at least 10% tree canopy cover.

[3] For above-ground biomass growth rates with no standard deviation, IPCC Tier 1 default uncertainties apply.

[4] Forest Resources Assessment (FRA). (2015). *Global Eological Zones for FAO Forest Reporting 2010 Update. Forest Resources Assessment Working Paper 179.*

Observations on ecological zone and continent columns

Above-ground biomass growth rate was taken from: Tropical moist deciduous forest - North and South America (Primary); Tropical moist deciduous forest - North and South America (Primary); Tropical moist deciduous forest - Africa (Secondary>20 years); Tropical dry forest – North and South America (Secondary>20 years); Tropical dry forest – North and South America (Secondary≤20 years); Tropical dry forest – North and South America (Secondary>20 years); Tropical dry forest – North and South America (Secondary≤20 years); Tropical mountain system – North and South America (Primary); Tropical mountain system – North and South America (Secondary>20 years); Subtropical humid forest – Asia (Secondary>20 years); Subtropical humid forest – Asia (Secondary≤20 years)

Subtropical humid forest – Asia (Secondary>20 years); Subtropical humid forest – Asia (Secondary≤20 years); Subtropical mountain system – Asia (Secondary>20 years); Subtropical mountain system – Asia (Secondary≤20 years); Subtropical mountain system – Asia (Secondary>20 years); Subtropical mountain system – Asia (Secondary≤20 years).

Note: SD = standard deviation, CI = confidence interval, SE = standard error.

*Recommendation based on IPCC 2006 estimates for Forests > 20 years.

References

1Lewis, S. L., et al., 2009; 2Lopez-Gonzalez, G. et al., 2011; 3Anderson-Teixeira, K. J., et al., 2018a; 4Anderson-Teixeira, K. J., et al., 2018b; 5Omeja, P. A. et al., 2011; 6Palm, C.A., et al., 1999; 7N'Guessan, A. E., et al., 2019; 8Gourlet-Fleury, S., et al., 2013; 9Thenkabail, P. S., et al., 2004; 10Brienen, R. J. W., et al., 2014: 11Brienen, R. J. W., et al., 2015; 12Poorter, L. et al., 2016a; 13L. Poorter et al., 2016b; 14Salimon, C. I., Brown, I. F., 2000; 15Rutishauser, E., et al., 2015; 16Qie, L., et al., 2017; 17Mukul, S. A., Herbohn, J., Firn, F., 2016; 18Hiratsuka, M., et al., 2006; 19Ewel, J. J., Chai, P., Tsai, L. M., 1983; 20Kalaba, F. K., et al., 2013; 21Manlay, R., et al., 2002; 22Peña, M. A., Duque, A., 2013; 23Salinas-Mendoza, M. A. et al., 2017; 24IPCC, 2003; 25Otuoma, J., et al., 2016; 26Giday, K., et al., 2013; 27Mekurja, W., Veldkamp, E., Corre, M. D., 2010; 28Tang, J. W., et al., 1998; 29Fujiki, S., 2017; 30Chan, N., Takeda, S., 2016; 31Schomakers, J., et al., 2017; 32Dang, C. L., Wu, Z. L., 1991; 33Holdaway, R.J., et al. 2017; 34Beets P.N., et al. 2014; 35IPCC 2006; 36June 18, 2018. Forest Inventory and Analysis Database, St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station. (Available only on internet: https://apps.fs.usda.gov/fia/datamart/datamart.html).

Source: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Table A-4 Above-ground net biomass growth in forest plantations (t-d.m./ha/year)

TABLE 4.10 (UPDATED)
ABOVE-GROUND NET BIOMASS GROWTH IN TROPICAL AND SUB-TROPICAL PLANTATION FORESTS (TONNES D.M. HA^{-1} YR^{-1})

Domain	Ecological zone[1]	Continent	Species	Above-ground biomass [tonnes d.m. ha^{-1} yr^{-1}]	Range [tonnes d.m. ha^{-1} yr^{-1}][2]	References
Tropical	Tropical rainforest	Africa	*Pinus* sp. ≤ 20 y	20		1
			Other ≤ 20 y	6	5-8	1
		North and South America	*Eucalyptus* sp.	20	6-40	1
			Pinus sp.	20		1
			Tectona grandis	15		1
			Other broadleaf	20	5-35	1
		Asia	*Eucalyptus* sp.	5	4-8	1
			Other	5	2-8	1
	Tropical moist deciduous forest	Africa	*Eucalyptus* sp. >20 y	25		1
			Eucalyptus sp. ≤20 y	20		1
			Other ≤ 20 y	9	3-15	1
		North and South America	*Eucalyptus* sp.	16		2
			Tectona grandis	8	4-12	1
			Other broadleaf	6-20	6-20	3
		Asia		8		1
	Tropical dry forest	Africa	*Eucalyptus* sp. ≤20 y	13		1
			Pinus sp. > 20 y	9	7-10	4
			Pinus sp. ≤ 20 y	6	5-8	4
			Other ≤ 20 y	10	4-20	1
		North and South America	*Eucalyptus* sp.	20	6-30	1
			Pinus sp.	7	4-10	1
			Tectona grandis	8	4-12	1
			Other broadleaf	10	3-12	1
		Asia	*Eucalyptus* sp.	15	5-25	1
			Other	7	2-13	1
	Tropical shrubland	Africa	*Eucalyptus* sp. >20 y	8	5-14	1
			Eucalyptus sp. ≤20 y	5	3-7	1
			Pinus sp. > 20 y	2.5		1
			Pinus sp. ≤ 20 y	3	0.5-6	1
			Other > 20 y	10		1
			Other ≤ 20 y	15		1
		North and South America	*Eucalyptus* sp.	20		1
			Pinus sp.	5		1
		Asia		6	1-12	1

TABLE 4.10 (UPDATED) (CONTINUED)
ABOVE-GROUND NET BIOMASS GROWTH IN TROPICAL AND SUB-TROPICAL PLANTATION FORESTS (TONNES D.M. HA^{-1} YR^{-1})

Domain	Ecological zone[1]	Continent	Species	Above-ground biomass [tonnes d.m. ha^{-1} yr^{-1}]	Range [tonnes d.m. ha^{-1} yr^{-1}][2]	References
Tropical	Tropical mountain systems	Africa		10		1
		North and South America	Eucalyptus sp.	10	8-18	1
			Pinus sp.	10		1
		Asia	Tectona grandis	2		1
			other broadleaf	4		1
			Eucalyptus sp.	3		1
			Other	5	1-10	1
Sub-tropical	Subtropical humid forest	North and South America	Eucalyptus sp.	20	6-32	1
			Pinus sp.	7	4-10	1
			Tectona grandis	8	4-12	1
			Other broadleaf	10	3-12	1
		Asia		8		1
	Subtropical dry forest	Africa	Eucalyptus sp. ≤20 y	13		1
			Pinus sp. > 20 y	10		1
			Pinus sp. ≤ 20 y	8		1
			Other ≤ 20 y	10	4-20	1
		North and South America	Eucalyptus sp.	20	6-30	1
			Pinus sp.	7	4-10	1
			Tectona grandis	8	4-12	1
			Other broadleaf	10	3-12	1
		Asia	Eucalyptus sp.	15	5-25	1
			Other	7	2-13	1
	Subtropical steppe	Africa	Eucalyptus sp. >20 y	8	5-14	1
			Eucalyptus sp. ≤20 y	5	3-7	1
			Pinus sp. > 20 y	2.5		1
			Pinus sp. ≤ 20 y	3	0.5-6	1
			Other > 20 y	10		1
			Other ≤ 20 y	15		1
		North and South America	Eucalyptus sp.	20		1
			Pinus sp.	5		1
		Asia		6	1-12	1
	Subtropical mountain systems	Africa		10		1
		North and South America	Eucalyptus sp.	10	8-18	1
			Pinus sp.	10		1
			Tectona grandis	2		1
			Other broadleaf	4		1

TABLE 4.10 (UPDATED) (CONTINUED)
ABOVE-GROUND NET BIOMASS GROWTH IN TROPICAL AND SUB-TROPICAL PLANTATION FORESTS (TONNES D.M. HA^{-1} YR^{-1})

Domain	Ecological zone[1]	Continent	Species	Above-ground biomass [tonnes d.m. ha^{-1} yr^{-1}]	Range [tonnes d.m. ha^{-1} yr^{-1}][2]	References
Subtropical	Subtropical mountain systems	Asia	Eucalyptus sp.	3		1
			Other	5	1-10	1
Temperate	Continental	North and South America	Secondary >20 years	4	5	5
			Secondary ≤20 years	5	4	5
	Mountain	North and South America	Secondary >20 years	9	7	5
			Secondary ≤20 years	10	86	5
	Oceanic	North and South America	Secondary >20 years	10	8	5
			Secondary ≤20 years	6	4	5
	Steppe	North and South America	Secondary >20 years	11	56	5
			Secondary ≤20 years	4	3	5
Boreal	Coniferous	Asia, Europe, North America	Secondary >20 years	1.0		1
			Secondary ≤20 years	1.0		1
	Tundra woodland	Asia, Europe, North America	Secondary >20 years	0.4		1
			Secondary ≤20 years	0.4		1
	Mountain	Asia, Europe, North America	Secondary >20 years	1.0		1
			Secondary ≤20 years	1.0		1

[1] Forest Resources Assessment (FRA). (2015). Global Eological Zones for FAO Forest Reporting 2010 Update. Forest Resources Assessment Working Paper 179.

[2] If a single estimate is included in this column it refers to the standard deviation of the mean estimate.

References

1IPCC 2003; 2Stape et al., 2004; 3Lugo et al., 1990; 4Masota et al 2016; 5June 18, 2018. Forest Inventory and Analysis Database, St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station (Available only on internet: http://apps.fs.fed.us/fiadb-downloads/datamart.html).

Source: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Table A-5 Average belowground to aboveground biomass ratio (Root-Shoot ratio)（R）

TABLE 4.4 (UPDATED)
RATIO OF BELOW-GROUND BIOMASS TO ABOVE-GROUND BIOMASS (R) [TONNE ROOT D.M. (TONNE SHOOT D.M.)$^{-1}$]

Domain	Ecological zone[1]	Continent	Origin (Natural/Plantation)	Above-ground biomass (tonnes ha^{-1})	R [tonne root d.m. (tonne shoot d.m.)$^{-1}$]	Uncertainty	Uncertainty type	References
Tropical	Tropical Rainforest	Africa	Natural	≤ 125	0.825	±90%	default	1, 2
			Natural	> 125	0.532	±90%	default	2, 3
		North and South America	Natural	≤ 125	0.221	0.036	SD	4
			Planted	≤ 125	0.170	0.11	SD	5
			Natural	> 125	0.221	0.036	SD	4
			Planted	> 125	0.170	0.11	SD	5
		Asia	Natural	≤ 125	0.207	0.072	SD	6, 7, 8
			Planted	≤ 125	0.325	0.025	SD	8
			Natural	> 125	0.212	0.077	SD	7, 8, 9, 10, 11
	Tropical Moist	Africa	Natural	≤ 125	0.232	±90%	default	12
			Natural	> 125	0.232	±90%	default	12
		North and South America	Natural	≤ 125	0.2845	0.061	SD	12
			Natural	> 125	0.284	0.061	SD	12
		Asia	Natural	≤ 125	0.323	0.073	SD	1, 13, 14, 5
			Natural	> 125	0.246	0.036	SD	12, 16
	Tropical Dry	Africa	Natural	≤ 125	0.332	0.247	SD	1, 12, 17, 18, 19
			Natural	> 125	0.379	0.040	SD	12
		North and South America	Natural	≤ 125	0.334	0.040	SD	4, 12, 20
			Natural	> 125	0.379	0.040	SD	12
		Asia	Natural	≤ 125	0.440	±90%	default	12
			Natural	> 125	0.379	0.040	SD	12
	Tropical Mountain	North and South America	Natural	≤ 125	0.348	±90%	default	4
			Planted	≤ 125	2.158	±90%	default	12
			Natural	> 125	0.283	0.16	SD	21
		Asia	Natural	≤ 125	0.322	0.084	SD	22, 23
			Natural	> 125	0.345	0.280	SD	22, 23

TABLE 4.4 (UPDATED) (CONTINUED)
RATIO OF BELOW-GROUND BIOMASS TO ABOVE-GROUND BIOMASS (R) [TONNE ROOT D.M. (TONNE SHOOT D.M.)$^{-1}$]

Domain	Ecological zone[1]	Continent	Origin (Natural/ Plantation)	Above-ground biomass (tonnes ha^{-1})	R [tonne root d.m. (tonne shoot d.m.)$^{-1}$]	Uncertainty	Uncertainty type	References
Sub-tropical	Sub-tropical Humid	Africa	Natural	≤ 125	0.232	±90%	default	12
			Natural	> 125	0.232	±90%	default	12
		North and South America	Natural	≤ 125	0.175	±90%	default	12
			Natural	> 125	0.284	±90%	default	12
		Asia	Natural	≤ 125	0.230	±90%	default	12
			Natural	> 125	0.246	±90%	default	12
	Sub-tropical Dry	North and South America	Natural	≤ 125	0.336	±90%	default	12
			Natural	> 125	0.352	0.047	SD	12
		Asia	Natural	≤ 125	0.440	0.184	SD	12
			Natural	> 125	0.440	0.184	SD	12
	Sub-tropical Steppe	North and South America	Natural	≤ 125	1.338	±90%	default	12
		Asia	Natural	> 125	1.338	±90%	default	12
			Planted	≤ 125	2.158	±90%	default	12
Temperate	Oceanic	Europe	Natural/Planted (Other Broadleaf)	all size classes	0.192	±90%	default	24
			Natural (Conifer)	≤ 125	0.359	±90%	default	12
			Natural (Other Broadleaf)	>125	0.172	±90%	default	12
			Planted (Conifer)	>125	0.206	±90%	default	12, 25, 26, 27
			Planted (Conifer)	all size classes	0.359	0.145	SD	28
			Planted (Quercus)	≤ 125	1.400	±90%	default	29
		North and South America	Natural (Conifer)	≤ 125	0.337	±90%	default	12
			Natural (Conifer)	>125	0.338	±90%	default	12
			Natural (Other Broadleaf)	≤ 125	0.466	±90%	default	12, 30
			Natural (Other Broadleaf)	>125	0.190	±90%	default	12, 31
			Planted (Conifer)	>125	0.203	±90%	default	12, 32

TABLE. 4.4 (UPDATED) (CONTINUED)
RATIO OF BELOW-GROUND BIOMASS TO ABOVE-GROUND BIOMASS (R) [TONNE ROOT D.M. (TONNE SHOOT D.M.)$^{-1}$]

Domain	Ecological zone[1]	Continent	Origin (Natural/Plantation)	Above-ground biomass (tonnes ha^{-1})	R [tonne root d.m. (tonne shoot d.m.)$^{-1}$]	Uncertainty	Uncertainty type	References
Temperate	Oceanic	Oceania	Natural (Eucalyptus)	≤ 125	0.464	±90%	default	12
			Natural (Eucalyptus)	>125	0.257	±90%	default	12
			Natural (Other Broadleaf)	≤ 125	0.213	±90%	default	34-36
			Natural (Other Broadleaf)	>125	0.313	±90%	default	37, 38
			Planted (Conifer)	all size classes	0.190	±90%	default	39
			Planted (Conifer)	≤ 125	0.634	±90%	default	12
			Planted (Conifer)	>125	0.294	±90%	default	12
			Planted (Eucalyptus)	≤ 125	0.391	±90%	default	12
			Natural (Eucalyptus)	>125	0.188	±90%	default	12, 40
	Continental	Europe	Natural (Quercus)	>125	0.477	±90%	default	12
			Planted (Conifer)	≤ 125	0.340	±90%	default	12
		North and South America	Natural (Other Broadleaf)	≤ 125	0.481	±90%	default	12
			Natural (Other Broadleaf)	>125	0.277	±90%	default	12
			Planted (Conifer)	≤ 125	0.237	±90%	default	12
	Oceanic Continental Mountain	Asia	Natural (Conifer)	≤ 125	0.243	±90%	default	33
			Natural (Conifer)	>125	0.262	±90%	default	33
			Natural (Other Broadleaf)	≤ 125	0.225	±90%	default	33
			Natural (Other Broadleaf)	>125	0.229	±90%	default	33

TABLE. 4.4 (UPDATED) (CONTINUED)
RATIO OF BELOW-GROUND BIOMASS TO ABOVE-GROUND BIOMASS (R) [TONNE ROOT D.M. (TONNE SHOOT D.M.)$^{-1}$]

Domain	Ecological zone[1]	Continent	Origin (Natural/Plantation)	Above-ground biomass (tonnes ha^{-1})	R [tonne root d.m. (tonne shoot d.m.)$^{-1}$]	Uncertainty	Uncertainty type	References
Temperate	Oceanic Continental Mountain	Asia	Planted (Conifer)	≤ 125	0.224	±90%	default	33
			Planted (Conifer)	>125	0.232	±90%	default	33
			Planted (other Broadleaf)	≤ 125	0.307	±90%	default	33
			Planted (other Broadleaf)	>125	0.248	±90%	default	33
Boreal	Coniferous, tundra woodland, mountain systems	-	-	≤ 75	0.390	0.23 - 0.96	Range	12, 46
				>75	0.240	0.15 - 0.37	Range	12, 46

[1] Forest Resources Assessment (FRA). (2015). Global Eological Zones for FAO Forest Reporting 2010 Update. Forest Resources Assessment Working Paper 179.

References:

1Masota, A.M., et al., 2016; 2Njana, M.A., et al., 2015; 3Masota, A.M., et al., 2015; 4FAO, 2015; 5Sanquetta, et al., 2011; 6Saner, P., et al., 2012; 7Murdiyarso, M., et al., 2015; 8Kotowska, M.M., et al., 2015; 9Lu, X.T., et al., 2010; 10Niiyama K, et al., 2010; 11Krisnawati, H., et al., 2014; 12Mokany, K., et al., 2006; 13Wang, X.P., et al., 2008; 14Li, X., et al., 2010; 15Monda, Y., et al., 2016; 16Gautum, T.P., Mandal, T.N., 2016; 17Mugasha, W.A., et al., 2013; 18Malimbwi, R.E., et al., 2016; 19Makero, et al., 2016; 20Sato, T., et al., 2015; 21Moser, G., 2011; 22Iqbal, K., et al., 2014; 23Sharma, D.P., 2009; 24Skovsgaard, J.P., Nord-Larsen, T., 2012; 25Green C., et al., 2007; 26Urban, J., et al., 2015; 27Xiao, C.W., et al., 2003; 28Levy, P.E., et al., 2004; 29Cotillas, M., et al., 2016; 30Gargaglione, et al., 2010; 31Frangi, J.L., et al., 2005; 32Miller, A.T., et al., 2006; 33Luo, Y., et al., 2014; 34Schwendenmann, L., Mitchell, N., 2014; 35Watson, A,. O'Loughlin, C., 1985; 36Watson, A., 1995; 37Beets, P.N., 1980; 38Miller, R. B. 1963; 39Beets PN, et al. 2007; 40Oliver GR, et al. 2009; 41Battles, J. J., et al. 2002; 42Laclau P. 2003; 43Grimm, U., Fassbender, H., 1981, 44Edwards, P., Grubb, P., 1977; 45Scott, N.A., et al., 2005; 46Li, et al., 2003.

Source：2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

Table A-6 CO_2 Emissions from Fertilizer, lLakages and Effects of GHG emissions Reduction[1]

Project	Host Parties	fertilizer (tonnes of CO2 e)	Estimation of baseline net GHG removals by sinks (tonnes of CO2 e)	Estimation of actual net GHG removals by sinks (tonnes of CO2 e)	Estimation of leakage (tonnes of CO2 e) [A]	Estimation of net anthropogenic GHG removals by sinks (tonnes of CO2 e) [B]	Ratio of leakage [A]/[B]
CARBON SEQUESTRATION THROUGH REFORESTATION IN THE Comunidades Agropecuarias de Rurrenabaque (FECAR)"	Bolivia	zero	0	11,529	24,124	91,165	26%
Reforestation of croplands and grasslands in low income communities	Paraguy	3	8,737	58,188	18,983	30,468	62%
Facilitating Reforestation for Guangxi Watershed Management in Pearl River Basin	China	zero	531	794,225	19,852	773,842	3%
The International Small Group and Tree Planting Program (TIST), Tamil Nadu, India	India	zero	0	107,810	0	107,810	0%
Moldova Soil Conservation Project	Moldova	zero	109,962	3,702,513	7,705	3,584,846	0%
Southern Nicaragua CDM Reforestation Project	Nicaragua	zero	0	237,448	0	237,448	0%
Uganda Nile Basin Reforestation Project No 3	Uganda	zero	0	111,798	0	111,798	0%
Reforestation, sustainable production and carbon sequestration project	Peru	zero	171,545	1,145,332	0	973,788	0%
Reforestation on Degraded Lands in Northwest Guangxi	China		15,394	1,761,552	0	1,746,158	0%
Reforestation of grazing Lands in Santo Domingo, Argentina	Argentina	zero	21,366	1,342,140	0	1,320,775	0%
Assisted Natural Regeneration of Degraded Lands in Albania	Albania	zero	6,250	465,537	0	459,287	0%
	Uruguay	zero	0	659	0	659	0%
	Columbia	zero	0	755,678	0	755,678	0%
production (Democratic Republic of Congo)	Congo	zero	0	1,635,338	0	1,635,338	0%
Paulo, Brazil	Brasil	—	59,257	4,788,332	0	4,729,074	0%
Humbo Ethiopia Assisted Natural Regeneration Project	Ethiopia	zero	0	880,296	0	880,296	0%
Cao Phong Reforestation Project	Vietnam	22	0	53,735	11,090	42,645	26%
and Watersheds	India	zero	0	828,016	0	828,016	0%
Improving Rural Livelihoods Through Carbon Sequestration By Adopting Environment Friendly Technology based Agroforestry Practices	India	—	0	146,888	0	146,888	0%
Reforestation as Renewable Source of Wood Supplies for Industrial Use in Brazil	Brasil	—	751,894	30,409,091	15,522	2,273,493	1%
Argos CO2 Offset Project, through reforestation activities for commercial use.	Columbia	—	133,021	1,079,384	23,100	923,263	3%
Small Scale Cooperative Afforestation CDM Pilot Project Activity on Private Lands Affected by Shifting Sand Dunes in Sirsa, Haryana.	India	zero	43	29,785	0	231,920	0%
Nerquihue Small-Scale CDM Afforestation Project using Mycorrhizal Inoculation in Chile	Chile	zero	0	185,836	0	185,836	0%
Forestry Project in Strategic Ecological Areas of the Colombian Caribbean Savannas	Columbia	zero	279	1,999,849	0	1,999,571	0%

[1] UNFCCC CDM http://cdm.unfccc.int/Projects/projsearch.html

Table A-7 Examples of Stratification in Afforestation Projects（CDM Project）[2]

Country： Paraguay
Project participants：Japan International Research Center for Agricultural Sciences
Instituto Forestal Nacional (Public entity)
https://cdm.unfccc.int/Projects/DB/TUEV-SUED1245074838.6/view
Title： Reforestation of croplands and grasslands in low income communities of Paraguari Department, Paraguay
CDM registered 2009

Stratum	Tree species	Tree spacing(m)	Plant age	Forested area (ha)
S1	Eucalyptus grandis	3.0×2.5	2007	30.05
S2	Eucalyptus grandis	3.0×2.5	2008	31.17
S3	Eucalyptus camaldulensis	3.0×2.5	2007	16.36
S4	Eucalyptus camaldulensis	3.0×2.5	2008	64.48
S5	Grevillea robusta	3.0×2.5	2007	5.59
S6	Grevillea robusta	3.0×2.5	2008	15.16
S7	Grevillea robusta	5.0×4.0	2007	14.05
S8	Grevillea robusta	5.0×4.0	2008	38.30
Total				215.16

Country： India
Project participants：Haryana CDM Variksh Kisan Samiti, Ellenabad, Sirsa
Title： Small Scale Cooperative Afforestation CDM Pilot Project Activity on Private Lands Affected by Shifting Sand Dunes in Sirsa, Haryana.
https://cdm.unfccc.int/Projects/DB/TUEV-SUED1229620290.53/view
CDM registered 2008

Stratum	Tree species	Tree spacing(m)	Plant age	Forested area (ha)
S1	*Eucalyptus hybrid*		2007	26.30
S2	*Ailanthus excelsa*		2007	57.86
S3	*Acacia tortilis*		2007	61.65
S4	*Dalbergia sissoo*		2007	53.65
S5	*Acacia nilotica*		2007	60.75
S6	*Prosopis cineraria*		2007	74.20
S7	*Zizyphus mauritiana*		2007	35.46
Total				369.87

[2] UNFCCC: http://cdm.unfccc.int/Projects/projsearch.html

Country： Bolivia

Project participants：FECAR (community organization), (Private entity)
Foundation Centro Tecnico Forestal (CETEFOR) (Private entity)
Asociación Accidental Cetefor-Sicirec (Private entity)
Vlaams Gewest (Public entry)

Title： CARBON SEQUESTRATION THROUGH REFORESTATION IN THE BOLIVIAN TROPICS BY SMALLHOLDERS OF "The Federación de Comunidades Agropecuarias de Rurrenabaque (FECAR)" Version 2.03
https://cdm.unfccc.int/Projects/DB/JACO1239802765.75/view

CDM registered 2009

Stratum	Tree species	Tree spacing(m)	Plant age	Forested area (ha)
S1	*Fast growing/ plantation*	—	—	—
S2	*Fast growing/Agroforestry System*	—	—	—
S3	*Fast growing/ Silvipastoral System*	—	—	—
S4	*Midium growing/ plantation*	—	—	—
S5	*Midiumgrowing/AgroforestrySystem*	—	—	—
S6	*Midium growing/ Silvipastoral System*	—	—	—
S7	*Slow growing/ plantation*	—	—	—
S8	*Slow growing/Agroforestry System*	—	—	—
S9	*Slow growing/ Silvipastoral System*	—	—	—
Total				317ha

Table A-8 Example of Stratification for Deforestation and Forest Degradation Prpjects

Comparison of land use category classification between IPCC and Ministry of Forestry, Indonesia

林業省土地区分	IPCC 土地区分対応
23 土地区分	6 土地区分
1. Forest (7 categories) 1) Primary Dry land Forest 2) Secondary Dry land Forest 3) Primary Mangrove Forest 4) Secondary Mangrove Forest 5) Primary Swamp Forest 6) Secondary Swamp Forest 7) Plantation Forest 2. Non-forest (14 categories) : 8) Agriculture dry land 9) Dry land Agriculture and shrubs 10) Plantation 11) Rice 12) shrub / scrub 13) Savanna 14) Kingfisher swamp 15) Swamp 16) Transmigration 17) Settlement 18) Pond 19) Land open 20) Mining 21) Port of air / sea 3. No data (category 2), 22) Cloud 23) No data	1. Forest land (4 sub categories) 1) Dry land Forest 2) Mangrove Forest 3) Swamp Forest 4) Forest Plantation 2. Crop land (3 subcategories), 5) Dry land Agriculture 6) Plantation 7) Rice 3. Grass Land (1 sub categories),: 8) Grass Land 4. Wetlands (1 sub categories), 9) Swamp 5. Settlements (1 sub categories), 10) Settlement 6. Other Lands (1 sub categories), 11) Pond, Cloud

Source: Survey on REDD in Indonesia (Global Warming Mitigation Technology Promotion Projects in 2010 (METI))

Stratification and LULUC

Class Identifier		Average carbon density ($tCO_2.ha^{-1}$)		
ID	Name	CD_{AB}	CD_{BB}	Total average carbon density
Native1	Floresta Arbórea Densa	90,99	379,13	470,13
Native2	Floresta Arbórea Aberta	91,16	42,91	134,08
Native3	Vegetação gramínio-lenhosa	51,87	16,03	67,90
Native4	Solo-exposto natural	51,87	16,03	67,90
Antrop1	Área cultivada	N.A.	N.A.	17,23
Antrop2	Pastagem	N.A.	N.A.	27,75

Note:
CD_{AB} – Average Carbon Density in the above-ground biomass carbon pool; $tCO_2.ha^{-1}$
CD_{BB} – Average Carbon Density in the below-ground biomass carbon pool; $tCO_2.ha^{-1}$
N.A. – denotes Not Available
Sources:
Native1 to Native4 - Castro and Kauffman, 1998
Antrop1 and Antrop2 - IPCC, 2006

The reference, leakage and project emission are determined based on the aboveground and belowground biomasses stock changes as for 6 stratum defined

Source: REDD survey in Mato Grosso, Brasil (2009, CDM/JICA)。

Stratification by Forest Types and Regions

Arrangement of the national forest inventory data Results (Mean AGB+BGB par Regions and F.Types

(CO_2t/ha)

※2 / ※1	1	2	3	4	5	6	7	8	9	10	11	12
1			181	157								75
2	604	282	144	157	178		279					
3										115		104
4	798	299										
5	508	275	158	131		78	219	92				67
6	516	272	135	94		66	118				165	103
7	417	272	171	116		82	181	146				70
8												
9		271	110	115		86	122		105	4		85
10	465	282	158	148	196	138	249					94
11	502	291	162	135	153	91	199	253	292			163
12	511	280	120	128	189	104	240		271			106
14												102

※1 (Bio-ecoregions):1=Cardamom Mountains rain forests, 2=Central Indochina dry forests, 3=Indochina mangroves, 4=Luang Prabang montane rain forests, 5=Northern Annamites rain forests, 6=Northern Indochina subtropical forests, 7=Northern Vietnam lowland rain forests, 8=Red River freshwater swamp forests, 9=South China-Vietnam subtropical evergreen forests, 10=Southeastern Indochina dry evergreen forests
11=Southern Annamites montane rain forests, 12=Southern Vietnam lowland dry forests, 14=Tonle Sap-Mekong peat swamp forests

※2（Forest types）; 1=Evergreen broadleaf forest(rich forest), 2=Evergreen broadleaf forest(medium forest), 3=Evergreen broadleaf forest(poor forest), 4=Evergreen broadleaf forest(rehabilitationr forest), 5=Deciduous forest, 6=Bamboo forest, 7=Mixed timber and bamboo forest, 8=Coniferous forest, 9=Mixed broadleaf and coniferous forest, 10=Mangrove forest, 11=Limestone forest, 12=Plantation

Source : Baseline Scenario Survey in Vietnam (Japan Forest Technology Association)