Assumptions made to estimate emission reductions per REDD+ region and REDD+ activity

Avoided deforestation

- For Tierras Bajas del Norte the deforestation risk map constructed for the reference region (using the VM0015 methodology, VCS) was used to identify the areas to be deforested between 2011-2020 using the amount of deforestation projected to occur using the average value of between circa 2001-circa 2010 in concordance with the guidance of the CF MF. The resulting projected deforestation within the three projects (Guatecarbon, Bosques para la Vida-Lacandon and Carbon Lachuá) in the REDD+ region was calculated and then an effectivity of 60% of deforestation reduction assumed. Calculations are presented in Table A01.

Table A01. Calculated avoided deforestation emissions for the Guatecarbon, Lacandon and Lachuá projects in the Tierras Bajas del Norte REDD+ region

	Forest to non Forest (ha)			Emissions (emission factor = 203.2 tCO2e/ha) tCO2e			Emission reductios (60% effectivity rate) tCO2e		
Year	Guatecarbon	Lacandón	Lachuá	Guatecarbon	Lacandón	Lachuá	Guatecarbon	Lacandón	Lachuá
2011	8,587	13,588	0	1,744,895	2,761,177	0	1,046,937	1,656,706	0
2012	6,341	6,827	107	1,288,572	1,387,291	21,726	773,143	832,375	13,036
2013	5,384	5,967	465	1,094,043	1,212,531	94,458	656,426	727,519	56,675
2014	5,240	5,632	580	1,064,672	1,144,426	117,848	638,803	686,656	70,709
2015	4,971	4,961	430	1,010,101	1,008,163	87,289	606,061	604,898	52,373
2016	6,441	3,219	491	1,308,799	654,107	99,761	785,279	392,464	59,857
2017	6,777	3,781	764	1,377,086	768,315	155,265	826,252	460,989	93,159
2018	6,687	3,650	771	1,358,780	741,633	156,710	815,268	444,980	94,026
2019	9,174	3,355	866	1,864,132	681,740	175,876	1,118,479	409,044	105,526
2020	8,305	3,061	898	1,687,635	622,085	182,514	1,012,581	373,251	109,508
				Average annual emission reductions 2016-2020 (tCO2e/yr)			911,572	416,146	92,415
				Emission reductions for 2016-2020 based on average annual * 5 years (tCO2e)			7,100,663		

- For Sarstún-Motagua the average annual deforestation between circa 2001-circa 2010 was calculated, then converted to emissions and projected for the period 2011-2020 (this simplified method was used because there is no deforestation risk map available). An effectivity of 60% of deforestation reduction was assumed. Calculations in Table A02.

Table A02. Calculated avoided deforestation emissions for the Caribbean Protected Areas project in the Sarstun-Motagua REDD+ region

Variable	Circa 2001-Circa 2006	Circa 2006-Circa 2010	Circa 2001-Circa 2010
Forest loss (ha)	30,672	26,693	44,716
Fores loss rate (ha/yr)	5,199	7,024	4,610
Average annual emission reductions (tCO2/yr)	-1,056,132	-1,427,063	-936,524
	Average annual emission reductions at 60% effectivity rate (tCO2e/yr)		-561,914

Emission reductions for 2016-2020 based on average annual * 5 years (tCO2e)	-2,809,572

- For Occidente and, Centro - Oriente a 5% effectivity value was used to make room for eventual REDD+ projects, still not planned or identified. Calculations are presented in Table A03.

Table A03. Calculated avoided deforestation emissions for projects (not identified or planned in the Occidente and Centro-Oriente REDD+ regions

Forest loss (ha)	Circa 2001-Circa 2006	Circa 2006-Circa 2010	Circa 2001-Circa 2010
Occidente	125,367	105,076	161,232
Centro – Oriente	72,226	69,008	107,974
Forest loss rate (ha/yr)	Circa 2001-Circa 2006	Circa 2006-Circa 2010	Circa 2001-Circa 2010
Occidente	21,249	27,651	16,622
Centro – Oriente	12,242	18,160	11,131
Emissions from forest loss (tCO2/yr)	Circa 2001-Circa 2006	Circa 2006-Circa 2010	Circa 2001-Circa 2010
Occidente	-4,316,798	-5,617,578	-3,376,848
Centro - Oriente	-2,486,967	-3,689,324	-2,261,409
	Average annual emission reductions at 5% effectivity rate (tCO2e/yr) for **Occidente**		-168,842
	Emission reductions for 2016-2020 based on average annual * 5 years (tCO2e) for **Occidente**		-844,212
	Average annual emission reductions at 5% effectivity rate (tCO2e/yr) for **Centro - Oriente**		-113,070
	Emission reductions for 2016-2020 based on average annual * 5 years (tCO2e) for **Centro - Oriente**		-565,352

- For Costa Sur there is no projected avoided deforestation since the REDD+ region is already almost completely deforested.

Reforestation and stock increase activities

We annual values of reforestation and stock increase activities included go from 2010-2020 by REDD+ region. Different tree plantation densities where used for the activities related to reforestation and the activity of stock enhancement in agroforestry systems. This areas and densities are presented in Table A04

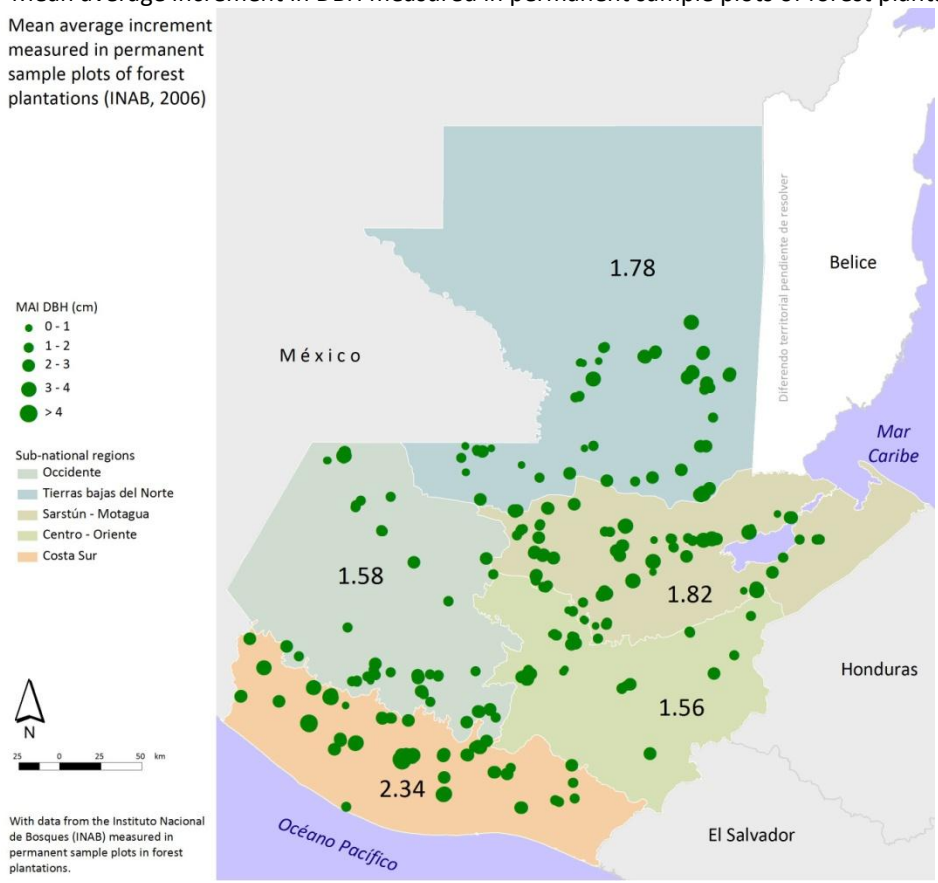
Table A04. Stock increase activities by type and REDD+ region

REDD+ region	Reforestation (broadleaved) and management of plantations	Reforestation using conifer species	Stock increase in agro-forestry systems	Reforestation for fuelwood production
Tree density	500 trees/ha	500 trees/ha	50 trees/ha	500 trees/ha
Occidente (ha/year)	370	925	131	400
Tierras Bajas del Norte (ha/year)	1,480	1,110	44	1,600
Sarstún - Motagua (ha/year)	925	1,110	795	1,000
Centro - Oriente (ha/year)	185	370	54	200

Costa Sur (ha/year)	20	185	65	800

To estimate growth we used an unpublished database of permanent measurement plots established in plantations and with data collected by INAB. The database contains information on mean annual increment (MAI) in diameter at breast height (DBH) and is geographically referenced. We estimated the MAI DBH by REDD+ region by averaging the values of the permanent plots within each of the REDD+ regions. The map in Figure A01 shows the location of permanent plots and the MAI-DBH average value for the REDD+ regions.

Figure A01. Mean average increment in DBH measured in permanent sample plots of forest plantations



We projected the growth of DBH using the corresponding average MAI value and then estimated the accumulated biomass using the equations:

For conifer species[1]*: Y = EXP (-1,170 + 2,119 * LnD)*
For broadleaved species[2]*: Y = 42,69 – 12,8 (D) + 1,242 (D2)*

where Y = above-ground biomass in kilograms and D= Tree diameter at breast height in centimeters.

[1] Used in the National Forest Inventory (http://www.fao.org/forestry/23224-015b0b120eb03aa8b646ce6e3095c7a6a.pdf, page 47) and cited to come from Brown, S. 1996. A Primer for Estimating Biomass and Biomass Change in Tropical Forests. FAO. S. Brown 200 SW 35th St Corvallis, Oregon 97333, USA.

[2] Used in the National Forest Inventory (http://www.fao.org/forestry/23224-015b0b120eb03aa8b646ce6e3095c7a6a.pdf, page 47) and cited to come from Brown, S., A.J.R. Gillespie, A.E. Lugo. 1989. "Biomass Estimation Methods for Tropical Forests with Applications to Forest Inventory Data". Forest Science 35:881-902

Tables A05 and A06 presents estimations of growth in DBH and CO2e by year and broadleaved/conifers species.

Table A05. Estimations of growth in DBH and CO2e by year and REDD+ region for broadleaved species

	DBH increment using average MAI values (cm)					Dry biomass by tree in kg (using Y = 42,69 – 12,8 (D) + 1,242 (D2))					tCO2e/ha assuming 500 trees/ha (using biomass by tree (kg)*0.5*44/12*500/1000)				
Year	Occidente	TBNG	Sarstún Motagua	Centro - Oriente	Costa Sur	Occidente	TBNG	Sarstún Motagua	Centro - Oriente	Costa Sur	Occidente	TBNG	Sarstún Motagua	Centro - Oriente	Costa Sur
0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	1.58	1.78	1.82	1.56	2.34	25.6	23.8	23.5	25.7	19.5	23.4	21.9	21.5	23.6	17.9
2	3.16	3.56	3.64	3.12	4.68	14.6	12.9	12.6	14.8	10.0	13.4	11.8	11.5	13.6	9.2
3	4.74	5.34	5.46	4.68	7.02	9.9	9.8	9.8	10.0	14.0	9.1	8.9	9.0	9.2	12.9
4	6.32	7.12	7.28	6.24	9.36	11.4	14.5	15.3	11.2	31.7	10.5	13.3	14.1	10.2	29.1
5	7.9	8.9	9.1	7.8	11.7	19.1	27.1	29.1	18.4	62.9	17.5	24.9	26.6	16.9	57.7
6	9.48	10.68	10.92	9.36	14.04	33.0	47.7	51.0	31.7	107.8	30.2	43.7	46.8	29.1	98.8
7	11.06	12.46	12.74	10.92	16.38	53.0	76.0	81.2	51.0	166.3	48.6	69.7	74.4	46.8	152.4
8	12.64	14.24	14.56	12.48	18.72	79.3	112.3	119.6	76.4	238.3	72.7	102.9	109.6	70.0	218.5
9	14.22	16.02	16.38	14.04	21.06	111.8	156.4	166.3	107.8	324.0	102.5	143.3	152.4	98.8	297.0
10	15.8	17.8	18.2	15.6	23.4	150.5	208.4	221.1	145.3	423.2	138.0	191.0	202.7	133.2	388.0

Table A06. Estimations of growth in DBH and CO2e by year and REDD+ region for conifer species

	DBH increment using average MAI values (cm)					Dry biomass by tree in kg Y = exp { - 1.170 + 2.119*ln(D)}					tCO2e/ha assuming 500 trees/ha (using biomass by tree (kg)*0.5*44/12*500/1000)				
Year	Occidente	TBNG	Sarstún Motagua	Centro - Oriente	Costa Sur	Occidente	TBNG	Sarstún Motagua	Centro - Oriente	Costa Sur	Occidente	TBNG	Sarstún Motagua	Centro - Oriente	Costa Sur
0	0	0	0	0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	1.58	1.78	1.82	1.56	2.34	0.8	1.1	1.1	0.8	1.9	0.7	1.0	1.0	0.7	1.7
2	3.16	3.56	3.64	3.12	4.68	3.6	4.6	4.8	3.5	8.2	3.3	4.2	4.4	3.2	7.5
3	4.74	5.34	5.46	4.68	7.02	8.4	10.8	11.3	8.2	19.3	7.7	9.9	10.4	7.5	17.7
4	6.32	7.12	7.28	6.24	9.36	15.4	19.9	20.8	15.0	35.5	14.2	18.2	19.1	13.8	32.5
5	7.9	8.9	9.1	7.8	11.7	24.8	31.9	33.4	24.1	56.9	22.7	29.2	30.6	22.1	52.2
6	9.48	10.68	10.92	9.36	14.04	36.5	46.9	49.2	35.5	83.8	33.4	43.0	45.1	32.5	76.8
7	11.06	12.46	12.74	10.92	16.38	50.5	65.1	68.2	49.2	116.1	46.3	59.6	62.5	45.1	106.5
8	12.64	14.24	14.56	12.48	18.72	67.1	86.3	90.5	65.3	154.1	61.5	79.1	83.0	59.8	141.3
9	14.22	16.02	16.38	14.04	21.06	86.1	110.8	116.1	83.8	197.8	78.9	101.6	106.5	76.8	181.3
10	15.8	17.8	18.2	15.6	23.4	107.6	138.5	145.2	104.7	247.3	98.6	127.0	133.1	96.0	226.7

Using increments in CO2e estimated by REDD+ region and annual area planted we estimated removals by stock increase activities by year, presented in Table A06. Detailed calculations made to produce this table can be found in Annex ZZ05 and Annex ZZ06.

Table A06. Estimate removalss by stock increase activities by year and REDD+ region

Year	**REDD+ region**	**Reforestation (broadleaved)**	**Reforestation using conifer species**	**Stock increase in agro-forestry systems**	**Reforestation for fuelwood production**	**Total**
2016	Occidente	11,181	30,909	395	12,087	54,572
2016	Tierras Bajas del Norte	182,058	47,748	190	69,889	299,885

2016	Sarstún – Motagua	131,258	50,050	3,719	46,767	231,794
2016	Centro – Oriente	5,375	12,034	158	5,810	23,378
2016	Costa Sur	257,342	14,208	646	79,056	351,251
2017	Occidente	17,992	42,849	636	19,451	80,928
2017	Tierras Bajas del Norte	241,242	66,193	304	111,503	419,241
2017	Sarstún - Motagua	172,574	69,385	5,919	74,437	322,315
2017	Centro - Oriente	8,652	16,683	255	9,353	34,943
2017	Costa Sur	305,127	19,697	996	121,924	447,744
2018	Occidente	26,907	56,863	951	29,088	113,809
2018	Tierras Bajas del Norte	305,780	87,841	448	164,659	558,729
2018	Sarstún - Motagua	216,980	92,077	8,719	109,650	427,425
2018	Centro - Oriente	12,954	22,139	381	14,004	49,479
2018	Costa Sur	353,337	26,138	1,428	174,767	555,670
2019	Occidente	37,925	72,983	1,340	41,000	153,247
2019	Tierras Bajas del Norte	379,156	112,743	625	229,359	721,883
2019	Sarstún - Motagua	266,948	118,179	12,119	152,405	549,651
2019	Centro - Oriente	18,282	28,416	538	19,764	66,999
2019	Costa Sur	401,935	33,548	1,941	237,584	675,008
2020	Occidente	51,046	91,240	1,803	55,184	199,273
2020	Tierras Bajas del Norte	651,268	140,945	832	305,602	1,098,647
2020	Sarstún - Motagua	466,076	147,741	16,119	202,703	832,638
2020	Centro - Oriente	24,634	35,524	725	26,632	87,515
2020	Costa Sur	936,374	41,940	2,536	310,376	1,291,225
	Total	**5,482,400**	**1,478,073**	**63,723**	**2,623,054**	**9,647,249**