



## Ministry of Forests and Soil Conservation REDD Implementation Centre

Develop National Database of Basic Attributes of all Forest Management Regimes and Develop National REDD+ Information System or Registry

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Technical Working Document n. 1 to Final Report

**Methodologies for calculating forest biomass and carbon contents for Nepal forests in the framework of NFD-NFIS**

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## 1. Introduction and definitions

Forest biomass and carbon contents are essential variables for NFD and NFIS in a REDD+ context.

The information to be generated is described in table 17 of Annex 15 CF guidelines, but the methodology described here can be applied to any forest management regime if needed input data are available.

Table 1: Expected output

Nominal CFUG area (ha)	Actual CFUG forest area (ha)	Average growing stock per ha (m <sup>3</sup> /ha)	Total growing stock (m <sup>3</sup> )	Total Above ground biomass (Mg)	Total aboveground carbon content (Mg)	Total below ground Carbon content (Mg)	Grand Total carbon content (above + below ground)
(1)	(2)	(3)	(4)				

(1) Nominal CFUG area (ha). This refers to the area defined under Section 1 – General Information 1.6.1: Area (ha) of Annex 15 of CF Guidelines.

(2) Actual CFUG forest area (ha). This refers to the portion of the Forest Management Unit actually covered with forests. (= net forest area). For estimating the net forest area the following information is needed:

1. Spatial boundaries of the Forest Management Unit
2. Updated forest or vegetation map

If this information is available a simple GIS overlay operation will provide the net area and this must be used for all further calculations of Total growing stock (4), biomass and carbon contents.

(3) The calculation of average growing stock is highly dependent on data availability. In particular, following the terminology used by IPCC, three Tiers are defined for Carbon calculations, where Tier 1 is coarser while Tier 2 and 3 are respectively more accurate but require more data.

In the case of Nepal we propose to adopt Tier 2 or Tier 3 for aboveground, belowground biomass and carbon calculations, depending on growing stock data availability. From experience, the majority of growing stock data for Nepal are available only at aggregated level (i.e. total growing stock per hectare, expressed in cubic feet or cubic meters (item 1.6.4 of Section 1 or Table 17 of Annex 15). In fact it could be possible to use a more detailed approach (similar to Tier 3) by using original field inventory data tally sheets, compiled during the inventories carried out for the preparation of Forest Operational Plans. However no such inventory tally sheets were available to the writer. In fact most of the forest inventories for CF

and other forest management regimes are outsourced to external consultants, which normally deliver forest inventory reports with aggregated results only. It is strongly advisable that in future the original forest inventory data are collected and recorded in the NFD database. In this way it will be possible to apply specific volume and biomass equations (at present the ones developed by Sharma and Pukkala are officially endorsed by the Government of Nepal), to individual trees using diameter, tree height and species wood density in order to obtain more precise biomass and carbon contents estimations.

However if growing stock is available only at aggregated level then Tier 2 must be used as follows:

Tier 2 will be used and the following methodology suggested by “*GOFC-GOLD, 2012, A sourcebook of methods and procedures for monitoring and reporting anthropogenic greenhouse gas emissions and removals associated with deforestation, gains and losses of carbon stocks in forests remaining forests, and forestation. GOFC-GOLD Report version COP18-1, (GOFC-GOLD Land Cover Project Office, Wageningen University, The Netherlands)*” will be adopted.

Biomass density can be calculated from volume over bark of merchantable growing stock wood (VOB) by "expanding" this value to take into account the biomass of the other aboveground components—this is referred to as the biomass conversion and expansion factor (BCEF). When using this approach and default values of the BCEF provided in the IPCC AFOLU, it is important that the definitions of VOB match. The values of BCEF for tropical forests in the AFOLU report are based on a definition of VOB as follows:

*Volume Over Bark (VOB) is equal to inventoried volume over bark of free bole, i.e. from stump or buttress to crown point or first main branch. Inventoried volume must include all trees, whether presently commercial or not, with a minimum diameter of 10 cm at breast height or above buttress if this is higher.*

Table 2: Variables naming and units of measure

Variable name	Variable description	Unit of measure
VOB_HA	Volume Over Bark per hectare (see definition above)	M3 or Cubic feet per ha
VOB_HA_M3	Volume Over Bark per hectare in m3/ha	M3 /ha
VOB_TOT	Total Growing Stock	M3
BCEF t/m <sup>3</sup>	Biomass conversion and expansion factor (ratio of aboveground oven-dry biomass of trees [t/ha] to merchantable growing stock volume over bark [m <sup>3</sup> /ha]).	Dimensionless
AGB_HA	Aboveground tree biomass (oven dry weight) per hectare	Mg/ha or t/ha (*)
TAGB	Total Aboveground tree biomass (oven dry weight)	Mg or t
TAGCC	Total Aboveground Carbon Content	MgC or tC
TBGCC	Total Belowground Carbon Content	MgC or tC
TCC	Total Carbon Content (Mg or tons)	MgC or tC

(\*) Unit of measure for biomass is better represented by Mg (Mega grams) = 1,000,000 grams, = 1,000 kg. This is to avoid confusion between ton of decimal metric system = 1,000 kg, also referred as Metric ton, and the various definition of ton used in English and American Systems

## 2. Methodology

### STEP 1: CONVERT TOTAL GROWING STOCK PER HECTARE (VOB) IN M3/HA

Input data		Process	Output
Average growing stock per hectare (Volume Over Bark)	Unit		
VOB_HA	Cuft or m3		
		IF Unit = m3 then VOB_M3_HA = VOB_HA ELSE (if cu ft) VOB_M3_HA = VOB_HA*0.02831685	VOB_M3_HA

### STEP 2: CALCULATE TOTAL GROWING STOCK (M3)

Input data		Process	Output
VOB_HA	M3/HA	TOT_VOB = VOB_HA*	TOT_VOB (M3)
AREA	HA	AREA	Note: Net Forest area should be used whenever available

### STEP 3: CONVERT TOTAL GROWING STOCK PER HECTARE INTO TOTAL ABOVEGROUND BIOMASS (tons or Mg)

Aboveground biomass (t/ha) is then estimated as follows: = VOB \* BCEF

where:

BCEF t/m<sup>3</sup> = biomass conversion and expansion factor (ratio of aboveground oven-dry biomass of trees [t/ha] to merchantable growing stock volume over bark [m<sup>3</sup>/ha]).

Values of the BCEF relevant to tropical humid broadleaved, coniferous forests and mixed broadleaved / coniferous forests are shown in the following table.

Table 2: Values of BCEF (average) for application to volume data. (Modified from Table 4.5 in IPCC AFOLU)

Forest type	Growing stock volume range (VOB m <sup>3</sup> /ha)						
	<= 20	21-40	41-60	61-80	81-120	121-200	>201
Broadleaved	4.0	2.8	2.1	1.7	1.5	1.3	1.0
Coniferous	1.8	1.3	1.0	0.8	0.8	0.7	0.7
Mixed Broadleaved / Coniferous	2.9	2.1	1.6	1.3	1.2	1.0	0.9

### 3.1 CALCULATIONS

Input data	Process	Output
Average growing stock per hectare (Volume Over Bark) VOB_HA M3		
BIOMASS CONVERSION AND EXPANSION FACTOR (BCEF)		
	<p>ABOVEGROUND BIOMASS = VOB * BCEF Where BCEF is taken from the Table above depending on VOB range and Forest type</p> <p>TAGB = AGB * FOREST AREA</p>	<p>AGB in tons/ha, also expressed as Mg per ha = ABOVEGROUND BIOMASS (Oven dry weight).</p> <p>TOTAL ABOVEGROUND BIOMASS = TAGB is then obtained multiplying AGB * FOREST AREA. (Note: net forest area should be used, rather than total area, whenever available)</p>

#### STEP 4: CALCULATE TOTAL ABOVEGROUND CARBON CONTENT

According to literature, the average carbon content of tree biomass is 47%. Hence a factor of 0.47 is applied to TOTAL ABOVEGROUND BIOMASS to obtain the corresponding Carbon content = TOTAL ABOVEGROUND CARBON CONTENT (TAGCC)

#### 4.1 CALCULATIONS

Input data	Process	Output
TAGB= Total Aboveground Biomass (tons or Mg)	TOTAL ABOVEGROUND CARBON CONTENT (TAGCC) = TAGB * 0.47	TAGCC (Total Aboveground Carbon Content – tons or MgC)

#### STEP 5: CALCULATE BELOWGROUND BIOMASS AND BELOWGROUND CARBON CONTENT

Belowground tree biomass (roots) is almost never measured, but instead is included through a relationship to aboveground biomass (usually a root-to-shoot ratio). In the case of Nepal the root-to-shoot ratio has been defined by DFRS for FRA Nepal to 0.2, and this value will be adopted. Similarly to Aboveground Carbon Content, also Belowground Carbon Content is calculated using a conversion factor of 0.47 of the oven dry biomass weight.

#### 5.1 CALCULATIONS

Input data	Process	Output
-TAGB in tons, or Mg = TOTAL ABOVEGROUND BIOMASS (Oven dry weight) -ROOT TO SHOOT RATIO = 0.2 -BIOMASS TO CARBON CONVERSION FACTOR = 0.47	TBGCC = TAGB * 0.2 * 0.47	TBGCC = Total Belowground Carbon Content. (MgC or tC)

#### STEP 6: CALCULATE TOTAL CARBON CONTENT (ABOVE GROUND + BELOW GROUND)

Total Carbon Content is simply the sum of Total Aboveground Carbon Content plus Total Belowground Carbon Content

#### 6.1 CALCULATIONS

Input data	Process	Output
TAGCC TBGCC	TCC = TAGCC + TBGCC	TCC = Total Carbon Content (MgC or tC)



### 3. Worked out example

#### 3.1 Sample of original data

Table 3: Input data

District	VDC Name	Ward	Community Forest Group No	User Code	Name	Operational Plan review/renewed date:	Annual Report for fiscal year:	Area (ha)	Estimated Growing Stock (CUFT/ha)
Terhathum	Sabla	4,5,6,7,8	TTM/CT/14/13		Kholi Ramite Community forest	01/10/2071	2071/2072	18.79	5515

#### STEP 1: CONVERT TOTAL GROWING STOCK PER HECTARE (VOB) IN M3/HA

In the example above input data are as follows:

Growing Stock = **5515 cuft/ha**

VOB\_M3\_HA = 5515 \* 0.02831685 = **156.2 m3/ha**

#### STEP 2: CALCULATE TOTAL GROWING STOCK (M3)

VOB\_HA = 156.2 m3/ha

Area = 18.79 ha

TOT\_VOB = VOB\_HA \* AREA

TOT\_VOB = 156.2 \* 18.79 = **2935.00 m3**

#### STEP 3: CONVERT TOTAL GROWING STOCK PER HECTARE INTO PER HECTARE AND TOTAL ABOVEGROUND BIOMASS

Using the values contained in Table 2 above the corresponding BCEF (biomass conversion and expansion factor) for a VOB of 156.2 m3/ha (falling in the range 121-200 m3/ha) and broadleaved forest type is equal to 1.3.

Then

ABOVEGROUND BIOMASS per ha (AGB) = VOB \* BCEF

AGB = 156.2 \* 1.3 = **203.06 Mg /ha.**

And

$$\text{TOTAL ABOVEGROUND BIOMASS (TAGB)} = \text{AGB} * \text{AREA}$$

$$\text{TAGB} = 203.06 * 18.76 = \mathbf{3815.50 \text{ Mg}}$$

STEP 4: CALCULATE TOTAL ABOVEGROUND CARBON CONTENT

$$\text{TAGCC} = \text{TAGB} * 0.47$$

$$\text{TAGCC} = 3815.50 * 0.47 = \mathbf{1793.28 \text{ MgC}}$$

STEP 5: CALCULATE BELOWGROUND BIOMASS AND BELOWGROUND CARBON CONTENT

$$\text{TBGCC} = \text{TAGB} * 0.2 * 0.47$$

$$\text{TBGCC} = 3815.50 * 0.2 * 0.47 = \mathbf{358.66 \text{ MgC}}$$

STEP 6: CALCULATE TOTAL CARBON CONTENT (ABOVE GROUND + BELOW GROUND)

$$\text{TCC} = \text{TAGCC} + \text{TBGCC}$$

$$\text{TCC} = 1793.28 + 358.66 = \mathbf{2151.94 \text{ MgC}}$$

### 3.2 Results

Using the calculations performed above, then Table 17 of Annex 15 of CF Guidelines can be filled as follows:

Table 4: Example of results

Nominal CFUG area (ha)	Actual CFUG forest area (ha)	Average growing stock per ha (m3/ha)	Total growing stock (m3)	Total Above ground biomass (Mg)	Total aboveground carbon content (MgC)	Total belowground Carbon content (MgC)	Grand Total carbon content (above + below ground) (MgC)
18.79	18.79	156.2	2935.00	3815.50	1793.28	358.66	2151.94

## 4. Reporting

The algorithms described above will be applied to each CF or other management regime where growing stock (VOB), forest area and species composition are known.

The reporting can be done at individual forest management regime or at aggregated (District) level.

### 4.1 Reporting at individual CF or forest management regime

Table 5: Report at CF level

District: Terhathum

CFUG_Name	Forest area ha	Volume per ha m <sup>3</sup>	Aboveg. Biomass Mg/ha	Total volume Mg	Total Aboveg. Biomass Mg	Total Aboveg. Carbon Content MGC	Total Carbon Content MgC
Adau Community Forest	2.5	125	162	312	406	191	229
Aaitabare Community Forest	3.1	180	234	550	715	336	403
Ratmate Community forest	2.1	151	196	320	416	196	235
Tinjure Baisakethalo Community forest	19.6	156	203	3060	3978	1870	2244
Chitre Community Forest	36.3	159	207	5780	7514	3532	4238
Karkale Community Forest	21.8	153	107	3325	2328	1094	1313
Daduwa community forest	41.9	168	218	7030	9139	4295	5154
Dhadejokepani Community Forest	13.3	157	204	2090	2717	1277	1532
Jaubari Kalikhola Community Forest	43.6	161	209	7020	9126	4289	5147
Tinjure Ratpokhari Community Forest	523.2	172	224	90001	117001	54991	65989
Namuna Community Forest	10.7	171	223	1830	2379	1118	1342
Devithan Salghari Community Forest	41.3	175	227	7220	9386	4411	5294
Panitanki Community Forest	4.6	145	188	661	859	404	485
Sansari Community Forest	8.0	155	202	1240	1612	758	909
BhaluKhop Bagthala Community Forest	177.3	160	208	28400	36920	17353	20823
Salleri Community forest	13.5	97	77	1304	1043	490	588
Jamune Community forest	11.5	164	115	1890	1323	622	746
Bhadaure Pakha Community Forest	7.5	164	214	1240	1612	758	909
ChuliDanda Community Forest	5.4	148	104	800	560	263	316
Chaite Community Forest	226.4	180	235	40850	53106	24960	29952
Gairigaun Community Forest	68.5	171	222	11700	15210	7149	8579
Durali Bhuilke dhara Community Forest	79.3	180	234	14250	18525	8707	10448
Pakhrabari community Forest	5.8	61	91	350	525	247	296
SarkoDhad Utteseni Community Forest	25.9	160	208	4140	5382	2530	3035
Salla Bote Community Forest	17.3	157	203	2700	3510	1650	1980
Saisaile Bhir Community Forest	19.9	143	186	2850	3705	1741	2090
Sano Community Forest	1.3	150	196	188	244	115	138
ChyanDanda Community Forest	33.5	170	221	5700	7410	3483	4179

CFUG_Name	Forest area ha	Volume per ha m3	Aboveg. Biomass Mg/ha	Total volume Mg	Total Aboveg. Biomass Mg	Total Aboveg. Carbon Content MGC	Total Carbon Content MgC
Mahhabhir Community Forest	12.1	102	153	1230	1845	867	1041
Chitre Community Forest	194.1	176	229	34200	44460	20896	25076
Bhotekharka Majhuwatar Community Forest	343.7	164	213	56401	73321	34461	41353
Ramite community Forest	19.6	83	124	1620	2430	1142	1371
Aphthyaro Simaltar Community Forest	10.1	0	0	0	0	0	0
Singhdevi Community Forest	99.0	166	216	16450	21385	10051	12061
Majhuwatar Community Forest	69.7	173	224	12032	15642	7352	8822
Salleri Bahuudesya Community Forest	50.7	176	229	8930	11609	5456	6548
Katushe Sigenda Community Forest	1.8	103	154	180	270	127	152
Kale Gairo Community Forest	26.6	180	235	4800	6240	2933	3519
Aphthyaro Yakse Chautare Community Forest	33.0	173	225	5700	7410	3483	4179
Budhobhor Community Forest	6.5	157	204	1020	1326	623	748
Kalaije Salghari Community Forest	4.2	172	224	720	936	440	528
Hiudiya Community Forest	17.2	168	218	2880	3744	1760	2112
Alchepakha Community Forest	2.5	150	195	375	488	229	275
ChyaneGhumti Takure Community Forest	21.8	157	204	3420	4446	2090	2508
Dhadpakha Community Forest	0.7	171	223	120	156	73	88
Sisne Tamfule Community Forest	14.9	1483	1483	22100	22100	10387	12465
Tarebhir Dharape Community forest	27.5	170	221	4680	6084	2860	3431
Bhirale Pakha Community Forest	0.9	153	199	130	169	79	95
Lamche Ahal Community Forest	10.1	160	208	1620	2106	990	1188
Pathibhara Community Forest	6.3	151	196	950	1235	580	697
Ipungeip Community Forest	1.8	106	158	190	285	134	161
Kattikekagune Community Forest	18.4	166	216	3060	3978	1870	2244
Silgadhi Community Forest	123.8	145	189	18000	23400	10998	13198
Salle Sisnepani Community Forest	18.4	165	214	3036	3947	1855	2226
DhanpeChyane Danda Community Forest	15.5	161	112	2494	1746	821	985
Devithan Community Forest	18.8	153	199	2880	3744	1760	2112
Manebatase Community Forest	15.4	145	102	2240	1568	737	884
Phalate Ramite Community Forest	5.3	149	193	780	1014	477	572
Bijaya Bagesal Community Forest	10.1	150	195	1520	1976	929	1114
Supare Bagthala Community Forest	72.8	178	231	12930	16809	7900	9480
Bhulke Supare Community Forest	6.9	138	179	950	1235	580	697
Bhangekiteni Community Forest	5.2	146	102	760	532	250	300
Gadipakha Community Forest	1.2	154	200	185	241	113	136
Maule Kopche Community Forest	26.3	152	198	3995	5194	2441	2929
Golebari Keureni Community Forest	29.1	155	201	4500	5850	2750	3299
Simsar Chiplitar Community Forest	1.4	121	158	170	221	104	125
Tintire Community Forest	10.9	137	178	1485	1931	907	1089
Aunshi Danda Salleri Community Forest	8.6	147	103	1260	882	415	497
Tamang Damda Community Forest	8.5	148	104	1260	882	415	497

CFUG_Name	Forest area ha	Volume per ha m3	Aboveg. Biomass Mg/ha	Total volume Mg	Total Aboveg. Biomass Mg	Total Aboveg. Carbon Content MGC	Total Carbon Content MgC
Dandungepakha Salleri Community Forest	5.6	150	105	838	587	276	331
Panitar Community Forest	12.3	146	190	1800	2340	1100	1320
Kharbari Pakha Community Forest	5.7	130	91	738	517	243	291
KoltarForest	11.8	137	96	1620	1134	533	640
Devkot Salleri Community Forest	12.3	166	116	2035	1425	670	803
Ramite Community Forest	6.1	158	205	963	1252	588	706
sansari Danda Community Forest	8.8	140	98	1230	861	405	486
Bagthala Salleri Community Forest	15.0	132	92	1980	1386	651	782
Pangretar Salleri Community Forest	20.2	152	106	3060	2142	1007	1208
Bagthala khopidhunga Community Forest	44.7	170	119	7600	5320	2500	3001
Kalika Devi Community Forest	5.6	168	218	940	1222	574	689
Pilunge Community Forest	23.1	168	117	3875	2713	1275	1530
Ghoretar Community Forest	61.6	174	226	10720	13936	6550	7860
Lamochautara Community Forest	153.0	186	242	28500	37050	17414	20896
Hattikimbha Belbote community Forest	130.8	182	236	23750	30875	14511	17414
Khaireni Nibutar Community Forest	87.5	184	240	16150	20995	9868	11841
Danda Kharka Community Forest	238.9	200	260	47750	62076	29176	35011
Kalumdanda Community Forest	20.8	145	188	3000	3900	1833	2200
Babu Community Forest	88.9	171	222	15200	19760	9287	11145
DhulPuje Community Forest	1.2	142	184	170	221	104	125
Rani Pokhari Community Forest	4.3	158	205	671	872	410	492
Gadi Community Forest	38.7	172	223	6650	8645	4063	4876
Shreejanga Community Forest	0.7	50	105	35	74	35	41
Yalambar community Forest	1.3	134	175	168	218	103	123
Simalpakha Community Forest	6.2	167	217	1030	1339	629	755
Kanashe Community Forest	1.3	152	198	190	247	116	139
Juke Satlunge Community Forest	9.9	142	185	1400	1820	855	1026
Kattike Kothesangu Salghari Community Forest	66.6	162	211	10800	14040	6599	7919
Sano Sabla Community Forest	19.5	53	112	1040	2184	1026	1232
Sathimude community Forest	29.2	497	497	14500	14500	6815	8178
Kholi Ramite Community forest	18.8	156	203	2935	3816	1793	2152
Daskate Community forest	5.2	137	179	720	936	440	528
Lachhimune Community forest	6.1	149	193	900	1170	550	660
Patle Chaur Panigahiro Community Forest	19.6	159	207	3120	4056	1906	2288
JanPriya Community Forest	11.5	151	196	1735	2256	1060	1272
Shreejanshil Aakashe Pakha Community Forest	9.5	161	113	1530	1071	503	604
Musune Jiptar Community Forest	580.0	49	103	28500	59851	28130	33756
Gupha Salleri Community Foresty	3.5	166	116	580	406	191	229
Chisapani Gadi Community Forest	49.0	148	192	7240	9412	4424	5308
Keureni Community Forest	841.6	179	125	150301	105211	49449	59339
Susling Salghari Community Forest	87.4	174	226	15200	19760	9287	11145
Sundar Uttesini Comunity Forest	1.1	162	210	173	225	106	127
Bokredada Community Forest	24.4	169	220	4136	5377	2527	3033
Sera Community Forest	6.7	139	97	925	648	304	365

CFUG_Name	Forest area ha	Volume per ha m3	Aboveg. Biomass Mg/ha	Total volume Mg	Total Aboveg. Biomass Mg	Total Aboveg. Carbon Content MGC	Total Carbon Content MgC
Ratmate Banpala Community Forest	2.3	165	215	380	494	232	279
Megha Multipurpose Community Forest	22.1	181	235	3990	5187	2438	2925
Tinjure Community forest	446.8	177	230	79201	102961	48392	58070
Chintang Devi Dhad Community Forest	2.9	125	163	360	468	220	264
Kalika Community Forest	1.0	136	177	135	176	82	99
Hattiahaal Community Forest	50.7	176	229	8930	11609	5456	6548
Seselung Chapalete Community Forest	1.3	154	201	196	255	120	144
Kalika Devi Than Community Forest	1.0	0	0	0	0	0	0
Kane Ghaderi Community Forest	6.2	145	188	890	1157	544	653
Urathe Community Forest	47.2	177	124	8360	5852	2750	3301
Thuloban community Forest	54.0	185	130	10000	7000	3290	3948
Pathibhara Jorsalla Community Forest	11.5	150	105	1730	1211	569	683
Tumligatar Bhadaure Community Forest	500.0	19	34	9500	17100	8037	9644
Karkale Community Forest	668.8	161	209	107401	139621	65622	78746
Pujari Danda Community forest	2.5	100	80	250	200	94	113
Boldhunga Batashe Community Forest	63.7	17	69	1100	4400	2068	2482
Lishabote Community Forest	228.8	0	0	0	0	0	0
Sanduwa Community Forest	56.1	160	209	9000	11700	5499	6599
Kopche Hadikhop Community Forest	158.8	170	221	27000	35100	16497	19797
Mechyamadhap Community Forest	365.8	184	240	67451	87686	41212	49455
Khalde Community Forest	200.0	189	246	37810	49153	23102	27723
Tarebhor Community Forest	284.7	160	208	45600	59281	27862	33434
Lashune Community Forest	259.8	104	156	27000	40500	19035	22842
Gauthali Pakha Community Forest	10.5	162	210	1700	2210	1039	1246
AkashDanda Community Forest	11.7	162	211	1900	2470	1161	1393
Thokchungchyantar Manchuwachuli Community Forest	294.5	171	222	50400	65521	30795	36954
Khopi Community Forest	146.0	189	245	27550	35815	16833	20200
Pathibhara Tinmude Community Forest	135.0	177	230	23880	31044	14591	17509
Deurali Community Forest	226.8	184	240	41800	54341	25540	30648
Gairinagi Community Forest	42.7	183	237	7800	10140	4766	5719
Lishabote community Forest	76.3	0	0	0	0	0	0
Ukhubari Community Forest	186.0	183	128	34020	23814	11193	13431
Chuli Community Forest	1.1	128	167	136	177	83	100
Sirisepani Tyanki Community Forest	0.6	61	79	37	48	23	27
Salleri Community forest	9.3	164	115	1520	1064	500	600
ChauriKharkh Chiseni Community forest	51.1	170	221	8688	11295	5308	6370
Dangijor Community Forest	107.5	167	218	18000	23400	10998	13198
Hukkaphor Community Forest	18.1	151	196	2720	3536	1662	1994

CFUG_Name	Forest area ha	Volume per ha m3	Aboveg. Biomass Mg/ha	Total volume Mg	Total Aboveg. Biomass Mg	Total Aboveg. Carbon Content MGC	Total Carbon Content MgC
Tintale Community Forest	4.6	159	206	730	949	446	535
AhalDanda Community Forest	12.3	147	191	1800	2340	1100	1320
Lundrung Kholathewa Community Forest	11.4	157	204	1791	2328	1094	1313
Chyane pakha community forest	2.0	60	78	120	156	73	88
Naminta Community forest	47.2	185	241	8740	11362	5340	6408
Mahabhir Khola community Forest	36.4	168	219	6120	7956	3739	4487
Sirsabek Community Forest	78.6	163	211	12780	16614	7809	9370
Puchchar Saibek Community Forest	110.4	172	224	19000	24700	11609	13931
Jaganpata Community Forest	41.9	166	216	6956	9043	4250	5100
Malingeni Community Forest	44.4	171	120	7600	5320	2500	3001
Sasaling Kathare Community forest	12.0	146	189	1740	2262	1063	1276
Kavre Community Forest	1.2	158	206	190	247	116	139
Chaite Mahavir Community Forest	85.0	187	244	15928	20707	9732	11679
Gyaljepati Community Forest	1.3	149	193	199	259	122	146
Surya Community Forest	1.5	123	159	185	241	113	136
Gotheni Community Forest	20.3	151	196	3060	3978	1870	2244
Imek Silaji Community Forest	36.2	223	223	8090	8090	3802	4563
Manemalegini Community Forest	139.0	194	252	27000	35100	16497	19797
Pathibhara Community Forest	76.6	32174	32174	2463278	2463278	1157740	1389289
Chuli Thumki Community Forest	5.0	99	148	492	738	347	416
Panchami Salleri Community Forest	34.4	2065	2065	70979	70979	33360	40032
Yabara Patleghari Community Forest	14.1	14800	14800	208093	208093	97804	117364
Namuna Community Forest	3.4	381	381	1308	1308	615	738
Aarubote Community Forest	11.1	154	200	1710	2223	1045	1254
Ratmate Community forest	7.5	760	532	5700	3990	1875	2250
Aaldanda Community Forest	38.8	172	223	6650	8645	4063	4876
Thumki Danda community Forest	3.2	170	221	540	702	330	396
Golphe Salleri Community Forest	9.5	139	97	1316	921	433	520
Chijebung Katushe Community Forest	20.5	128	166	2620	3406	1601	1921
Deurali Community forest	44.4	171	120	7600	5320	2500	3001
Jure Bhagwati Community Forest	94.0	188	245	17711	23025	10822	12986
Mulpani Chishapani Community Forest	42.4	155	201	6549	8514	4001	4802
Lukuwa Chautare Community Forest	105.7	157	204	16600	21580	10143	12171
Singtapo Banpal Community Forest User Group	20.9	232	232	4849	4849	2279	2735
Leguwa Pakha Community Forest	5.8	118	177	684	1026	482	579
Sahale Pakha Community Forest	39.6	116	174	4575	6863	3225	3870
Tarebhir Community Forest	58.8	2	8	115	459	216	259
Chishapani Jangale Ghumaune Community Forest	3.6	42	88	150	315	148	178
Naminta Community forest	17.5	146	189	2550	3315	1558	1870
Jaljale Marshe Community Forest	229.4	185	241	42453	55189	25939	31127
Jordhunge Salghari Community Forest	85.0	957	957	81298	81298	38210	45852

CFUG_Name	Forest area ha	Volume per ha m3	Aboveg. Biomass Mg/ha	Total volume Mg	Total Aboveg. Biomass Mg	Total Aboveg. Carbon Content MGC	Total Carbon Content MgC
Chichiling Pokhari community Forest	113.1	26	72	2893	8100	3807	4569
Rani Salleri Community Forest	6.7	252	252	1683	1683	791	949
Siyebani Chhoredanda Community Forest	13.4	206	206	2765	2765	1300	1559
Tansep Danwa Bhauletar Community Forest	1.9	83	125	158	237	111	134
aaitebare Pakha Community Forest	1.2	237	237	280	280	132	158
Manahange Salghari Community Forest	8.4	217	217	1823	1823	857	1028
Ramite Khadgini Community Forest	87.5	375	262	32820	22974	10798	12957
Bhadaure Gahiro Community Forest	3.4	5006	5006	17170	17170	8070	9684
Bhirbari Rani Community Forest	12.4	336	336	4175	4175	1962	2355
Chuche Dhunge Community Forest	1.4	346	346	495	495	232	279
Iwali Communit Forest Group	13.4	6441	4509	86499	60549	28458	34150
Sakhfara Community Forest	8.1	475	475	3825	3825	1798	2157
Phusre Namsuwa Community Forest	188.6	156	202	29328	38127	17920	21503
Rani Salleri Communtiy Forest	20.2	141	184	2850	3705	1741	2090
Pandashe Bhanme Salleri Community Forest	88.8	153	199	13600	17680	8310	9972
Dhande Rani Community Forest	194.5	640	640	124481	124481	58506	70207
Chautari Community Forest	16.1	165	215	2660	3458	1625	1950
Bikhesaureni Community Forest	11.8	131	170	1535	1996	938	1125
Patleghari Community Forest	6.4	147	190	933	1213	570	684
Salleri Community forest	14.8	134	94	1980	1386	651	782
Chilaune Bote Community Forest	3.0	79	135	238	405	190	228
Bhorleni Community Forest	111.6	165	115	18360	12852	6040	7249
BhorleSalleri Community Forest	2.2	140	98	300	210	99	118
Deurali Community forest	542.0	181	235	97851	127206	59787	71744
Tibari Community Forest	4.1	93	74	377	302	142	170
Aishulutar Community Forest	1012.0	169	220	171002	222302	104482	125378
Pipal danda Community Forest	1.7	104	155	177	266	125	150
Dobato Thumkidanda Community Forest	46.2	181	127	8360	5852	2750	3301
Nausinge Rani Community Forest	152.9	165	214	25160	32708	15373	18447
Kavre Community Forest	39.6	184	239	7272	9454	4443	5332
Phulmane Danda Community Forest	24.8	156	109	3860	2702	1270	1524
Madhu Community Forest	158.4	175	228	27750	36075	16955	20346
Bbhisen Than Community Forest	4.4	144	101	640	448	211	253
Rani Pokhari Srijsansil Mahila Community Forest	0.8	0	0	0	0	0	0
Gadi Hattidhunge Community Forest	148.4	187	243	27740	36062	16949	20339
Palungtar Community forest	133.0	186	242	24750	32175	15122	18147
Khaireni Danda Community Forest	88.0	18	71	1568	6272	2948	3537
Pakhinde Danda Community Forest	0.7	0	0	0	0	0	0
Gadi Salleri Community Forest	46.8	159	111	7440	5208	2448	2937
Phirke Chituwakhola Community	56.7	144	101	8158	5711	2684	3221



CFUG_Name	Forest area ha	Volume per ha m3	Aboveg. Biomass Mg/ha	Total volume Mg	Total Aboveg. Biomass Mg	Total Aboveg. Carbon Content MGC	Total Carbon Content MgC
Forest							
Khauwa Community Forest	78.4	167	217	13090	17017	7998	9598
Dhamekalidaha Community Forest	57.3	165	115	9440	6608	3106	3727
Dhodre Chil Basne Community Forest	3.4	160	208	540	702	330	396
Kulkule Community Forest	13.5	190	247	2561	3329	1565	1878
Jalpadevi Community Forest	14.7	227	227	3332	3332	1566	1879
Mahabhir Community Forest	12.8	136	176	1735	2256	1060	1272
Helebung Community forest	31.5	164	213	5150	6695	3147	3776
Malika Bote Community Forest	10.9	155	202	1690	2197	1033	1239
Jurithunki community forest	13.9	142	185	1978	2571	1209	1450
Kalyanakari Community Forest	1.6	104	156	169	254	119	143
Padhero Danda Community Forest	0.4	0	0	0	0	0	0
Deurali Community Forestb	3.1	170	220	517	672	316	379
Dhageropakha Community Forest	9.5	152	197	1440	1872	880	1056
Jaldevi Community Forest	2.9	101	152	297	446	209	251
Dhudepakha Salghari Community forest	13.4	157	204	2090	2717	1277	1532
Batasehiunde Danda Community Forest	12.5	148	192	1850	2405	1130	1356
Mulkharka Community Forest	78.2	142	185	11100	14430	6782	8139
Margapokhari Community forest	119.9	179	232	21420	27846	13088	15705
Gurudum Community Forest	23.1	80	136	1840	3128	1470	1764
Thumkidada Jarkatedhad Community Forest	9.0	130	169	1167	1517	713	856
Singhadevi Aitabare Community Forest	33.9	176	229	5970	7761	3648	4377
Jalpadevi Hariyali Community Forest	17.1	167	217	2850	3705	1741	2090
Salleri Community Forest	21.2	151	106	3196	2237	1051	1262
Panchakanya Devi Community Forest	47.2	159	111	7480	5236	2461	2953
Chenchengadi Community forest	10.7	184	240	1980	2574	1210	1452
Bahundanda Community Forest	8.4	160	207	1340	1742	819	982
Adhero Pahira community Forest	13.5	139	98	1880	1316	619	742
Achchameretar community Forest	62.6	175	228	10967	14257	6701	8041
Lahabari Beltar Community Forest	72.7	169	118	12285	8600	4042	4850
Malagiri Community Forest	23.7	151	196	3580	4654	2187	2625
Utiseni Rani Community Forest	3.7	0	0	0	0	0	0
Putali Kharka Community Forest	43.8	169	220	7400	9620	4521	5426
Khambuwan Community Forest	102.8	171	222	17550	22815	10723	12868
Khuwalbung Community Forest	140.2	305	305	42700	42700	20069	24083
Dobhanepakha Community Forest	4.5	78	132	351	597	280	337
Tintale Singhadevi Community Forest	21.4	138	180	2960	3848	1809	2170
Ramite Community Forest	3.4	87	131	299	449	211	253
Singha Devi Community Forest	3.1	93	139	288	432	203	244
Bukimanepakha Community Forest	37.9	173	121	6567	4597	2161	2593
Deurali Community forest	40.9	190	247	7790	10127	4760	5712
Khamnu Community Forest	67.5	192	250	13000	16900	7943	9532
Simkharka Community Forest	125.6	19	76	2400	9600	4512	5414

CFUG_Name	Forest area ha	Volume per ha m3	Aboveg. Biomass Mg/ha	Total volume Mg	Total Aboveg. Biomass Mg	Total Aboveg. Carbon Content MGC	Total Carbon Content MgC
Kattike Community Forest	40.8	153	199	6230	8099	3807	4568
Danda Kharkh Mahabhir Hiude Community Forest	81.7	176	229	14400	18720	8798	10558
Gauthali Pakha Community Forest	15.1	163	212	2470	3211	1509	1811
Pokhari Kharkh Community Forest	107.7	194	252	20895	27164	12767	15320
Sati Chyandanda Community forest	0.3	67	113	20	34	16	19
Thulopakha Utiseni Community Forest	9.1	182	237	1665	2165	1017	1221
Sarke Community Forest	31.9	178	232	5694	7402	3479	4175
Mauladada Community Forest	2.7	97	145	259	389	183	219
Nigale Ramite Community Forest	84.3	179	232	15040	19552	9190	11027
Ratmate Pale Community Forest	26.0	179	232	4645	6039	2838	3406
Bhalu Khop Community Forest	30.5	168	219	5130	6669	3134	3761
Dumse Community Forest	1.8	109	163	190	285	134	161
Lapsibote Community Forest	10.3	165	215	1701	2211	1039	1247
Jukepani Community Forest	17.3	72	123	1246	2118	996	1195
Barhaane Community Forest	287.6	200	259	57401	74621	35072	42086
Juketar Pani Community Forest	5.3	157	204	830	1079	507	609
Yakse Community Forest	8.3	165	214	1360	1768	831	997
Homechokti Community Forest	18.6	164	214	3060	3978	1870	2244
Chitre Community Forest	60.1	175	228	10530	13689	6434	7721
Mashbari Community Forest	4.8	166	216	788	1024	481	578
Jharmuni community forest	5.0	167	218	837	1088	511	614
Saunepani Community Forest	3.5	154	201	540	702	330	396
Singha Devi Community Forest	31.5	185	241	5840	7592	3568	4282
Okharbote Community Forest	12.5	151	197	1890	2457	1155	1386
Chihanepakha Community Forest	8.6	155	202	1330	1729	813	975
Thulitar Community Forest	16.3	163	212	2660	3458	1625	1950
Yakumbagadi Community Forest	51.5	136	95	6990	4893	2300	2760
Phagetar Community Forest	10.3	168	218	1730	2249	1057	1268
Chauki Bhangtar Community Forest	57.9	171	222	9900	12870	6049	7259
Salle Pakha Community Forest	6.3	150	196	940	1222	574	689
Bidhane Community Forest	41.9	154	201	6460	8398	3947	4737
Siruwani community Forest	2.2	165	215	360	468	220	264
Kolchaur Community Forest	13.4	165	215	2208	2870	1349	1619
Ratmate Community forest	0.3	116	174	36	54	25	30
Sepile Talla Kharkh Gaucharan Community Forest	4.6	16	62	72	288	135	162
BukimaneDanda Aaru Bote Community Forest	11.0	155	108	1700	1190	559	671
Aitebare Community Forest	2.9	0	0	0	0	0	0
Sisnepani Pakha Community Forest	2.4	152	197	360	468	220	264
Bishwokarma Devithan Community Forest	3.5	137	178	480	624	293	352
KhariKhani Sagune Danda Community Forest	16.4	156	202	2546	3310	1556	1867
Deurali Community forest	47.8	166	216	7955	10342	4861	5833
Ramite Community Forest	7.2	143	186	1030	1339	629	755
Chyandanda Kanchirne Community Forest	11.9	1432	1003	17100	11970	5626	6751

CFUG_Name	Forest area ha	Volume per ha m3	Aboveg. Biomass Mg/ha	Total volume Mg	Total Aboveg. Biomass Mg	Total Aboveg. Carbon Content MGC	Total Carbon Content MgC
Budhabare Saththumke Community Forest	50.9	186	130	9450	6615	3109	3731
Ramailo Salleri Community Forest	9.1	146	102	1335	935	439	527
Thulopakha salleri Community Forest	26.2	174	122	4560	3192	1500	1800
Panchkanya Community Forest	9.0	163	114	1467	1027	483	579
Devithane Community Forest	5.5	175	123	963	674	317	380
Chiyandada Dhalekobar Community Forest	1.2	153	107	180	126	59	71
Pathibhara Community Forest	2.5	144	101	360	252	118	142
Bahubikas Community Forest	41.3	175	123	7220	5054	2375	2850
Bhanjyang Dada Community Forest	7.4	140	98	1030	721	339	407
Loktantrik Community Forest	151.9	170	221	25824	33572	15779	18934
Ahaltar Community Forest	48.0	159	207	7654	9950	4677	5612
Ashare Khop Community forest	4.1	173	225	714	928	436	524
Lakshumane Community Forest	2.9	84	126	241	362	170	204

(\*) Please note that there are CFUG (highlighted in the table) with estimated volume greater than 1,000 m<sup>3</sup>/ha and sometimes up to more than 32,000 m<sup>3</sup>/ha (!). These are evident errors (likely typing errors) in the original data coming from the Districts. The calculations made here are just examples and original data should be carefully checked at source level to avoid unrealistic results which have nothing to do with the calculations made here.

## 4.2 Reporting at District level

Volume, biomass and Carbon contents should also be reported at District level. In case of average values by District these should be reported as weighted average (weighted by area) to take into account the relative areas of different CFUG.

Example

$$\text{Average VOB/ha} = \frac{\sum(\text{VOBha} * \text{Area})}{\sum \text{Area}}$$

Please note that also in this case the weighted averages and totals are just examples of reporting and still suffer from the inconsistencies in the original data.

Table 6: Reporting at District level

District Name	# of observations	Average volume m <sup>3</sup> /ha	Average Aboveg. Biomass Mg/ha	Total Volume Mg	Total Aboveg. Biomass Mg	Total Aboveg. Carbon Content Mg	Total Belowg. Biomass Mg	Total Carbon Content Mg
Bhojpur	534	14	31	612,780	1,383,432	650,213	130,043	780,256
Jajarkot	159	36	52	874,317	1,249,602	587,313	117,463	704,776
Parbat	95	318	291	1,169,722	1,069,373	502,605	100,521	603,126
Terhathum	330	322	355	5,935,464	6,530,307	3,069,244	613,849	3,683,093

## Annex 1: Example of VBA coding for volume, biomass and Carbon calculations.

Option Compare Database

Private Sub Calculate\_Click()

Dim db As Database  
Dim rs As Recordset

Dim species As Integer  
*'Broadleaved or Coniferous*

Dim bef As Single  
*'Biomass expansion factor*

Dim vol As Double  
*'volume per hectare*

Set db = CurrentDb  
Set rs = db.OpenRecordset("VOB\_CARBON")

Do While Not rs.EOF

rs.Edit

*' Volume per ha in m3(vob is in cuft in the table)*  
vol = rs!vob \* 0.02831685  
rs!vob\_ha = vol

*' Total volume*  
rs!tot\_vob = rs!vob\_ha \* rs!netarea

*'Forest type from table forest\_type*  
species = rs!forest\_type

Select Case species

Case 3, 7

*'Coniferous*

Select Case vol

*'Biomass expansion factor relative to volume per ha*

Case Is <= 20

bef = 1.8

Case 21 To 40

bef = 1.3

Case 41 To 60

bef = 1

Case 61 To 80  
bef = 0.8  
  
Case 81 To 120  
bef = 0.8  
  
Case 121 To 200  
bef = 0.7  
  
Case Is > 200  
bef = 0.7  
  
End Select

Case Else  
*'Broadleaved*  
Select Case vol  
  
Case Is <= 20  
bef = 4  
  
Case 21 To 40  
bef = 2.8  
  
Case 41 To 60  
bef = 2.1  
  
Case 61 To 80  
bef = 1.7  
  
Case 81 To 120  
bef = 1.5  
  
Case 121 To 200  
bef = 1.3  
  
Case Is > 200  
bef = 1  
  
End Select

End Select

*'Aboveground biomass per hectare*

rs!agb\_ha = rs!vob\_ha \* bef

*'Total Aboveground biomass*

rs!tagb = rs!agb\_ha \* rs!netarea

*'Total Aboveground Carbon Content*

rs!tagcc = rs!tagb \* 0.47

*'Total Belowground Carbon Content*

rs!tbgcc = rs!tagcc \* 0.2

*'Total Carbon Content (Aboveground + Belowground)*

rs!tcc = rs!tagcc + rs!tbgcc

rs.Update

rs.MoveNext

Loop

rs.Close

End Sub