ANNEX 3

3.a Additional data for agriculture

3.b Other detailed methodological descriptions for LULUCF

3.a Additional data for agriculture

Cattle population 2000-2011

Population	2000	2001	2002	2003	2004	2005	2006
Dairy cattle	**140236**	**135805**	**139980**	**130711**	**134009**	**120273**	**112510**
Non-dairy cattle	**353434**	**341270**	**333262**	**319515**	**317127**	**332244**	**341523**
Other cows	53896	52777	55011	55165	48065	56955	60511
Young cattle under 1 year	145730	136992	138783	131142	136689	135504	136617
Fattening bulls & steers older than 1 year	69873	69324	61929	56932	59803	66662	68404
Heifers for fattening older than one year	13747	11865	8740	7650	7734	8915	8236
Breeding heifers 1-2 years	52841	54192	52791	52189	49030	48945	50006
Breeding heifers - over 2 years	16427	15001	15124	15526	15057	14208	16777
Breeding bulls-over 2 years	920	1120	884	910	749	1053	972
Cattle - TOTAL	**493670**	**477075**	**473242**	**450226**	**451136**	**452517**	**454033**

Population	2007	2008	2009	2010	2011	2012
Dairy cattle	**116391**	**113400**	**113103**	**109467**	**109068**	
Non-dairy cattle	**363190**	**356583**	**359775**	**360684**	**353232**	
Other cows	61245	62562	60973	63887	61671	
Young cattle under 1 year	149750	145375	147338	146770	146203	
Fattening bulls & steers older than 1 year	73967	69816	69664	68463	64737	
Heifers for fattening older than one year	8470	9911	9691	10655	9936	
Breeding heifers 1-2 years	48719	48551	50319	48778	48202	
Breeding heifers - over 2 years	19977	18965	19915	20231	20147	
Breeding bulls-over 2 years	1062	1403	1875	1900	2336	
Cattle - TOTAL	**479581**	**469983**	**472878**	**470151**	**462300**	

Other parameters, Cattle – 1986-2011

	1986	1987	1988	1989	1990	1991	1992	1993	1994
Dairy cattle									
DE (%)	62.2	62.1	62.1	62.1	62.1	63.0	62.2	62.1	62.6
Energy requirements (MJ / animal / year)									
NE maintenance	13060	13028	13033	13047	13035	13322	13071	13050	13179
NE grazing	131	131	131	131	131	147	157	169	184
NE lactation	8346	8190	8218	8287	8231	9697	8499	8442	9140
NE pregnancy	926	920	921	920	922	947	925	928	932
NE total	22464	22269	22302	22384	22318	24112	22653	22588	23435
NE/DE	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
GE	71346	70899	70978	71167	71020	75122	71887	71799	73776
Ym	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
VS (kg/year)	1345	1341	1342	1344	1342	1385	1354	1355	1377

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Dairy cattle									
DE (%)	62.9	64.1	64.4	64.6	64.9	65.5	65.8	66.5	66.2
Energy requirements (MJ / animal / year)									
NE maintenance	13273	13668	13754	13822	13918	14138	14245	14474	14394
NE grazing	199	218	233	248	263	281	283	288	286
NE lactation	9668	11731	12219	12624	13172	14385	14989	16229	15824
NE pregnancy	939	970	971	972	981	999	1007	1023	1011
NE total	24078	26587	27177	27666	28333	29802	30524	32014	31515
NE/DE	0.51	0.51	0.51	0.51	0.52	0.52	0.52	0.52	0.52
GE	75281	80850	82171	83271	84748	88234	89781	92903	91877
Ym	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
VS (kg/year)	1393	1446	1459	1470	1484	1517	1530	1554	1547

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Dairy cattle									
DE (%)	65.9	66.9	67.2	67.3	67.3	67.0	66.9	66.9	
Energy requirements (MJ / animal / year)									
NE maintenance	14272	14638	14770	14781	14803	14667	14659	14659	
NE grazing	284	291	294	294	294	292	292	292	
NE lactation	15211	17151	17708	17831	17881	17244	17246	17264	
NE pregnancy	996	1019	1025	1023	1024	1009	1006	1004	
NE total	30763	33099	33797	33929	34003	33213	33204	33218	
NE/DE	0.52	0.52	0.52	0.52	0.52	0.52	0,52	0,52	
GE	90335	95172	96481	96805	96903	95344	95359	95406	
Ym	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	
VS (kg/year)	1536	1571	1576	1580	1585	1570	1572	1573	

	1986	1987	1988	1989	1990	1991	1992	1993	1994
Other cows									
DE (%)	*	*	*	*	*	62.5	62.5	62.5	62.5
Energy requirements (MJ / animal / year)	*	*	*	*	*				
NE maintenance	*	*	*	*	*	13171	13171	13171	13171
NE grazing	*	*	*	*	*	262	262	262	262
NE lactation	*	*	*	*	*	9330	9330	9330	9330
NE pregnancy	*	*	*	*	*	940	940	940	940
NE total	*	*	*	*	*	23702	23702	23702	23702
NE/DE	*	*	*	*	*	0.51	0.51	0.51	0.51
GE	*	*	*	*	*	74663	74663	74663	74663
Ym	*	*	*	*	*	0.06	0.06	0.06	0.06
VS (kg/year)	*	*	*	*	*	1394	1394	1394	1394

* there were no suckler cows before 1991

	1995	1996	1997	1998	1999	2000	2001	2002	2003
Other cows									
DE (%)	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5
Energy requirements (MJ / animal / year)									
NE maintenance	13171	13171	13171	13171	13171	13171	13171	13171	13171
NE grazing	262	262	262	262	262	262	262	262	262
NE lactation	9330	9330	9330	9330	9330	9330	9330	9330	9330
NE pregnancy	940	940	940	940	940	940	940	940	940
NE total	23702	23702	23702	23702	23702	23702	23702	23702	23702
NE/DE	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51
GE	74663	74663	74663	74663	74663	74663	74663	74663	74663
Ym	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
VS (kg/year)	1394	1394	1394	1394	1394	1394	1394	1394	1394

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Other cows									
DE (%)	62.5	62.5	62.5	62.5	62.5	62.5	62.5	62.5	
Energy requirements (MJ / animal / year)									
NE maintenance	13171	13171	13171	13171	13171	13171	13171	13171	
NE grazing	262	262	262	262	262	262	262	262	
NE lactation	9330	9330	9330	9330	9330	9330	9330	9330	
NE pregnancy	940	940	940	940	940	940	940	940	
NE total	23702	23702	23702	23702	23702	23702	23702	23702	
NE/DE	0.51	0.51	0.51	0.51	0.51	0.51	0.51	0.51	
GE	74663	74663	74663	74663	74663	74663	74663	74663	
Ym	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	
VS (kg/year)	1394	1394	1394	1394	1394	1394	1394	1394	

	1986	2000	2001	2002	2003	2004	2005	2006
Other non-dairy cattle								
DE (%)	67	67	67	67	67	68	68	68
Energy requirements (MJ / animal / year)								
NE maintenance	7340	8198	8284	8140	8212	8101	8201	8271
NE grazing	97	183	185	182	184	181	183	185
NE growth	3032	3590	3631	3592	3624	3631	3696	3726
NE pregnancy	116	55	52	54	58	56	51	59
NE total	10586	12026	12151	11968	12077	11969	12132	12242
NE/DE	0.519	0.521	0.522	0.522	0.522	0.522	0.522	0.522
NEg/DE	0.317	0.321	0.321	0.321	0.321	0.322	0.322	0.322
GE	36451	40983	41383	40763	41118	40693	41182	41546
Ym	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
VS (kg/year)	613	739	744	737	741	734	738	743

	2007	2008	2009	2010	2011	2012
Other non-dairy cattle						
DE (%)	68	68	68	68	68	
Energy requirements (MJ / animal / year)						
NE maintenance	8250	8239	8233	8234	8215	
NE grazing	184	184	184	184	184	
NE growth	3791	3721	3632	3647	3658	
NE pregnancy	66	64	66	68	69	
NE total	12292	12208	12115	12133	12125	
NE/DE	0.523	0.523	0.522	0.522	0.522	
NEg/DE	0.323	0.322	0.321	0.322	0.322	
GE	41602	41406	41205	41241	41174	
Ym	0.06	0.06	0.06	0.06	0.06	
VS (kg/year)	742	742	742	742	741	

No data are available for the period 1987-1999. The final emission factors were interpolated on the basis of years 1986 and 2000. More detailed data for other non-dairy cattle are available since 2000 and are presented on the tables bellow.

	2000	2001	2002	2003	2004	2005	2006
Young cattle under 1 year							
DE (%)	68.2	68.3	68.4	68.5	68.6	68.6	68.7
Energy requirements (MJ / animal / year)							
NE maintenance	6078	6104	6134	6165	6190	6203	6229
NE grazing	136	136	137	138	138	139	139
NE growth	3404	3440	3483	3526	3563	3582	3619
NE pregnancy	0	0	0	0	0	0	0
NE total	9618	9681	9755	9829	9892	9924	9988
NE/DE	0.52	0.52	0.52	0.52	0.52	0.53	0.53
NEg/DE	0.32	0.33	0.33	0.33	0.33	0.33	0.33
GE	32741	32915	33117	33319	33492	33579	33752
Ym	0.06	0.06	0.06	0.06	0.06	0.06	0.06
VS (kg/year)	519	520	522	523	525	525	526

	2007	2008	2009	2010	2011	2012
Young cattle under 1 year						
DE (%)	69.0	68.8	68.5	68.6	68.7	
Energy requirements (MJ / animal / year)						
NE maintenance	6306	6242	6165	6182	6225	
NE grazing	141	140	138	138	139	
NE growth	3732	3638	3526	3551	3613	
NE pregnancy	0	0	0	0	0	
NE total	10180	10020	9829	9871	9977	
NE/DE	0.53	0.53	0.52	0.52	0.53	
NEg/DE	0.33	0.33	0.33	0.33	0.33	
GE	34270	33838	33319	33435	33723	
Ym	0.06	0.06	0.06	0.06	0.06	
VS (kg/year)	530	527	523	524	526	

	2000	2001	2002	2003	2004	2005	2006
Fattening bulls and steers older than 1 year							
DE (%)	68.2	68.3	68.4	68.5	68.6	68.6	68.7
Energy requirements (MJ per animal and year)							
NE maintenance	11227	11227	11227	11227	11227	11227	11227
NE grazing	251	251	251	251	251	251	251
NE growth	5244	5287	5336	5386	5429	5450	5493
NE pregnancy	0	0	0	0	0	0	0
NE total	16722	16765	16815	16864	16907	16928	16971
NE/DE	0.52	0.52	0.52	0.52	0.52	0.53	0.53
NEg/DE	0.32	0.33	0.33	0.33	0.33	0.33	0.33
GE	55770	55852	55947	56042	56123	56164	56245
Ym	0.06	0.06	0.06	0.06	0.06	0.06	0.06
VS (kg/year)	883	882	881	880	879	878	877

	2007	2008	2009	2010	2011	2012
Fattening bulls and steers older than 1 year						
DE (%)	69.0	68.8	68.5	68.6	68.7	
Energy requirements (MJ per animal and year)						
NE maintenance	11227	11227	11227	11227	11227	
NE grazing	251	251	251	251	251	
NE growth	5621	5514	5386	5414	5486	
NE pregnancy	0	0	0	0	0	
NE total	17099	16992	16864	16893	16964	
NE/DE	0.53	0.53	0.52	0.52	0.53	
NEg/DE	0.33	0.33	0.33	0.33	0.33	
GE	56485	56285	56042	56096	56231	
Ym	0.06	0.06	0.06	0.06	0.06	
VS (kg/year)	874	877	880	879	878	

	2000	2001	2002	2003	2004	2005	2006
Heifers for fattening older than 1 year							
DE (%)	68.2	68.3	68.4	68.5	68.6	68.6	68.7
Energy requirements (MJ / animal / year)							
NE maintenance	11227	11227	11227	11227	11227	11227	11227
NE grazing	251	251	251	251	251	251	251
NE growth	5244	5287	5336	5386	5429	5450	5493
NE pregnancy	0	0	0	0	0	0	0
NE total	16722	16765	16815	16864	16907	16928	16971
NE/DE	0.52	0.52	0.52	0.52	0.52	0.53	0.53
NEg/DE	0.32	0.33	0.33	0.33	0.33	0.33	0.33
GE	55770	55852	55947	56042	56123	56164	56245
Ym	0.06	0.06	0.06	0.06	0.06	0.06	0.06
VS (kg/year)	883	882	881	880	879	878	877

	2007	2008	2009	2010	2011	2012
Heifers for fattening older than 1 year						
DE (%)	69.0	68.8	68.5	68.6	68.7	
Energy requirements (MJ / animal / year)						
NE maintenance	11227	11227	11227	11227	11227	
NE grazing	251	251	251	251	251	
NE growth	5621	5514	5386	5414	5486	
NE pregnancy	0	0	0	0	0	
NE total	17099	16992	16864	16893	16964	
NE/DE	0.53	0.53	0.52	0.52	0.53	
NEg/DE	0.33	0.33	0.33	0.33	0.33	
GE	56485	56285	56042	56096	56231	
Ym	0.06	0.06	0.06	0.06	0.1	
VS (kg/year)	874	877	880	879	878	

	2000	2001	2002	2003	2004	2005	2006
Breeding heifers 1-2 years							
DE (%)	64.7	64.7	64.7	64.7	64.7	64.7	64.7
Energy requirements (MJ / animal / year)							
NE maintenance	11480	11480	11480	11480	11480	11480	11480
NE grazing	257	257	257	257	257	257	257
NE growth	3861	3861	3861	3861	3861	3861	3861
NE pregnancy	0	0	0	0	0	0	0
NE total	15598	15598	15598	15598	15598	15598	15598
NE/DE	0.51	0.51	0.51	0.51	0.51	0.51	0.51
NEg/DE	0.31	0.31	0.31	0.31	0.31	0.31	0.31
GE	54470	54470	54470	54470	54470	54470	54470
Ym	0.06	0.06	0.06	0.06	0.06	0.06	0.06
VS (kg/year)	959	959	959	959	959	959	959

	2007	2008	2009	2010	2011	2012
Breeding heifers 1-2 years						
DE (%)	64.7	64.7	64.7	64.7	64.7	
Energy requirements (MJ / animal / year)						
NE maintenance	11480	11480	11480	11480	11480	
NE grazing	257	257	257	257	257	
NE growth	3861	3861	3861	3861	3861	
NE pregnancy	0	0	0	0	0	
NE total	15598	15598	15598	15598	15598	
NE/DE	0.51	0.51	0.51	0.51	0.51	
NEg/DE	0.31	0.31	0.31	0.31	0.31	
GE	54470	54470	54470	54470	54470	
Ym	0.06	0.06	0.06	0.06	0.1	
VS (kg/year)	959	959	959	959	959	

	2000	2001	2002	2003	2004	2005	2006
Breeding heifers - over 2 years							
DE (%)	63.1	63.1	63.1	63.1	63.1	63.1	63.1
Energy requirements (MJ / animal / year)							
NE maintenance	14067	14067	14067	14067	14067	14067	14067
NE grazing	315	315	315	315	315	315	315
NE growth	3706	3706	3706	3706	3706	3706	3706
NE pregnancy	994	994	994	994	994	994	994
NE total	19081	19081	19081	19081	19081	19081	19081
NE/DE	0.51	0.51	0.51	0.51	0.51	0.51	0.51
NEg/DE	0.30	0.30	0.30	0.30	0.30	0.30	0.30
GE	67343	67343	67343	67343	67343	67343	67343
Ym	0.06	0.06	0.06	0.06	0.06	0.06	0.06
VS (kg/year)	1240	1240	1240	1240	1240	1240	1240

	2007	2008	2009	2010	2011	2012
Breeding heifers - over 2 years						
DE (%)	63.1	63.1	63.1	63.1	63.1	
Energy requirements (MJ / animal / year)						
NE maintenance	14067	14067	14067	14067	14067	
NE grazing	315	315	315	315	315	
NE growth	3706	3706	3706	3706	3706	
NE pregnancy	994	994	994	994	994	
NE total	19081	19081	19081	19081	19081	
NE/DE	0.51	0.51	0.51	0.51	0.51	
NEg/DE	0.30	0.30	0.30	0.30	0.30	
GE	67343	67343	67343	67343	67343	
Ym	0.06	0.06	0.06	0.06	0.06	
VS (kg/year)	1240	1240	1240	1240	1240	

	2000	2001	2002	2003	2004	2005	2006
Breeding bulls-over 2 years							
DE (%)	60.6	60.6	60.6	60.6	60.6	60.6	60.6
Energy requirements (MJ / animal / year)							
NE maintenance	15995	15995	15995	15995	15995	15995	15995
NE grazing	358	358	358	358	358	358	358
NE growth	0	0	0	0	0	0	0
NE pregnancy	0	0	0	0	0	0	0
NE total	16352	16352	16352	16352	16352	16352	16352
NE/DE	0.50	0.50	0.50	0.50	0.50	0.50	0.50
NEg/DE	0.29	0.29	0.29	0.29	0.29	0.29	0.29
GE	53859	53859	53859	53859	53859	53859	53859
Ym	0.06	0.06	0.06	0.06	0.06	0.06	0.06
VS (kg/year)	1058	1058	1058	1058	1058	1058	1058

	2007	2008	2009	2010	2011	2012
Breeding bulls-over 2 years						
DE (%)	60.6	60.6	60.6	60.6	60.6	
Energy requirements (MJ / animal / year)						
NE maintenance	15995	15995	15995	15995	15995	
NE grazing	358	358	358	358	358	
NE growth	0	0	0	0	0	
NE pregnancy	0	0	0	0	0	
NE total	16352	16352	16352	16352	16352	
NE/DE	0.50	0.50	0.50	0.50	0.50	
NEg/DE	0.29	0.29	0.29	0.29	0.29	
GE	53859	53859	53859	53859	53859	
Ym	0.06	0.06	0.06	0.06	0.06	
VS (kg/year)	1058	1058	1058	1058	1058	

3.b Other detailed methodological descriptions for LULUCF

National Forest Inventory 2007 (NFI 2007)

Methodology

When designing NFI 2007 for KP/UNFCCC reporting purposes, recommendations of GPG 2003 and COST Action E43 have been considered as far as possible. If NFI will be repeated in five years time (in the year 2012), its design and methodology will offer reliable data sets about volume of wood growing stock; state, changes (increment, felling) – development/trends – of all Slovenian forests.

Convention on long range transboundary air-pollution (UN/ECE 1979) presents the legislative framework for ICP monitoring scheme - Assessment and Monitoring of Air Pollution Effects on Forests (FCS - inventory in the year 2000). FCS as it is defined in Official Journal of the Republic of Slovenia (Official Journal of the RS, nr. 92/00, 56/06), presents basis for development of Slovenian national forest inventory 2007 (NFI 2007) design.

Assessment methodology is supplemented according to the findings of test inventory, which was carried out in the year 2006 on 43 sample plots (16 x 16 km sampling grid). NFI 2007 was performed on 778 sample plots in forests, organized by 4 x 4 km sample grid which covers the whole Slovenian territory

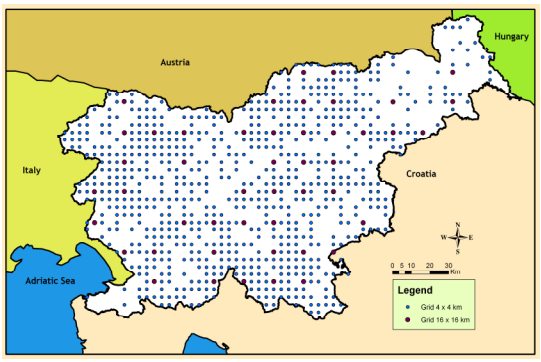

Figure 1: Arrangement of NFI 2007 sample plots on 4 x 4 km sample grid (●) and 16 x 16 km sample grid (●)

Arrangement of NFI 2007 sample plots principally remained the same as in the inventory in the year 2000 – FCS. Basic sample unit plot of NFI 2007 is CPP As written before the CPP is spatially identified by the geographical coordinates of the centre of the CPP, which is positioned 50 meters west from the base sample grid section (integer number of coordinates). Neither plots nor trees are visually marked with numbers, letters etc., so the inventory results and data remain representative due to unbiased forest management practice carried on in stands with sampling plots. Statistically, the NFI 2007 was characterized as a systematically single stage sampling.

Due to changes in FCS protocols and additional field data that were obtained, the design of CPP (2007) was changed in respect to the design of inventory in the year 2000. Inner concentric plot for volume of growing stock of small trees ($D_{1,3}$ > 0 cm) assessment was added. Basic characteristics for all 4 concentric plots which CPP is composed of are shown in Figure 2.

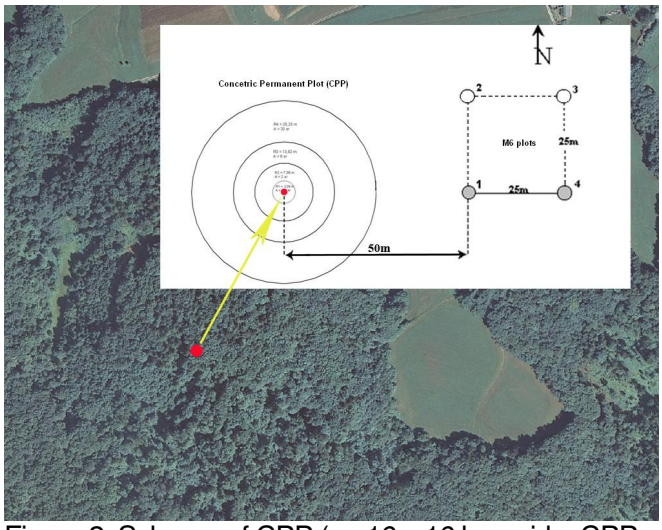

Figure 2: Scheme of CPP (on 16 x 16 km grid – CPP + all four M6 plots; on 4 x 4 grid – CPP + M6 plots nr. 1 and 4)

Table 1: Critical values for assessing living and dead tree wood stock on CPP in NFI 2007

Plots	CPP_1	CPP_2	CPP_3	CPP_4
Radius (R) of the plots [m]*	3,09	7,98	13,82	25,23
Area (P) of the plots [ar]	0,3	2	6	20
Characteristics of stand and site	Area of 20 ar			
Standing live trees	$D_{1,3} > 0$ cm H ≥ 1,3 m	$D_{1,3} \geq 10$ cm	$D_{1,3} \geq 30$ cm	/
Standing dead trees	$D_{1,3} \geq 10$ cm		$D_{1,3} \geq 30$ cm	
Lying dead trees	$D_{1,3} \geq 10$ cm		$D_{1,3} \geq 30$ cm	
Stumps	D ≥ 10 cm H ≥ 20 cm		/	
Snags	D ≥ 10 cm H ≥ 50 cm		D ≥ 30 cm H ≥ 50 cm	
Coarse woody debris – woody parts of trees (branches, parts of stem etc.)	D ≥ 10 cm L ≥ 50 cm		D ≥ 30 cm L ≥ 50 cm	

*Reduction of plot area regarding to terrain slope should be considered when defining radius of the plots!

Field work and assessment on CPP

Field work – measurements and assessment – on CPP in NFI 2007 consists of:

- detailed description of the plot (assessment of the site and stand),
- measurements and assessment of trees (diameter/circumference at breast height, distance and azimuth from the plot's centre to every measurable tree, tree species, social/height class, defoliation, height and age of the three thickest trees, tree status regarding to type of growing stock/biomass (living, dead, standing, lying), tree status code – present in both assessments (in the years 2000 and 2007), cut down/felling, dead etc.),
- measurements and assessment of dead wood (type of dead wood, diameter and length /height, tree species, decay class).

Dead wood assessment

Dead trees (fallen or still standing) are measured regardless of bark being present or not. Lying dead trees are measured if their diameter at breast height ($D_{1,3}$ – from the beginning of a stem) lies inside of a critical plot radius and is bigger or equal 30 cm (see examples 1, 2 and 3). Dead tree still has to have branches, so it can be recognised as a tree. If branches are no longer attached to a tree, it is treated as a large wooden piece. If a larger wooden piece lies on plot partially (example 5), only the part inside the critical radius is taken into consideration (length (L) and mean diameter (D) are measured). All critical values from the are also considered.

Stump is measured if its centre (see, example 6) is within the critical plot radius. Furthermore the following has to be considered:

- for stumps which lay on slope terrain or are of different shapes, upper and lower height is measured and mean value of the height (H) is calculated. Mean diameter (D) is also calculated for the bigger and smaller diameter.
- where roots were pulled out from soil, or if they grew above litter level, only stump without roots is measured.

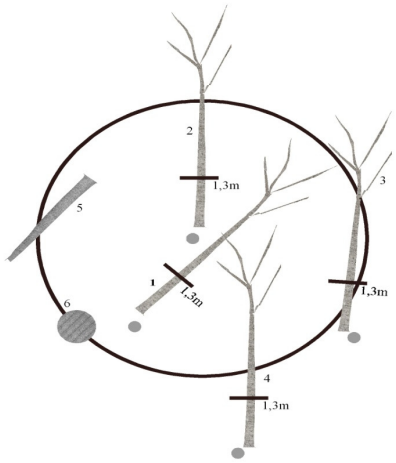

Figure 3: Examples of laying dead trees and stumps

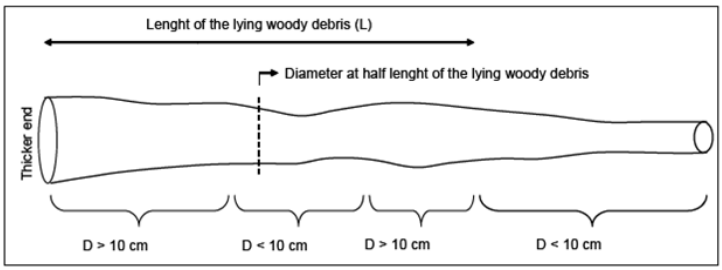

Figure 4: Example of a larger deadwood piece (length is measured from the thicker end to the thinnest end with D ≥ 10 cm)

Basic information about NFI 2007

Slovenian Forestry Institute (SFI) had lead the activities of NFI 2007 but the field work had been carried out mostly by the field crews composed of Slovenia Forest Service (SFS) staff and students.

Characteristics of NFI 2007 are:

- sample grid 4 x 4 km, 778 circular permanent plots (CPP),
- field work performed: July and August 2007,
- 35 field crews of SFS (inventory on plots on 4 x 4 km grid),
- 3 field crews of SFI (inventory on plots on 16 x 16 km grid, training of SFS field crews, control check and quality assurance – on 5 % of all plots),
- field crew mainly consists of one leader (university forest engineer) and one unskilled assistant (student).

Basic field crew equipment:

- handy GPS device for satellite navigation,
- measurement tape for diameter/circumference and distance measuring,
- diameter calliper,
- compass with stand-pole,
- Vertex instrument,
- tree height measurement instrument,
- inclinometer,
- field manual, data entry forms, code sheets, plot access maps.

Description of work in NFI 2007

Activities in NFI 2007 were carried out in following order:

- NFI 2007 field protocol preparation:
    - study of international protocols and requirements (KP, GPG 2003, COST E43) and harmonization of their demands (basis was the inventory performed in the year 2000),
    - harmonization of data sets which were later obtained in field between SFS, Ministry of agriculture, forestry and food (MAFF) and Ministry of the Environment and Spatial planning (MESP) (agreement on the set of field data, field crews, financing, equipment etc.),
    - defining of NFI 2007 concept (statistical design, sample grid, standards of quality and measurements, area of plots, algorithms etc.),
    - final edition of the NFI 2007 field protocol.
- Preparation of plot access information and data entry forms:
    - setting of spatial information system with all available information layers (topography, digital ortho-photo, theoretical plot coordinates, land use data for the year 2000 by the MAFF – forest/non-forest land etc.),
    - spatial control if all existing CPP are inside forests and adding of new plots regarding to land use data (MAFF),
    - preparation of the assessment data from the inventory in the year 2000 and printing data entry forms with data from the year 2000,
    - field testing of the protocol (plot access map, data entry forms, protocol, equipment etc.),
    - preparation and printing of data entry forms (stand, plot, trees, small living trees, dead wood),
    - preparation and printing of plot access information (maps and description of

access),
    - preparation and printing of code sheets (stand, plot, trees, small living trees, dead wood),
    - printing of NFI 2007 field protocol,
    - equipment purchase (examination and completion of equipment for SFI and SFS).
- Course and training for SFI and SFS field crews
    - preparation of the field crews list (SFI and SFS), course attendance for field workers in June was obligatory,
    - preparation of the programme and realization of the 4-day course and training (19.-22.6.2007, 50 attendees).
- Field measurements:
    - introducing SFS field crews into *in-situ* field work: 3 SFI field crews had visited each one of SFS field crews at the beginning of work and carried out the complete protocol of assessment in at least one of the plots,
    - field assessment on 760 plots of 4 x 4 km grid (35 SFS field crews),
    - field assessment on 40 plots of 16 x 16 km grid (3 SFI field crews),
    - resolving of actual problems that appeared on field assessments,
    - re-measurement for quality control purposes: 3 SFI field crews (5 % or 40 plots).
- Data entry:
    - preparation of FoxPro forms for entering data into NFI 2007 data base,
    - preparation of data entry manuals and short training course of data entry staff (4 students),
    - data entry and on-line control of data entry process.
- Data processing:
    - manual and logical checks of all entered data are carried out,
    - preparation of algorithms and programs for data calculation (volume of wood growing stock calculation, increment, volume of dead wood stock),
    - the final thorough quality check, data processing and preliminary results.
- Data management:
    - Plot's access maps, data entry forms (filled) and NFI 2007 data base had been in physical and in digital forms archived. Security back-up of all NFI 2007 data base, which is located on SFI server, is made on regular basis.

Quality assurance

All field crews had to attend training course where field measurement protocol was exhaustively presented. When actual field work started, SFI crews visited each SFS crew and carried out the whole procedure side by side in search for eventual misconceptions of the protocol. In the end, SFI crews re-assessed 40 plots (or at least 5 % of all plots) and evaluated the quality of field work.

Volume estimation

For **volume of tree calculation** (m^3) locally used tariffs are used as for:

- a single tree **tariff's code** (01-60) is selected from SFS forest's compartment data base respectively 8 different **tree species groups** (T_1-T_8). Tariff's **type** (equation) and class (coefficient) are defined by the tariff's code selection.
- the volume of tree is calculated using appropriate tariff's equation (type, class) with tree **diameter** ($D_{1,3}$) as explanatory variable,
- Tariff functions give values for volume of stem over bark (including stem parts (branches) with a diameter of more than 7 cm and a stump).

Equations:

Diameter ($D_{1,3}$) = Circumference ($O_{1,3}$) / π

Three different tariff's **types** (4 equations) and **20 tariff classes** with different coefficients (v_{45}) are used as for:

- even-aged stand/forest, slow Schaeffer's E tariffs

$$v = \frac{v_{45}}{1800} * d_{1,3} * (d_{1,3} - 5) = \frac{v_{45}}{1800} * (d_{1,3}^{\ 2} - 5 * d_{1,3})$$

- selective stand/forest (germ.: *plenterwald*), rapid Algan's P tariffs

$$v = \frac{v_{45}}{1400} * (d_{1,3} - 5) * (d_{1,3} - 10) = \frac{v_{45}}{1400} * (d_{1,3}^{\ 2} - 15 * d_{1,3} + 50)$$

and for trees which diameter ($D_{1,3}$) is thinner than 25 cm:

$$v = \frac{v_{45}}{1400} * (-226{,}33 + 38{,}575 * d_{1,3} - 1{,}9237 * d_{1,3}^{\ 2} + 0{,}04876 * d_{1,3}^{\ 3})$$

- uneven-aged stand/forest, intermediate Čokl's V tariffs

$$v = \frac{v_{45}}{1600} * (d_{1,3} - 2{,}5) * (d_{1,3} - 7{,}5) = \frac{v_{45}}{1600} * (d_{1,3}^{\ 2} - 10 * d_{1,3} + 18{,}75)$$

Table 2: Tariff's coefficients

	TARRIF'S CLASS from 1 to 10 (5)									
10 CLASSES	1		2		3		4		5	
20 CLASSES	1	2	3	4	5	6	7	8	9	10
k = v_{45}	1,143	1,200	1,263	1,326	1,396	1,466	1,543	1,620	1,706	1,791

	TARRIF'S CLASS from 6 to 20 (10)									
10 CLASSES	6		7		8		9		10	
20 CLASSES	11	12	13	14	15	16	17	18	19	20
k = v_{45}	1,885	1,979	2,084	2,188	2,303	2,418	2,546	2,673	2,814	2,954

Calculation of **volume of small trees** (m^3):

- Volume for single small tree is calculated by Huber's equation (see equation below),
- Volume of single small tree is then multiplied by the number of trees (N) which have the same $D_{1,3}$ and H.

Equations:

Basal area (G) = π * $(D_{1,3} / 2)^2$

V = G * H = π * $(D_{1,3} / 2)^2$ * H (Huber's equation – volume of cylinder)

Calculation of **volume of dead wood** (m^3):

- the choose of appropriate method (tariff's or Huber's equation) for volume of dead wood calculation is dependent on **type of dead wood** as for:
  - **tree** (standing dead tree, lying dead tree) calculation is the same as for living tree (using tariff's equations, see upper),
  - **stump**: from diameter (D) and high (H), by Huber equation (V = G * H),
  - **snag**: from diameter (D) and high (H), by Huber equation (V = G * H),
  - **coarse woody debris**: from diameter (D) and length (L), by Huber equation (V = G * L).

Equations: see above!

Growing stock estimation

Calculation of **volume of wood growing stock** per sample plot (m^3/ha):

- to calculate volume of tree per ha (from m^3 to m^3/ha) volume of tree is multiplied by area factor (FP),
- area factors (FP) are calculated on the basis of sample plots areas (P) and are for trees that have diameter ($D_{1,3}$) respectively:
    - from 10 to 29,9 cm: P_2 is 200 m^2, FP_2 is 50,
    - equal or bigger than 30 cm: P_3 is 600 m^2, FP_3 is 16,7,
    - for dead standing tree (code is 2) diameter must be equal or bigger than 30 cm: P_4 is 2000 m^2, FP_4 is 5.

Calculation of **volume of growing stock of small trees** per plot (m^3/ha):

- to calculate volume of small trees per ha (from m^3 to m^3/ha) volume of small trees is multiplied by area factor (FP): P_1 is 30 m^2, FP_1 is 333;

Calculation of **volume of dead wood stock** per plot (m^3/ha):

- to calculate volume of dead wood per ha (from m^3 to m^3/ha), volume of every single piece of dead wood is multiplied by different area factors (FP) according different types of dead wood,
- area factors (FP) are calculated on the basis of the sample plots areas (P) and dead wood types as for:
- **tree** (standing dead tree, lying dead tree), if diameter ($D_{1,3}$) is:
    - from 10 to 29,9 cm: P_2 is 200 m^2, FP_2 is 50,
    - equal or bigger than 30 cm: P_4 is 2000 m^2, FP_4 is 5.
- **stump**: P_2 is 200 m^2, FP_2 is 50,
- **snag**, if diameter (D) is:
    - from 10 to 29,9 cm: P_2 is 200 m^2, FP_2 is 50,
    - equal or bigger than 30 cm: P_4 is 2000 m^2, FP_4 is 5.
- **coarse woody debris,** if diameter (D) is:
    - from 10 to 29,9 cm: P_2 is 200 m^2, FP_2 is 50,
    - equal or bigger than 30 cm: P_4 is 2000 m^2, FP_4 is 5.

Biomass and carbon stock estimation

How to calculate amount of biomass and carbon from volume of growing stock?

Above-ground biomass (AGB):

- growing stock (GS) (m^3/ha) * forest area (ha) → (m^3)
- from GS to carbon stock in AGB (tree species)
    - biomass expansion factors (BEF): GS (m^3) → AGB (m^3)
    - wood density (WD): AGB (m^3) → AGB (t)
    - biomass/carbon factor (CC): AGB (t) → CDWB (t)

Below ground biomass (BGB):

- input data: AGB (t)
- from AGB to carbon stock in BGB (tree species):
    - root-shoot ratio (R): AGB (t) → BGB (t)
    - biomass/carbon factor (CC): BGB (t) → CBGB (t)

Dead wood biomass (DWB):

- dead wood stock (DWS) (m^3/ha) * area (ha) → (m^3)
- from DWS to carbon stock in DWS (tree species):
  - wood density (WD): DWB (m^3) → DWB (t)
  - biomass/carbon factor (CC): DWB (t) → CDWB (t)

As some research studies for national BEF factors for the main tree species are planned to be done in time period 2008-2012, basic wood density (WD) was gained for the main tree species from literature and some research studies as well as from table 3A.1.9 (GPG 2003). BEF **factors are from GPG 2003:**

Table 3: Factors used in calculation (according to GPG 2003)

	D	BEF_1	R	BEF_2	CF
Coniferous	0,407	1,15	0,32	1,35	0,5
Deciduous	0,567	1,20	0,26	1,36	0,5

Increment estimation

The national forest inventory which will be repeated in 2012 will make reliable calculation of growing stock increment possible. Increment can already be derived now from the years 2000 and 2007 inventory data.

Drain statistics estimation

The national forest inventory which will be repeated in 2012 will offer basis for reliable felling assessment, because every tree has appurtenant location data. Plots are not visually marked in any way so they reflex actual management practice.