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Slovenian Forest Institute

SLOVENIAN NATIONAL INVENTORY REPORT 2009 FOR SECTOR LULUCF

Specific responsibilities for the NIR 2C09 sector LULUCF have been:
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LULUCF (CRF sector 5)

1.1 Overview of sector

This sector contains GHG emissions and removals arising from land use, land use change and forestry. GHG emissions and removals are presented by six main land categories required by IPCC (2003): A. Forest Land, B. Cropland, C. Grassland, D. Wetlands, E. Settlements and F. Other Land. The sinks, (or *removals*), are presented as negative quantities. Sector LULUCF is estimated to be a net sink since 1998, amounting in 2007 to some -10.9 Mt CO_2 equivalents.

Table 1 and Figure 1 summarize the CO_2 emissions and removals in consequence of carbon losses and gains for the years 1998-2007. The total annual CO2 net emissions/ removals for period from 1998 to 2007 vary between -10,544.23 Gg (1998) and -10,955.93 Gg (2007).

Table 1: Emissions and removals from sector 5 LULUCF by sub categories in Gg CO_2

Year	**5 Total**	5.A Forest land	5.B cropland	5.C Grassland	5.D Wetland	5.E Settlement	5.F Other land
1998	**-10,544.23**	-11,000.00	91.88	363.90	NE, NO	NE, NO	NE, NO
1999	**-10,694.96**	-11,147.90	89.04	363.90	NE, NO	NE, NO	NE, NO
2000	**-10,748.61**	-11,196.15	83.65	363.90	NE, NO	NE, NO	NE, NO
2001	**-10,768.50**	-11,205.42	73.02	363.90	NE, NO	NE, NO	NE, NO
2002	**-10,804.48**	-11,257.28	88.90	363.90	NE, NO	NE, NO	NE, NO
2003	**-10,507.21**	-10,942.27	71.16	363.90	NE, NO	NE, NO	NE, NO
2004	**-10,875.36**	-11,305.46	66.20	363.90	NE, NO	NE, NO	NE, NO
2005	**-10,875.31**	-11,301.93	62.73	363.90	NE, NO	NE, NO	NE, NO
2006	**-10,693.55**	-11,115.51	58.06	363.90	NE, NO	NE, NO	NE, NO
2007	**-10,955.93**	-11,374.60	54.78	363.90	NE, NO	NE, NO	NE, NO

CO_2 emissions and removals occur as a result of land use changes and mainly from accumulation of CO_2 in forest land remaining forest land. Net sink in this sector was 10.9 Mt CO_2 eqv. in 2007. Data in table 1 shows that the most important category is 5.A Forest Land.

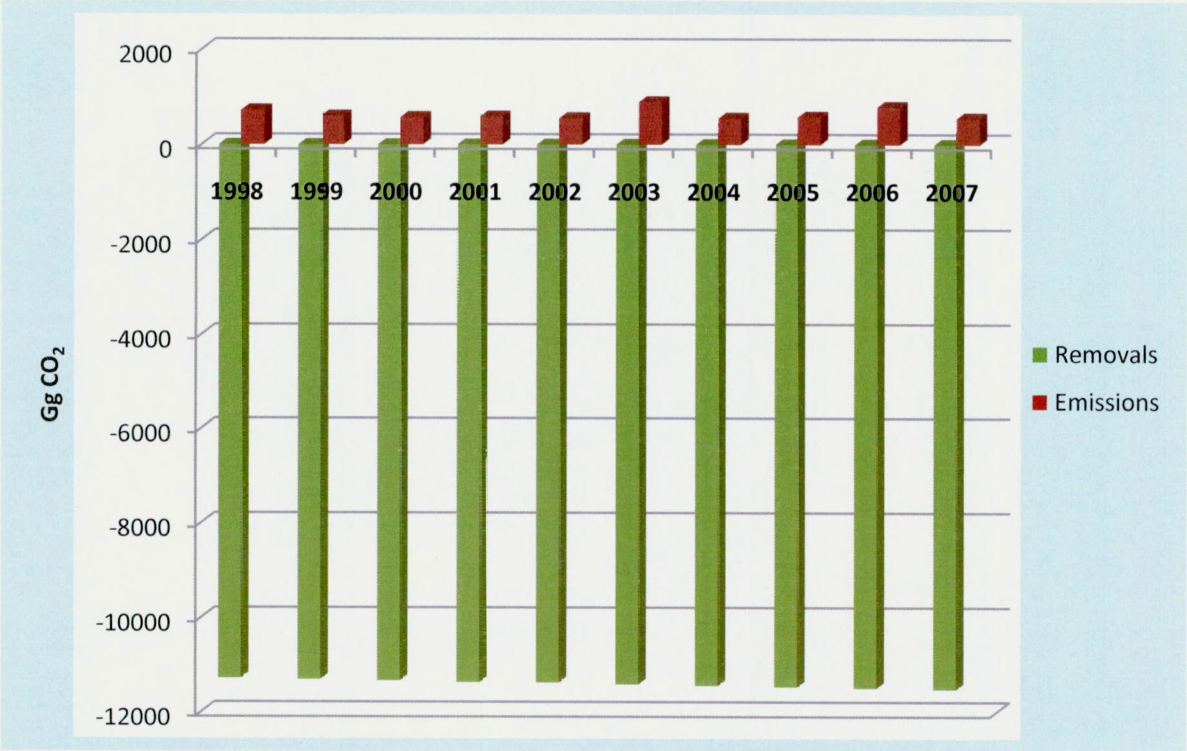

Figure 1: LULUCF sector emissions and removals from 1998 to 2007

Category 5.A.1 Forest land remaining forest land and category 5.B.1 Cropland remaining cropland were net CO2 sink, whereas the other sub-categories were net sources of CO2 emissions. However, total emissions arising from the other categories represent 5- 8 % of removals from *5 A Forest Land and 5 B Cropland* together.

The outcome of the key category analysis, according to a level and/or trend assessment (IPCC Tier 1 and Tier 2 approaches), is listed in table 2. Only CO_2 emissions and removals from forest land remaining forest land have been identified as a key category.

Table 2: Key categories identification in LULUCF sector

	Gas	***Categories***	
5.A.1	CO_2	Forest land remaining forest land	Key
5.A.2	CO_2	Conversion to forest land	Non-key
5.B.1	CO_2	Cropland remaining cropland	Non-key
5.B.2	CO_2	Conversion to cropland	Non-key
5.C.1	CO_2	Grassland	Non-key
5.C.2	CO_2	Conversion to grassland	Non-key
5.D	CO_2	Wetlands	Non-key
5.E	CO_2	Settlements	Non-key
5.F	CO_2	other land	Non-key
5.A.1	CH_4	Forest land remaining forest land	Non-key
5.A.1	N_2O	Forest land remaining forest land	Non-key
5.B.2	N_2O	Conversion to cropland	Non-key

Reported calculations are based on the Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC 2003) completed by country-specific methodologies. The land areas from 1998 to 2007 are represented by geographically explicit land-use data with a resolution of 0.25 ha. Study of land use by Slovenian Forestry institute enables to calculate spatially explicit land-use change matrices.

Areas and shares of land uses are presented in Table 3:

Table 3: Land use by categories in year 2007

Area	ha	%
Forests	1,266,075	62.45
Cropland	259,024	12.78
Grassland	375,119	18.50
Wetlands	13,839	0.68
Settlements	109,236	5.39
Other land	12,810	0.63
Sum	2,027,300	100.00

Slovenia has not yet developed land use data for years before 1998. The data about land use cover between years 1986 and 1997 will be recalculated and reported in subsequential report.

1.2 Methodological issues for LULUCF in Slovenia

1.2.1 LU and LU change methodological issues

Among the various land use (LU) changes in Slovenia the most relevant for the CO_2 emission and /or removals is the abandonment of agriculture activities. The abandoned agricultural areas usually enter a process of spontaneous afforestation. However these LU changes contribute a relatively minor part to the LULUCF carbon sink, as compared to the increase in woody biomass per hectare in category Forest land remaining forest land. According to Key categories identification in LULUCF sector (Table 2) Tier 1 approach was selected to assess emissions and removals of CO_2 for the LU changes in Slovenia.

For the calculation of CO_2 emissions / removals available updated version of the Agricultural Land Use Map (ALUM, Ministry of Agriculture, Forestry and Food (MAFF)) was used. To capture land cover changes two versions of ALUM map were used: the one published in the year 2002 (reflecting the land use / land cover for the year 1998), and ALUM map published in 2008 (reflecting the situation in the year 2007). This are the first Slovenian databases, where directly comparable data could be used for estimation of land use and land use change.

Table 4: References to sources of information (GFRA 2010)

References to sources of information	Variable(s)	Year(s)	Additional comments
Cadastre of Actual Agricultural Land Use. Ministry of Agriculture, Forestry and Food (MAFF). 2002 and 2008.	Land use / Land cover	1998, 2007	Land use photo interpreted in scale 1:5 000 from aerial imagery acquired in years 1994 to 2001; 1998 is the average year; covers also all the forested and urban areas.

Table 5 shows a simplified land-use chance matrix developed from ALUM map (MAFF 2002 and MAFF 2008) for the years 1998 and 2007. Land use change matrices including subdivisions of land categories (in ha) and the annual changes interpolated for the periods 1998-1999, 1999-2000, 2000-2001, 2001-2002, till 2006-2007. The matrices enable us to point out the average areas of transition land, separately for each initial and final land use as shown in table 5.

Table 5: LU change matrix for whole the period 1998 – 2007 in ha

	F	Cp	Ca	G	W	S	O	LUC (ha)
F		7,892.0	359.8	25,108.6	NO	NO	NO	33,860.4
Cp	8,070.1		1,948.9	12,706.2	NO	NO	NO	22,725.2
Ca	2,994.9	3,955.2		45,599.5	NO	NO	NO	52,549.6
G	30,873.8	16,507.3	19,673.8		NO	11,459.7	NO	78,514.6
W	NO	NO	NO	NO			NO	NO
S	NO	NO	NO	NO	NO		NO	NO
O	15,019.7	NO	NO	NO	NO	NO		15,019.7
Sum	56,958.4	28,354.5	22,482.6	83,414.3	NO	11,459.7	NO	202,669.4

F – forest land, Cp – cropland (perennia), Ca – cropland (annual), G – grassland, W – wetland, S – settlements and O – other land

Table 6: LU change matrix in % of LU in 2007

	F	Cp	Ca	G	W	S	O	LUC (%)
F		0,39	0,04	1,24	NO	NO	NO	1,67
Cp	0,40		0,10	0,63	NO	NO	NO	1,12
Ca	0,15	0,20		2,25	NO	NO	NO	2,59
G	1,52	0,81	0,97		NO	0,57	NO	3,87
W	NO	NO	NO	NO		NO	NO	NO
S	NO	NO	NO	NO	NO		NO	NO
O	0,74	NO	NO	NO	NO	NO		0,74
Sum	2,81	1,40	1,11	4,11	NO	NO	0	9,99

F – forest land, Cp – cropland (perennial), Ca – cropland (annual), G – grassland, W – wetland, S – settlements and O – other land

Land use changes to and from one land use to another are of minor importance in Slovenia. We took in to consideration only land use changes that represent more than 5 % of total land use change in the given period. In the period 1998 – 2007 total annual land use change occurred on less than 10 % of total area. As shows in Table 5 or Table 6 the land use changes to Forest land is only due to conversion of Cropland, Grassland and Other land to forest land (this change represents less than 5 % of all Forest land in whole period from 1998 to 2007). Forest land was in this period also converted to Cropland and Grassland, but net change of forest land is positive (the forest land was enlarged for more than 23,000 ha). Grassland was converted to Forest land, Cropland or Settlements (this change represents 20 % of all Grassland in whole period from 1998 to 2007), but also some Forest land and Cropland was converted to Grassland. Cropland area was reduced mainly due to conversion of Cropland to Forest land and Grassland. Settlements enlarged due to conversion of Grassland to Settlements. The land use changes from or to other categories that are not represented in table 5 are below 5 % of respective areas and were not included in calculation of LUC, due to a high degree of uncertainty. It is important to take in consideration that data in table 5 are areas of LUC for 9 year period.

1.2.2 Carbon stock in soils and in litters

For carbon determination in soils databases were the primary source of basic soil properties. The existent databases in Slovenia were not established to be used for mineral soil carbon pool and litter pool assessment. For our assessment there are a total of 909 soil profiles (mineral soil) descriptions with analytical data. Soil data included information on soil depth, C:N ratio of the top soil, soil carbon pool, soil texture but no soil bulk density data, which need to be calculated and is planned to be considered in subsequent submissions.

1.2.3 Methodological issues

Carbon stock in mineral part of soil (SOM) was calculated according to equation 1.

$$C_{pool} = \sum_{i=1}^{k} (\%C_{org,i} \cdot d_i \cdot \rho_i \cdot 100) \qquad \text{(Equation 1)}$$

C_{pool} – carbon stock $[Gg\ ha^{-1}]$,

$\%C_{org,i}$ – organic carbon content [%] in soil horizont i,

d_i – thickness [m] of soil horizon i,

ρ_i – soil bulk density [g cm – 3] of horizon i

k – number of soil horizon in soil profile.

Because no measurements of bulk density were available, the soil bulk density [g/cm^3] was estimated from the following transfer function 2:

$$\rho_i = \begin{cases} 1/(0{,}625 + 0{,}05 \cdot \%C_{org} + 0{,}0015 \cdot \%clay) \rightarrow if\ \%C_{org} \leq 5\% \\ 1{,}55 - 0{,}0814 \cdot \%C_{org} \rightarrow if\ 5\% < \%C_{org} \leq 15\% \\ 0{,}725 - 0{,}337 \cdot \log_{10} \%C_{org} \rightarrow if\ \%C_{org} \geq 15\% \end{cases} \qquad \text{(Equation 2)}$$

C_{org} – the organic carbon content and clay the clay content (both in %).

The top equation for mineral soils is based on data by Hoekstra and Poelman (1982), the bottom equation for peat(y) soils is derived from Van Wallenburg (1988) and the central equation is a linear interpolation (for clay=0) between the two (Reinds *et al.* 2001).

Table 7: Average carbon stock (SOC) and soil depth in mineral part of soil

Aggregated nomenclature	n	Average soil depth [cm]	Average carbon stock [Gg ha^{-1}]	Uncertainty (95%CI) %
Forest	314	55.1	150.4	±5.3
Cropland	197	81.2	157.9	±7.0
Wetlands	2	45.0	198.8	NA
Urban area	1	82.0	197.1	NA
Abundant land	24	44.4	143.5	±10.8
Grasslands	371	57.6	145.7	±4.2

LITTER

Carbon stock in litter was calculated according to equation 3.

$$C_{pool} = \sum_{i=1}^{k} (\%C_{org,i} \cdot M_{105°C,i} / 100) \qquad \text{(Equation 3)}$$

C_{pool} – *carbon stock* $[Gg\ ha^{-1}]$,

$\%C_{org,i}$ – *organic carbon content* $[\%]$ *in organic sub horizon i,*

$M_{105°C,i}$ – *quantity* $[Gg\ ha^{-1}]$ *of dry soil in sub horizon i,*

k – *number of sub horizon in organic part of soil profile.*

Table 8: Average carbon stock in litter and thickness of litter

Aggregated nomenclature	n	Average soil thickness [cm]	Average carbon stock [Gg ha^{-1}]	Uncertainty (95%CI) %
Forest	280	4.1	5.6	±0.7

1.2.4 Source-Specific QA/QC and Verification

No source-specific QA/QC activities have been carried out. Further development is described in section 1.2.5.

1.2.5 Source-specific planned improvements

Due to the fact that in existing soil database there are uncomplete data about bulk density of the soils two forest soil surveys were conducted.. Forest soil survey on 16x16 km grid started in year 2005 as a part of demonstration project BioSoil – module soil and EU Forest Focus program and in year 2007 on national 8x8 km grid (16x16 km grid is a part of 8x8 km grid). Surveys will generate additional 200 plots with soil carbon data.

In order to secure a comparability of carbon stocks between sites, soil sampling was traced by depth. The organic layers at the soil surface and mineral layers are sampled separately. The top of the mineral soil corresponds with the zero level for depth measurements. A frame of 25 cm by 25 cm is used for sampling the organic layer. Samples were taken for each sub-horizont separately (Ol, Of, Oh). The mineral soils were sampled at exactly the same locations as organic layers, i.e. we sampled the mineral soil underneath the organic layer that has already been removed for sampling. Mineral soil samples were taken in 5 cm to a depth of 10 cm, steps of 10 to a depth of 20 cm, and then steps of 20 cm were sampled. This resulted in following sampling depths: 0-5 cm, 5-10 cm, 10-20 cm, 20-40 cm, 40- 60 cm, 60-80 cm.

At each site, one pit was also excavated and samples from soil horizons were taken. To be able to calculate carbon stocks, it was necessary to take samples of a defined volume. This was achieved by taking five parallel cylinders ($V = 5\ cm^3$) at each sampling horizon.

At each site, one pit was also excavated and samples from soil horizons were taken. To be able to calculate element stocks, it was necessary to take samples of a defined volume. This was achieved by taking five parallel cylinders ($V = 5\ cm^3$) at each sampling horizon.

In 2007 additional soil samples were collected on 155 plots of the Slovenian 8x8 km grid. The design of soil sampling in year 2007 was modified. Soil samples were taken only in three locations. The organic layers at the soil surface and mineral layers were sampled separately.

A frame of 25 cm by 25 cm was also used for sampling the organic layer. Litter subhorizont (O_l) and fermented (O_f) sub horizons were collected together while humic horizon (O_h) was sampled separately. The mineral soils are sampled at the same locations as organic layers. Also in year 2007 mineral layer sampling was done with auger (∅ = 7 cm) in fixed depths, i.e. 0 – 10 cm, 10 – 40 cm.

All samples were first air dried, then dried at 40°C and stored until further preparation. Mineral soil samples were crushed and sieved through a 2 mm test sieve. Weight of mineral soil, roots, and skeleton was determined separately.

Sub-samples were ground for C/N analysis. For later bulk density calculations the volume of the stones and roots were subtracted from the total volume of the samples. The root volume was determined using water replacement, but because of inaccuracy of measurements on fine roots, estimated by taking root mass times tree species specific density (ρ). Skeleton density was determined using water replacement method on ten stone samples.

As carbon losses are expected at high temperatures, absolute dry weight of mineral soil samples was determined on sub-samples (Mettler, accuracy 0.001g) by oven drying for 36 h at 105°C. The absolute dry weight of the entire sample could therefore be determined through the ratio of dry weight at 40°C (DW 40) and dry weight at 105°C (DW 105). Litter samples were assorted, and after drying at 70° C, dry weight (DW 70) was determined.

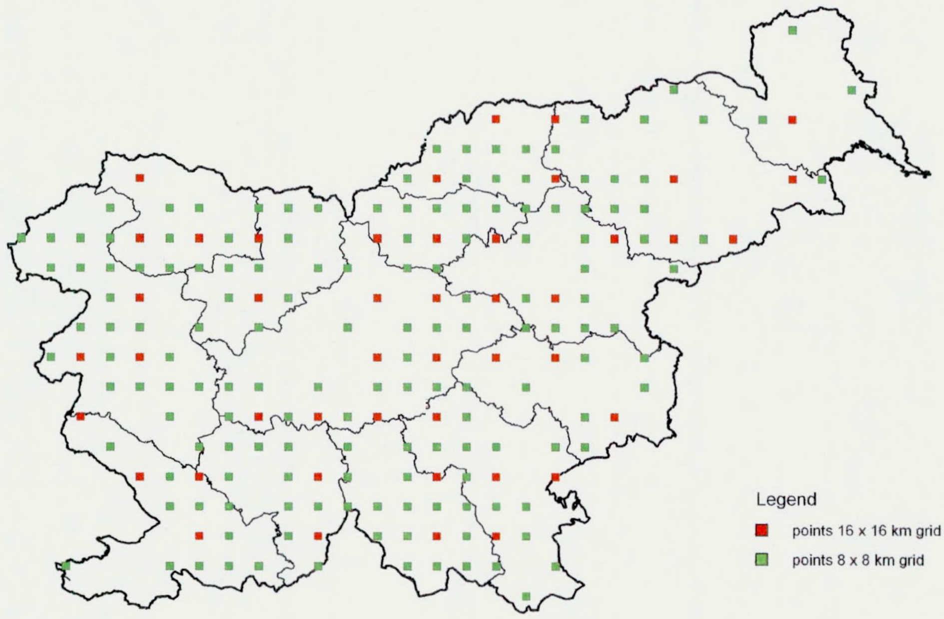

Figure 2: 16x16 grid and 8x8 grid

1.3 Forest Land (5A)

In 1953, 1956 and 1958, all areas grown over with forest trees as well as smaller incorporated forest areas were considered as forest. Since 1961 the term forest covers areas larger than 0.05 ha that are covered with forest trees, irrespective of their height and growth. Trees lining paths, parks in inhabited areas, forest nurseries and groups of trees on areas smaller than 0.05 ha are not considered as forest (Statistical Yearbook of the Republic of Slovenia 2005)

According to Slovenian forestry act (1995, section 2):
Forest means land overgrown with forest trees in the form of stands or other forest plants which provides any of the functions of a forest. Forest according to this Act also includes overgrown plots of land defined as forest in the spatial element of the forest management plan.
(2) The forest infrastructure not allocated into separate lot is an integral part of the forest land.
(3) The following are not forest within the meaning of this act: individual forest trees, groups of forest trees up to an area of 0.05 hectares, non-autochthonous riverine and windbelt trees, avenues, parks, plantations of forest trees, pens for rearing game, and pastures overgrown with forest trees if used for pasturing, irrespective of how they are described in the land register.
(4) The provisions of this act and regulations issued on the basis hereof shall also apply to forest trees which grow outside forests insofar as they are specifically defined.

In December 2007 Slovenian forest act was changed – also in section 2. According to this new definition forest is land covered with forest trees in the form of stands with minimal tree height 5 m and with minimal area of 0.25 ha.

Abandoned agricultural land on area more than 0.25 ha, which have been abandoned for more than 20 years, with minimal tree height 5.00 m and have a tree crown cover between up to 75 % are defined as forests.

All forests in Slovenia are considered managed, because forest management plans are prepared for all forests, regardless ownership, conservation degree or natural conditions.

1.3.1 Source category description

Under this category, CO_2 emissions removals from living biomass (above and below ground), dead organic matter, soils and non CO_2 greenhouse gas, from forest remaining forest and land converted to forest have been recalculated. Net carbon stocks change by land converted to forest land, for living biomass, dead organic matter, soils and Non greenhouse gas, is included in the assessment of carbon stocks change.

With regard to forest land the annual net CO_2 removals under sector 5 of the reported period 1998–2007 was between 10,942.00 Gg CO_2 and 11,374.00 Gg CO_2. New estimate is considerably higher compared to past reports, because of using the different method and new data from NFI. Inventory period is in our case 2000 – 2007 and we are planning to repeat the inventor in 2012. According to new data from NFI growing stock in Slovenian forests is high (more than 150 t/ha). The sub category 5.A.1 (Forestland remaining Forestland) was selected as key category (Table 2), contrary the land use changes to Forestland (5.A.2) have minor influence on the net CO_2 balance. The removals from dead wood in generally have a minor influence on the net CO_2 balance of sector 5.

Emissions of CO_2 from Wild fires in forest areas are included in sector 5 A (table 10).

The reported CO_2 emissions from forest soils have to be considered with high uncertainty whereas dead organic matter in general have a small influence on the net CO_2 balance of sector (about 650 Gg CO_2).

Details on the methodology, uncerta nty assessment, quality assurance, quality control and verification are given in each subchapter (except soils and litter – see chapter **Error! Reference source not found.** and land use change matrix – see chapter 1.2.1).

For the reported period 1998 to 2007 the total annual net removals (biomass, soils and dead wood) from land use changes to forest were around 75 Gg CO_2 per year.

Table 9: Activity data for forest land (1998 – 2007) in ha

Year	5.A Total forestland	5.A.1 Forestland remaining forestland	Land converted to forestland						Wildfires
			5.A.2 Land converted to forestland	5.A.2.1 Cropland converted to forestland	5.A.2.2 Grassland converted to forestland	5.A.2.3 Wetland converted to forestland	5.A.2.4 Settlements converted to forestland	5.A.2.5 Other land converted to forestland	
1998	1 243 348	1 237 019	6 328	1 229	3 430	NO	NO	1 669	1 254
1999	1 245 873	1 239 545	6 328	1 229	3 430	NO	NO	1 669	433
2000*	1 248 399	1 242 070	6 328	1 229	3 430	NO	NO	1 669	265
2001	1 250 924	1 244 595	6 328	1 229	3 430	NO	NO	1 669	340
2002	1 253 449	1 247 120	6 328	1 229	3 430	NO	NO	1 669	161
2003	1 255 974	1 249 645	6 328	1 229	3 430	NO	NO	1 669	2 100
2004	1 258 499	1 252 171	6 328	1 229	3 430	NO	NO	1 669	138
2005	1 261 025	1 254 696	6 328	1 229	3 430	NO	NO	1 669	280
2006	1 263 550	1 257 221	6 328	1 229	3 430	NO	NO	1 669	1 401
2007*	1 266 074	1 259 746	6 328	1 229	3 430	NO	NO	1 669	124

* Inventory year

Table 10: Emissions/removals from forestland (1998 – 2007) in Gg CO_2

		Forestland remaining forestland		Land converted to forestland							
Year	5.A Total forestland**	5.A.1 Forestland remaining forestland	Dead organic matter	5.A.2 Land converted to forestland	5.A.2.1 Cropland converted to forestland	5.A.2.2 Grassland converted to forestland	5.A.2.3 Wetland converted to forestland	5.A.2.4 Settlements converted to forestland	5.A.2.5 Other land converted to forestland	Dead organic matter	Wildfires
1998	-11 000.00	-11 118.31	-630.55	-75.52	-20.63	-36.46	NO	NO	-18.41	-3.23	193.82
1999	-11 147.90	-11 141.01	-631.84	-75.52	-20.63	-36.46	NO	NO	-18.41	-3.23	68.62
2000*	-11 196.15	-11 163.70	-633.13	-75.52	-20.63	-36.46	NO	NO	-18.41	-3.23	43.07
2001	-11 205.42	-11 186.40	-634.41	-75.52	-20.63	-36.46	NO	NO	-18.41	-3.23	56.50
2002	-11 257.28	-11 209.10	-635.70	-75.52	-20.63	-36.46	NO	NO	-18.41	-3.23	27.33
2003	-10 942.27	-11 231.79	-636.99	-75.52	-20.63	-36.46	NO	NO	-18.41	-3.23	365.04
2004	-11 305.46	-11 254.49	-638.27	-75.52	-20.63	-36.46	NO	NO	-18.41	-3.23	24.55
2005	-11 301.93	-11 277.19	-639.56	-75.52	-20.63	-36.46	NO	NO	-18.41	-3.23	50.77
2006	-11 115.51	-11 299.88	-640.85	-75.52	-20.63	-36.46	NO	NO	-18.41	-3.23	259.89
2007*	-11 374.60	-11 322.58	-642.14	-75.52	-20.63	-36.46	NO	NO	-18.41	-3.23	23.50

* Inventory years

** In total net CO_2 balance of sector in the Table 10 the emissions of CO_2 from forest fires are included in total sum. In the CRF tables the emissions from wild fires are included in the table 5 (V) and they are not included in the table 5 A forest land.

1.3.2 FORESTLAND REMAINING FORESTLAND (5 A 1)

The sub category 5.A.1 (Forestland remaining Forestland) was selected as key category (Table 2). Forests in Slovenia cover more than 62 % of all land. Under this category, CO2 emissions from living biomass, dead organic matter and soils, from forest land remaining forest land have been reported.

Removals for category Forest land remaining forest land represents major share of total CO2 removals in LULUCF sector; in particular the living biomass removals represent 94%, while the removals from dead organic matter and soils stand for 6% of total 2005 forest land CO2 removals, respectively.

Table 11: Emissions/removals from Forestland remaining Forestland (1998 – 2007) in Gg CO_2 by pools

Year	Forest remaining forest			
	Area	Living biomass	Dead wood	Sum
	ha	Gg CO2	Gg CO2	Gg CO2
1998	1 237 019	-10 487,8	-630,551	-11118,31
1999	1 239 545	-10 509,2	-631,838	-11141,01
2000	1 242 070	-10 530,6	-633,126	-11163,70
2001	1 244 595	-10 552,0	-634,413	-11186,40
2002	1 247 120	-10 573,4	-635,700	-11209,10
2003	1 249 645	-10 594,8	-636,987	-11231,79
2004	1 252 171	-10 616,2	-638,274	-11254,49
2005	1 254 696	-10 637,6	-639,561	-11277,19
2006	1 257 221	-10 659,0	-640,849	-11299,88
2007	1 259746	-10 680,4	-642,136	-11322,58

1.3.2.1 Methodological issues

A method applied follows Tier 3 requirements in IPCC GPG for LULUCF (2003)... The use of some country specific conversion factors, measurements of dead wood biomass and data from soil inventory provides more accurate and transparent figures for Slovenian forests. Estimates are based on measured data of volume increment of the growing stock (for all living trees with d_{bh} > 9.99 cm in all forest areas) according to Slovenian national classification. The data are based on the results of the Slovenian National Forest inventory (NFI). The NFI was carried out in the years 2000-2007 and is planned to be repeated in 2012.

The NFI increment data cover all possible reasons for biomass increments and losses in the forest. That means that biomass increments due to abandonment of managed land or biomass loses due to traditional (non-commercial) fuel wood consumption, forestland conversion, forest fires and other damages are already considered in calculations based on the inventory data.

The estimate of growing stock of Slovenian forests from 1998 to 2007 is based on :

- The initial growing stock is calculated from NFI 2000 and NFI 2007.
- The growing stock between these years was interpolated.
- The growing stock from 2000 to year 1998 was extrapolated.

Changes of carbon stock in living biomass

In GPG-LULUCF two methods are described for estimating carbon stock change in living biomass. In our calculations of carbon stock change in living biomass the Method 2 (stock change method) was used. The method can be described as Tier 3, as defined in the GPG LULUCF (IPCC 2003). This sub category 5.A.1 (Forestland remaining Forestland) was selected as key category (Table 2), that why Tier 3 methodology is required. This method requires biomass carbon stock inventories for a given forest area at given points in time.

In time period from 2000 to 2007 the annual removals were between 10,925.00 Gg CO_2 and 11,361.00 Gg CO_2. The new estimate differ from previous reported figures due to change in methodology (default method was used in previous reports). With new and more accurate datasets from NFI we recalculated all data for period 1998-2007. Extrapolated figures for years 1986-1998 will be prepared in subsequential report. In previous report carbon stock change varied from 1.589 in base year to 5.430 Gg CO_2 in year 2005. The main reason for considerable difference in net CO_2 balance is related to underestimated figures of growing stock and due to the fact that in previous reports only carbon pool in living biomass was considered. According to new data from two successive inventories growing stock presented in tons of dry matter in Slovenian forests is considerable high (more than 150 t/ha).

Equation 3.2.3 from GPG-LULUFC was used in our calculation:

For calculation the equation 3.2.3 from GPG-LULUFC was used:

$$\Delta C = \frac{(C_{t2} - C_{t1})}{t_2 - t_1} * A \qquad \text{(Equation 4)}$$

$$C = (GS * WD * BEF_2) * (1 + R) * CF$$

$\Delta C - living\ biomass\ (t\ CO2)$

$A - area\ of\ forest\ land\ in\ ha$

$C_t -\ total\ carbon\ biomass\ calculated\ at\ time\ t1\ or\ t2\ (t\ C)$

$GS - growing\ stock\ (\ m\text{^}3/ha)$

$WD - basic\ wood\ density\ (\ t/m\text{\^{}}3)$

$BEF_2 - biomass\ expansion\ factor\ for\ conversion\ of\ merchantable\ volume\ to\ aboveground\ tree\ biomass$

$R - root{:}\ shoot\ ratio$

For the calculation of carbon stock in living biomass the factors presented in Table 12 were used. The conversion factors in the Table 12 are based on the species composition of wood stock in Slovenian forests and on default values for individual tree species (GPG-LULUCF table 3A.1.8 (R), 3A.1.9-1 (D) and 3A.1.10 (BEF2)). For calculations the lowest value of R and BEF_2 was used because the above ground biomass stock is higher than 150 t dry matter/ha.

According to analysis of national data from past research done by SFI, basic density for *Fagus sylvatica* (D = 0.584 t/m^3) and *Alnus* glutinosa (D = 0.445 t/m^3) were researched. National calculated values do not differ significantly from default values in table 3A.1.9-1 of GPG LULUCF. Further analysis on the rational and credible methodology is in progress. With these studies we will obtain data for basic wood density of major tree species in Slovenia.

Table 12: Factors for calculation of CO_2 accumulation in Slovenian forests

	D	BEF2	R	CF	C→ CO2
Coniferous	0.407	1.50	0.23	0.50	44/12
Deciduous	0.567	1.50	0.24	0.50	44/12

Dead wood

According to our definition dead wood is defined as all non-living woody biomass not included in the litter, either standing, lying on the ground, or in the soil. According to definition from NFI 2007, dead wood in Slovenia includes:

- dead trees (DBH > 10 cm);
- stumps (D > 10 cm and H > 20 cm);
- snags (D > 10 cm and H > 50 cm);
- coarse woody debris (D > 10 cm and L > 50 cm).

Since national data on the stock of dead wood are available from the NFI 2007 (National Forest Inventor) the stock change method Tier 3 was applied. There are no data about dead wood from the NFI 2000. So the dead wood biomass for year 2000 was estimated applying dead mass conversion percent from NFI 2007, as only available information. For calculations the equation 5 defined in subchapter 3.2.12 from GPG-LULUFC was used.

$$\Delta C_{FF(DW)} = \left[A * \frac{(B_{t2} - B_{t1})}{T}\right] * CF \qquad \text{(Equation 5)}$$

$\Delta C_{FF(DW)}$ – *annual change in carbon stocks in dead wood* $(t\ yr^{-1})$

A – *area of managed forest land remaining forest land (ha)*

B_{t2} – *dead wood stock at time t2 for managed forest remaining forest (t d.m.)*

B_{t1} – *dead wood stock at time t1 for managed forest remaining forest (t d.m.)*

T – *time period between t1 and t2 (yr)*

CF – *carbon fraction of dry matter (t d.m.)*

Average stock of dead wood is 8.17 t dry matter/ha (18.46 m^3/ha). . The annual sink of carbon stock in dead wood amounts to about 635.00 Gg CO_2.

Litter

Methodology for calculation net CO_2 balance in litter is described in chapter 1.2.2. Average carbon stock in litter is 5,6 Gg CO_2 per ha.

The dead organic matter is defined in the GPG LULUCF as the sum of the dead wood and the litter.

Change in carbon stock in soils

The changes in the carbon content of the soils are very small and slow. We estimate that increase of carbon stock in soils is only due to conversion of other land uses to forest land.

The methodology is described in chapter 1.2.2.

Data about carbon stock in soils will be recalculated on the same depth as it is recommended in GPG-LULUCF – 30 cm in subsequential report.

1.3.3 NON-CO_2 GREENHOUSE GAS EMISSION (5 A)

N_2O Emissions from N Fertilization and Drainage of Soils

Fertilization of forests is not practiced in Slovenia and due to non existing of reported events of fertilization in forests no emissions are reported in CRF Table 5(I).

Drainage of forests is not occurring in Slovenia. There are no data available; we estimate that the drained area is probably very small, if existing at all.

Emissions from Wildfires

As controlled burning is not allowed in Slovenia except controlled burning of branches due to sanitary reasons caused by bark beetle all fires are assigned to "wildfires". It was assumed that all wild fires affected productive forests. The areas of wildfires are very small, less than 1 % percent in the year 2003, which was the most problematic year in the reported period. For the calculation of non CO2 emissions caused by wildfires Tier 1 approach was used.

For calculations of greenhouse gas emissions the equation 3.2.20 (GPG 2003) was applied.

$$L_{fire}(t\ GHG) = A * B * C * D * 10^{-6} \qquad \text{(Equation 6)}$$

$A - area\ burnt\ in\ ha$

$B - mass\ of\ aviable\ fuel, kg\ d.m.ha^{-1}$

$C - combustion\ efficiency\ (table\ 3A.1.12\ in\ IPCC\ GPG - LULUCF\ 2003)$

$D - emission\ factor\ (Table\ 3A.1.16\ in\ IPCC\ GPG - LULUCF\ 2003)$

For all GHG, the default emission factors are applied (IPCC 2003, Table 3A.1.16). The mass of available fuel (growing wood stock in t/ha) is estimated to average 190 t above ground biomass ha^{-1}. The fraction of the biomass combusted is 0.45 (GPG-LULUCF 2003, Table 3A.1.12). Using equation 3.2.20 of IPCC GPG (2003), the emissions of all GHG are presented in Table 13.

Table 13: Productive forest land affected by wildfires and resulting GHG emissions for 1998-2007 time period.

Year	Area burnt (ha)	AGB* (t/ha)	**CO_2 (Gg)**	**N_2O (Gg)**	**NO_x (Gg)**	CH_4 (Gg)	CO (Gg)	NMHC (Gg)
1998	1 254	177.92	**193.82**	**0.01**	**0.09**	1.10	15.95	1.23
1999	433	182.34	**68.62**	**0.00**	**0.03**	0.39	5.65	0.43
2000	265	186.76	**43.07**	**0.00**	**0.02**	0.25	3.54	0.27
2001	340	191.18	**56.50**	**0.00**	**0.03**	0.32	4.65	0.36
2002	161	195.60	**27.33**	**0.00**	**0.01**	0.16	2.25	0.17
2003	2 100	200.02	**365.04**	**0.03**	**0.16**	2.08	30.03	2.31
2004	138	204.44	**24.55**	**0.00**	**0.01**	0.14	2.02	0.16
2005	280	208.86	**50.77**	**0.00**	**0.02**	0.29	4.18	0.32
2006	1 401	213.42	**259.89**	**0.02**	**0.12**	1.48	21.38	1.64
2007	124	217.98	**23.50**	**0.00**	**0.01**	0.13	1.93	0.15

*AGB – above ground biomass

1.3.4 LAND CONVERTED TO FOREST LAND

Data about land use change from other land uses to forestland are described in chapter 1.2.1 and chapter 1.2.2. Subategory 5.A.2 (Conversion to forest land) was selected as non- key category (Table 2). For the calculation of the annual change in carbon stocks in other land converted to forestland the IPCC GPG Tier 1 approach was used. Exception present soil carbon stocks, where the country specific methodology was used (see chapter **Error! Reference source not found.**).

The average annual area converted from other land to forest in period from year 1998 to 2007 was on average 6.660 ha. As described in Table 5 the land use change to forests is mainly caused by conversion of grassland and other land to forest land. The land use conversion from other categories to forest land is occurring in lesser extent and was considered as NO in our reporting.

Table 14: Emissions/removals from land converted to Forestland (1998 – 2007) in Gg CO_2 by pools

Year	Area	Living biomass	Dead wood	Soil	Sum
	ha	Gg CO_2	Gg CO_2	Gg CO_2	Gg CO_2
1998	6 329	-58,59	-3,23	-13,70	-75,52
1999	6 329	-58,59	-3,23	-13,70	-75,52
2000	6 329	-58,59	-3,23	-13,70	-75,52
2001	6 329	-58,59	-3,23	-13,70	-75,52
2002	6 329	-58,59	-3,23	-13,70	-75,52
2003	6 329	-58,59	-3,23	-13,70	-75,52
2004	6 329	-58,59	-3,23	-13,70	-75,52
2005	6 329	-58,59	-3,23	-13,70	-75,52
2006	6 329	-58,59	-3,23	-13,70	-75,52
2007	6 329	-58,59	-3,23	-13,70	-75,52

1.3.4.1 Methodological issues

Change in carbon stock Living biomass

The carbon stock change of living biomass has been calculated taking into account the increase and the decrease of carbon stock related to areas converted into forest land. The annual increment of steam wood over bark on areas converted to forestland was estimated at 3.00 m^3/ha for coniferous and 4.00 m^3/ha for deciduous (GPG-LULUCF Annex 3A.1, table 3A.1.5). For the calculation the equation 3.2.4 from GPG LULUCF was considered:

$$\Delta C_{growth} = A * G_{total} * CF \qquad \text{(Equation 7)}$$

$$G_{total} = G_W * (1 + R)$$

$A - area\ of\ land\ converted\ to\ forestland$

$G_{total} -\ awerage\ annual\ increment\ rate\ in\ total\ biomass\ in\ units\ of\ dray\ matter$

$CF - carbon\ fraction\ of\ dry\ matter$

$G_W -\ awerage\ annual\ aboweground\ biomass\ increment\ in\ t\ d.m.ha^{-1}yr^{-1}$

$R - root - shoot\ ratio\ appropriate\ to\ increments$

Table 15: Factors for calculation of CO_2 accumulation in land converted to forests

	Gw (t d.m./(ha*yr)	CF t C/(t d.m.)	R	C→ CO2
Deciduous	4	0.5	0.43	44/12
coniferous	3	0.5	0.46	44/12

The annual net sink of carbon in land converted to forest in living biomass is in average 61 Gg CO_2 per year.

Change in carbon stock in dead wood
In the Tier 1 calculation, the average transfer rate into dead wood pool equals the transfer rate out of the dead wood pool. The net change is therfor considered to be zero (GPG-LULUCF).

Change in carbon stock in soils
In the Tier 1 calculation it is assumed that on forestland remaining forestland there is no change in organic matter of carbon stock in soils. For land converted to forestland the Tier 1 method was followed. The initial soil carbon stock is determined from the same reference soil carbon stock used for all other land uses (Table 7). Stock change factors (F_{LU}, F_{MG}, F_I) appropriate for the previous land use were used. We estimate that annual *change in carbon stock in soils* is in average -13.5 Gg CO_2.

For calculation the equation 3.2.14 in GPG-LULUCF was applied.

$$\Delta C_{CCmineral} = \frac{[(SOC_{ref} - SOC_{non-forest\ land})*A]}{T} \qquad \text{(Equation 8)}$$

$\Delta C_{CCmineral}$ – *annual change in carbon stock in mineral soils* $(t\ C\ yr^{-1})$

SOC_{ref} = *reference carbon stock, under native, unmanaged forest on given soil* $(t\ C\ ha^{-1})$

$SOC_{non-forest\ land}$ = *stable soil organic carbon on previous land use* $(t\ C\ ha^{-1})$

T – *Time (default 20 years)*

A – *land area (ha)*

SOC_{REF} – *default value from table* Table 7 $(t\ C\ ha^{-1})$

Table 16: Relative change factors for different management activities

	Grassland			Forestland		
	F_{LU}	F_{MG}	F_I	F_{LU}	F_{MG}	F_I
1978	1.00	1.00	1.00	1.00	1.00	1.00
1987	1.00	1.00	1.00	1.00	1.00	1.00
1998	1.00	1.00	1.00	1.00	1.00	1.00
2007	1.00	1.00	1.00	1.00	1.00	1.00

1.3.5 Uncertainties and time-series consistency

A process of using models to time-shift the forest estate forwards to represent future forest growth and forest managed, and backwards to improve historical estimates, is performed to minimize errors. As the estimation of carbon stocks is continuously being improved, both past and future will be recalculated.

The NFI is based on a very comprehensive quality assurance system, which allows the exact identification of the right location of the grid and sample points guarantees the repeated measurement of the same trees (permanent marked grid). Also indicates at once implausible figures for individual parameters during the measurements on site and any missing trees compared to the period before.

One of the goals of NFI 2007 was to obtain accurate and reliable data about the state of volume of wood growing stock (carbon stock) as basis for KP/UNFCCC reporting for all Slovenian forests. Some of indicators from NFI 2007 are in Table 17.

Table 17: Indicators from NFI 2007

Carbon stock	326.40 m^3/ha	± 4.30 %
Living trees growing stock	8.65 m^3/ha	± 6.50 %
Dead wood	18.64 m^3/ha	± 16.60 %
Soil and litter	see chapter **Error! Reference source not found.** (Table 7 and Table 8)	

Variable	Uncertainty (95% CI)
Uncertainty in forestland remaining forestland	
ALUM 2002 (agricultural land use map)	
ALUM 2007	
Uncertainty in biomass accumulation rates	
Uncertainty from land converted to cropland	
Carbon stocks in previous land use	
Estimated uncertainty in land managed factors	± 12 % (GPG-LULUCF table 3.3.4)

1.3.6 Source specific QA/QC and verification

Systematic quality control activities have been carried out in order to ensure completeness and consistency in time series and correctness in the sum of sub-categories; where possible, activity data comparison among different sources (FAO database33, SORS) has been done. Data entries have been checked several times during the compilation of the NFI.

QC measures related to national Forestry Inventory data were:

- A manual for NFI was prepared.
- Field instruments were calibrated and checked.
- All methods were tested in pilot inventory in 2006 (grid 16 x 16 km).
- In preparatory phase all field personnel was trained for:
  - correct use equipments,
  - correct measurements and classifications,
  - understanding of the guidelines and specific instructions.
- Verification measurements were carried out during field seasons (4 mobile team from SFI were controlling the field measurements and work of SFS teams).
- Field data were entered in data base and checked for major discrepancies.
- All data used for our calculation are saved on our data server and are protected from unauthorized access.

All soil samples (from soil inventory on 8x8 km) were delivered and stored in laboratory at SFI according to internal quality management system.

1.3.7 Source specific recalculations

Recalculation of data set for forestland remaining forestland and land converted to forestland will be carried out when the data from NFI 2012 will be available. Calculations of emissions and removals for period from 1986 to 1997 will be carried out when the appropriate data about time consistency will be prepared. We expect to prepare this recalculation for the subsequential reporting year.

1.3.8 Source specific planed improvements

In the next submissions an upgrade of the calculation is foreseen to achieve needed improvements and to obtain accurate estimates of the carbon stored in all pools, using the outcomes of research projects on carbon stocks in soils and research project about wood density of major tree species in Slovenia.

1.4 Cropland (5B)

In this category emissions/removals from cropland management (cropland remaining cropland and land converted to cropland) are considered. Cropland cover 259 024 ha that represents 13.00 % of total area of Slovenia. Activity data of this land category is described in detail in section 1.1 (table 3). Data about carbon in soil are gathered in soil inventory - see section 1.2.2 (table 7).

Table 18: Activity data for cropland (1998 – 2007) in ha

		Cropland remaining cropland				**Land converted to cropland**					
Year	**5.B Total cropland**	5.B.1 Cropland remaining cropland	Perennial cropland remaining perennial cropland	Perennial cropland converted to annual cropland	Annual cropland converted to perennial cropland	5.B.2 Land converted to cropland	5.B.2.1 Forest converted to Cropland	5.B.2.2 Grassland converted to cropland	5.B.2.3 Wetlands converted to cropland	5.B.2.4 Settlements converted to cropland	5.B.2.5 Other lands converted to cropland
1998	**288 506**	282 858	65 722	217	439	4 993	972	4 020	NO	NO	NO
1999	**285 231**	279 582	66 359	217	439	4 993	972	4 020	NO	NO	NO
2000	**281 955**	276 306	66 997	217	439	4 993	972	4 020	NO	NO	NO
2001	**278 679**	273 030	67 634	217	439	4 993	972	4 020	NO	NO	NO
2002	**275 403**	269 754	68 271	217	439	4 993	972	4 020	NO	NO	NO
2003	**272 127**	266 479	68 908	217	439	4 993	972	4 020	NO	NO	NO
2004	**268 851**	263 203	69 546	217	439	4 993	972	4 020	NO	NO	NO
2005	**265 575**	259 927	70 183	217	439	4 993	972	4 020	NO	NO	NO
2006	**262 300**	256 651	70 820	217	439	4 993	972	4 020	NO	NO	NO
2007	**259 024**	253 375	71 457	217	439	4 993	972	4 020	NO	NO	NO

Table 19: Emission from cropland management (1998 – 2007) in Gg CO_2

Year	5.B Total cropland	Cropland remaining cropland				Land converted to cropland						
		5.B .1 Cropland remaining cropland	Perennial cropland remaining perennial cropland	Perennial cropland converted to annual cropland	Annual cropland converted to perennial cropland	5.B .2 Land converted to cropland	5.B .2.1 Forest converted to Cropland	5.B.2.2 Grassland converted to cropland	5.B.2.3 Wetlands converted to cropland	5.B.2.4 Settlements converted to cropland	5.B.2.5 Other lands converted to cropland	N_2O (in CO_2 Equivalent)*
1998	**91.88**	-26.64	-77.27	46.14	4.49	118.52	67.44	51.09	NO	NO	NO	IE
1999	**89.04**	-29.48	-80.12	46.14	4.49	118.52	67.44	51.09	NO	NO	NO	IE
2000	**83.65**	-34.88	-85.51	46.14	4.49	118.52	67.44	51.09	NO	NO	NO	IE
2001	**73.02**	-45.51	-96.14	46.14	4.49	118.52	67.44	51.09	NO	NO	NO	IE
2002	**88.90**	-29.62	-80.25	46.14	4.49	118.52	67.44	51.09	NO	NO	NO	IE
2003	**71.16**	-47.36	-98.00	46.14	4.49	118.52	67.44	51.09	NO	NO	NO	IE
2004	**66.20**	-52.32	-102.96	46.14	4.49	118.52	67.44	51.09	NO	NO	NO	IE
2005	**62.73**	-55.80	-106.43	46.14	4.49	118.52	67.44	51.09	NO	NO	NO	IE
2006	**58.06**	-60.47	-111.10	46.14	4.49	118.52	67.44	51.09	NO	NO	NO	IE
2007	**54.78**	-63.77	-114.50	46.24	4.49	118.55	67.46	51.09	NO	NO	NO	IE

1.4.1 CROPLAND REMAINING CROPLAND (5B1)

This section provides information about emissions/removals for cropland remaining cropland. This sub category 5.B.1 (Cropland remaining Cropland) was selected as non -key category (Table 2). Emissions/removals were estimated applying the IPCC Tier 1 methodology. For the calculation of emissions/removals in category Cropland remaining Cropland and conversion of other LU to Cropland the Cropland was divided in to two su-categories: Cropland with annual crops and Cropland with perennial crops.

Annual crops are harvested each year, so there is no storage carbon in biomass for longer period. According to GPG LULUCF we took in consideration only CO_2 emissions / removals for perennial woody vegetation (orchards, vineyards, tree nurseries, olive trees...).

According to our estimations the annual removals from Cropland remaining Cropland range between 26 Gg CO_2 and 64 Gg CO_2 in period from 1998 to 2007.

1.4.1.1 Methodological issues

Cropland includes annual and perennial crops; the change in biomass has been estimated only for perennial woody crops, since for annual crops the increase in biomass stocks in a single year is assumed equal to biomass losses from harvest and mortality in that same year. Activity data for cropland remaining cropland have been subdivided into annual and perennial woody crops. The estimates of carbon stocks changes are applied to aboveground biomass only, according to the LULUCF GPG (IPCC, 2003), as there is not sufficient information to estimate carbon stocks change in dead organic matter pools. To assess change in carbon in cropland biomass, the Tier 1 methodology based on highly aggregated area estimates for generic perennial woody crops, has been used; therefore default factors of aboveground biomass carbon stock at harvest, harvest/maturity cycle, biomass accumulation rate, biomass carbon loss, for the temperate climatic region have been taking into account

1.4.1.2 Changes of carbon stock in living biomass

<u>Perennial cropland remaining perennial cropland</u>

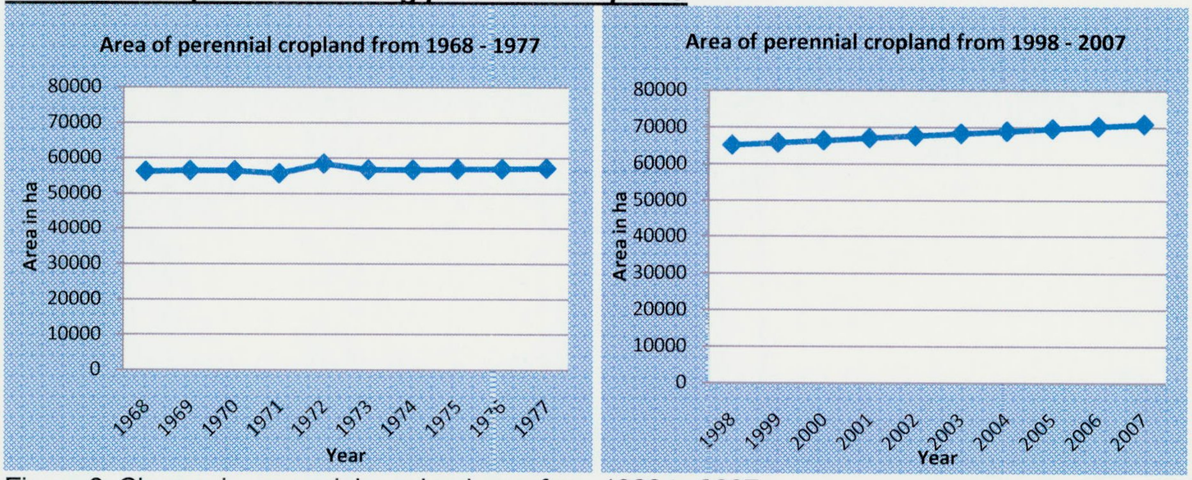

Figure 3: Change in perennial cropland area from 1968 to 2007

Values for the biomass accumulation rate (2.1 t C $ha^{-1}yr^{-1}$) in perennial vegetation and biomass carbon loss (63.0 t C ha^{-1}) are from GPG-LULUCF table 3.3.2. In Slovenia is using the values for temperate climate as this is default regime applicable to Slovenia (Europe).We took into account the 30 years rotation period for perennial cropland according to the table 3.3.2. 3.33 % area per year of perennial cropland is harvested and cause emissions. The observation period started in 1955 and the data were taken from SORS (Statistical office of the republic of Slovenia).

For calculating the carbon stock change in living biomass on perennial cropland the next formula was applied:

$$Annual\ change\ in\ biomass = (area\ of\ perennial\ cropland\ (ha) * Carbn\ acomulation\ rate) - (area\ of\ perennial\ cropland\ before\ 30\ years * 0.033 * biomass\ stock\ at\ harvested) \quad \text{(Equation 9)}$$

For the carbon accumulation rate the IPPC GPG default value of 2.1 t C $ha^{-1}yr^{-1}$ was used. For the above ground biomass carbon stock at harvest, the IPCC GPG default value of 63.0 t C ha^{-1} was used. (Table 3.3.2 in IPCC GPG)

<u>Changes of carbon stocks in biomass of perennial cropland converted to annual cropland</u>
The average annual land use change from perennial cropland to annual in the time period from 1998 to 2007 was 217 ha (see table 5).

For the calculation of annual change in carbon stocks in living biomass of land converted to cropland the IPCC Tier 1 method was applied (equation 3.3.8 in IPCC GPG).

$$Annual\ change\ in\ biomass\ = annual\ area\ of\ converted\ land * (L_{\ conversion} + \Delta C_{growht})$$

$$L_{\ conversion} = C_{\ after} - C_{\ before} \quad \text{(Equation 10)}$$

$C_{\ after}$ – $carbon\ stock\ after\ conversion\ is\ 0$

ΔC_{growht} – $IPCC\ default\ value\ for\ annual\ crops\ carbon\ accumulation\ rate\ 5.0\ t\ C\ (ha\ yr)^{-1}$

$C_{\ before}$ – $IPCC\ default\ value\ for\ carbon\ stock\ in\ woody\ biomass\ before\ is\ 63.0\ t\ C\ ha^{-1}$

<u>*Changes in carbon stocks in biomass of annual cropland converted to perennial*</u>
The average of annual land use change from annual cropland to perennial in the time period from 1998 to 2007 was 439 ha (see table 5).

For the calculation of annual change in carbon stocks in living biomass of land converted to cropland the IPCC Tier 1 method was applied (equation 3.3.8 in IPCC GPG).

$$Annual\ change\ in\ biomass = annual\ area\ of\ converted\ land * (L_{conversion} + \Delta C_{growht})$$

$$L_{conversion} = C_{after} - C_{before} \qquad \text{(Equation 11)}$$

C_{after} – carbon stock after conversion is 0

ΔC_{growht} – IPCC default value for perennial woody crops carbon accumulation rate is $2.1\ t\ C\ (ha\ yr)^{-1}$

C_{before} – IPCC default value for carbon stock of annual crops before conversion is $5.0\ t\ C\ ha^{-1}$

1.4.1.3 Change in carbon stock in soils

Emissions/removals were estimated applying the IPCC Tier 1 methodology. Changes in dead organic matter and inorganic carbon according to Tier 1 methodology are assumed to be zero.

Emissions/removals were calculated using the Tier 1 methodology, described in GPG-LULUCF equation 3.3.3. For the soil organic carbon content the Slovenian specific value (0–81.2 cm depth) of 157.9 t C ha^{-1} was used (Table 7, section 1.2.2).

The equation used includes a land use factor (F_{LU}), a tillage factor (F_{MG}) and an input factor (F_I) (Table 3.3.4 in GPG-LULUCF, see table 18 below).

$$\Delta C_{CCmineral} = \frac{[(SOC_0 - SOC_{0-T}) * A]}{T} \qquad \text{(Equation 12)}$$

$$SOC = SOC_{REF} * F_{LU} * F_{MG} * F_I$$

$\Delta C_{CCmineral}$ – annual change in carbon stock in mineral soils, $t\ C\ yr^{-1}$

SOC_0 = soil organic carbon stock in the invebtory year $t\ C\ ha^{-1}$

SOC_{0-T} = soil organic carbon stock T years prior to the inventory $t\ C\ ha^{-1}$

T – Time (default 20 years)

A – land area in ha

SOC_{REF} – default value from table Table 7 (for cropland is 157.9 $t\ C\ ha^{-1}$)

Table 20: Relative change factors for different management activities on cropland

Year	F_{LU}	F_{MG}	F_I
1978	0.71	1.09	1.11
1987	0.71	1.09	1.11
1998	0.71	1.09	1.11
2007	0.71	1.09	1.11

Data, calculations and results for organic soils are included elsewhere (see chapter 6.4.1.2 in table 6.3 of NIR).

1.4.1.4 Liming

For the liming the expert judgment will be taken in to account for calculation. For the calculation the next equation will be applied (from IPCC-GPG equation 3.3.6):

$$\Delta C_{lime} = M_{limstone} * EF_{limstone} + M_{dolomite} * EF_{dolomite} \quad \text{(Equation 13)}$$

$\Delta C_{lime} - annual\ C\ emissions\ from\ agricultural\ lime\ application, t\ C\ yr^{-1}$

$M - the\ annual\ amount\ of\ calic\ limstone\ or\ dolomite, tonnes\ yr^{-1}$

$EF - emission\ factor, t\ C^{-1}\ (default\ value\ 0.12)$

The data will be reported in the next report. They are in the process of evaluation.

1.4.2 LAND CONVERTED TO CROPLAND (5 B 2)

This sub category 5.B.2 (Land converted to Cropland) was selected as non -key category (Table 2).

Forest land converted to Cropland

The activity data are described in chapter 1.2. The annual area converted from forest land to cropland is 972 ha (see table 5) and the annual emissions from forestland conversion to cropland are around 67 Gg CO_2 per year.

Grassland converted to cropland

The annual area converted from grassland to cropland is 4020 ha (2186 ha in annual cropland and 1834 in perennial cropland) (see table 5).

1.4.2.1 Methodological issues

Data for land use change from grassland to cropland are described in chapter 1.2. Emissions were estimated applying the IPCC Tier 1 methodology while these sub-categories were identified as non-key category (see table 2).

Changes in carbon stock in living biomass

For the calculation of the annual change in carbon stocks in living biomass of forestland and grassland converted to cropland the following equation was applied (IPCC Tier 1, equation 3.3.8):

$$Annual\ change\ in\ biomass = annual\ area\ of\ the\ converted\ land * (L_{conversion} + \Delta\ C_{growth})$$

$$L_{conversion} = C_{after} - C_{before} \quad \text{(Equation 14)}$$

$\Delta\ C_{growth} = IPCC\ default\ value\ for\ carbon\ acomulation\ rate$

$accomulaion\ rates:\ annual\ crops\ is\ 5.0\ t\ C\ ha^{-1}yr^{-1}, perennial\ crops\ is\ 2.1\ t\ C\ ha^{-1}yr^{-1}$

$C_{after} - carbon\ stock\ after\ conversion\ is\ 0$

$C_{before} = IPCC\ default\ value\ for\ carbon\ stock\ of\ forest\ and\ grassland\ biomass\ before\ conversion\ (IPCC - GPG\ Table\ 3A.1.2\ for\ forest\ and\ Tables\ 3.4.2\ and\ 3.4.3)$

According to our estimation the emissions from changes in carbon stock in living biomass for Forestland converted to Cropland are 62.8 Gg CO2 per year, emissions from conversion of Grassland to Cropland are 25.0 Gg CO2 per year.

Changes in carbon stock in soils

Emissions/removals were calculated by country specific values for carbon stock in mineral soils of grassland and arable land (see table 7 in section 1.2.3). The Slovenian specific values are 150.4 t C per ha for forest soils, 145.7 t C/ha for grassland, and 157.9 t C/ha for annual and perennial cropland (see table 7, section 1.2.3). For the calculation of the annual change in carbon stock the following equation from GPG-LULUCF was applied (equation 3.3.3):

$$\Delta C_{CCmineral} = \left[\frac{(SOC_0 - SOC_{0-T})}{T}\right] = \qquad \text{(Equation 15)}$$

$$SOC = SOC_{REF} * F_{LU} * F_{MG} * F_I$$

$\Delta C_{CCmineral}$ – *annual change in carbon stock in mineral soils,* $(t\ C\ yr^{-1})$
SOC_0 = *soil organic carbon stock in the invetory year* $(t\ C\ ha^{-1})$
SOC_{0-T} = *soil organic carbon stock T years prior to the inventory* $(t\ C\ ha^{-1})$
T - Time (default 20 years)
A – land area in ha
SOC_{REF} – *slovenian national value for organic carbon stock in mineral soil (cropland is* $157.9\ t\ Cha^{-1}$, *grassland is* $145.7\ t\ C\ ha^{-1}$, *forest is* $150.4\ t\ C\ ha^{-1}$)

Table 21: Default values of managed factors

	Cropland			Grassland			Forestland		
Year	F_{LU}	F_{MG}	F_I	F_{LU}	F_{MG}	F_I	F_{LU}	F_{MG}	F_I
1978	0.71	1.09	1.11	1.00	1.00	1.00	1.00	1.00	1.00
1987	0.71	1.09	1.11	1.00	1.00	1.00	1.00	1.00	1.00
1998	0.71	1.09	1.11	1.00	1.00	1.00	1.00	1.00	1.00
2007	0.71	1.09	1.11	1.00	1.00	1.00	1.00	1.00	1.00

According to our estimation the emissions from Changes in carbon stock in soils for Forestland converted to Cropland are 4.6 Gg CO2 per year, emissions from conversion of Grassland to Cropland are 25.9 Gg CO2 per year.

N_2O emissions in soils of land converted to cropland

The area of forestland and grassland converted to cropland was taken from matrix of land use change in chapter 1.2 in Table 5. The annual release of N_2O was calculated using IPCC default values for Tier 1, using the equations 3.3.14 and 3.3.15 in GPG LULUCF. This sub category 5.B.2 (*N_2O emissions in soils of land converted to cropland*) was selected as non - key category (Table 2).

The C/N ratio in mineral soil organic matter was assumed to be 15.6 (by expert judgement). The annual emissions of N_2O from land converted to cropland was in years 1998 and 2007 was 0.025 Gg.

According to our estimation the N_2O emissions in soils of land converted to cropland for Forestland converted to Cropland are 0.0037 Gg CO2 per year, emissions from conversion of Grassland to Cropland are 0.0207 Gg CO2 per year.

Wetland, settlements and other land converted to cropland

According to results from Agricultural Land Use Map and matrix of LUC (period 1998 – 2007) all conversion from Wetland, settlements and other land_use to cropland are negligible so they were reported as NO (see tables 5 and 6).

1.4.3 Uncertainties and time-series consistency

Uncertainties can be analysed as uncertainty in activity data and uncertainty in variables such as emission factors, growth rates, effect of land management factors etc. It is the uncertainty in the IPCC default variables that dominates the overall uncertainty in the estimated provided by Slovenia.

The following uncertainties for 2007 were estimated. They are based on uncertainly values for IPCC default values taken from the IPCC-GPG (for the most sources these default values were used) and on expert judgement.

<table>
<tr><td colspan="2">Variable</td><td>Uncertainty (95% CI)</td></tr>
<tr><td colspan="2">Uncertainty in cropland remaining cropland</td><td></td></tr>
<tr><td colspan="2">ALUM 2002 (agricultural land use map)</td><td></td></tr>
<tr><td colspan="2">ALUM 2007</td><td></td></tr>
<tr><td colspan="2">Uncertainty in biomass accumulation rates</td><td>± 75 % (GPG-LULUCF table 3.3.2)</td></tr>
<tr><td colspan="2">Uncertainty from land converted to cropland</td><td></td></tr>
<tr><td rowspan="2">Carbon stocks in previous land use</td><td>Grassland</td><td>± 75 %; ± 95 %(GPG-LULUCF table 3.4.2; 3.4.3)</td></tr>
<tr><td>Forestland</td><td></td></tr>
<tr><td colspan="2">Estimated uncertainty in land managed factors</td><td>± 12 % (GPG-LULUCF table 3.3.4)</td></tr>
</table>

1.4.4 Category-specific QA/QC and verification

Quality control activities have been carried out in order to ensure completeness and consistency in time series and correctness in the sum of sub-categories; where possible, activity data comparison among different sources (SORS, FAO database, research project results) has been done.

1.4.5 Category-specific recalculations

Data were recalculated according to new data for period from 1998 to 2007. Emissions or removals for the period from 1986 to 1998 will be recalculated and reported in next submission.

1.4.6 Source-specific planned improvements

We are in process of preparation of uncertainty analysis for ALUM. We are planning to improve data for liming.

1.5 Grassland (5C)

In this category emissions/removals from grassland management (grassland remaining grassland and land converted to grassland) are considered. Grassland covers 375,049.00 ha of Slovenia in year 2007 that represents 18.0 % of total area (see table 3, section 1.1). Total grassland included meadows, pastures, swampy meadows, alpine meadows and alpine pastures.

The annual emissions are estimated to be around 356 Gg CO_2 (see table 21).

Table 22: Activity data of grassland in 1998 – 2007 in ha

Year	**5.B Total grassland**	5.B.1 Grassland remaining grassland	**Land converted to grassland**					
			5.B.2 Land converted to grassland	5.B.2.1 Forest converted to grassland	5.B.2.2 cropland converted to grassland	5.B.2.3 Wetlands converted to grassland	5.B.2.4 Settlements converted to grassland	5.B.2.5 Other lands converted to grassland
1998	356 515	347 247	9 268	2 790	6 478	NO	NO	NO
1999	357 078	349 314	9 268	2 790	6 478	NO	NO	NO
2000	357 641	351 381	9 268	2 790	6 478	NO	NO	NO
2001	358 204	353 448	9 268	2 790	6 478	NO	NO	NO
2002	358 767	355 515	9 268	2 790	6 478	NO	NO	NO
2003	359 330	357 582	9 268	2 790	6 478	NO	NO	NO
2004	359 893	359 650	9 268	2 790	6 478	NO	NO	NO
2005	360 456	361 717	9 268	2 790	6 478	NO	NO	NO
2006	361 019	363 784	9 268	2 790	6 478	NO	NO	NO
2007	375 119	365 851	9 268	2 790	6 478	NO	NO	NO

Table 23: Emission from grassland management (1998 – 2007) in Gg CO_2

Year	5.B Total grassland	**5.B.1 Grassland remaining grassland**	Land converted to grassland					
			5.B.2 Land converted to grassland	5.B.2.1 Forest converted to grassland	5.B.2.2 Cropland converted to grassland	5.B.2.3 Wetlands converted to grassland	5.B.2.4 Settlements converted to grassland	5.B.2.5 Other lands converted to grassland
1998	363.90	NO	363.90	133.14	230.76	NO	NO	NO
1999	363.90	NO	363.90	133.14	230.76	NO	NO	NO
2000	363.90	NO	363.90	133.14	230.76	NO	NO	NO
2001	363.90	NO	363.90	133.14	230.76	NO	NO	NO
2002	363.90	NO	363.90	133.14	230.76	NO	NO	NO
2003	363.90	NO	363.90	133.14	230.76	NO	NO	NO
2004	363.90	NO	363.90	133.14	230.76	NO	NO	NO
2005	363.90	NO	363.90	133.14	230.76	NO	NO	NO
2006	363.90	NO	363.90	133.14	230.76	NO	NO	NO
2007	363.90	NO	363.90	133.14	230.76	NO	NO	NO

1.5.1 GRASSLAND REMAINING GRASSLAND (5 C 1)

On average area of grassland remaining grassland in 2007 was 365 851 ha (see table 3). This sub category 5.C.1 (Grassland remaining Grassland) was selected as non -key category (Table 2).

1.5.1.1 Methodological issues

The area of grassland remaining grassland represents the total area of grassland decreased land converted to grassland. Data about area of this land category is described in detail in section 1.2. Data about carbon in soil are gathered in soil inventory - see section 1.2.2

Emissions/removals were estimated applying the IPCC Tier 1 methodology.

Changes in living biomass
According to GPG-LULUCF the biomass of grassland is not considered in the estimates. The Tier 1 assumption is that there is no change in living biomass carbon stocks. The rational is that in grassland where management practices are static, biomass carbon stock will be in an approximate steady-state where carbon accumulation trough plant growth is roughly balanced by losses.

Changes in carbon stocks in mineral soils
To provide a Tier 1 estimate, Slovenia uses the IPCC default method for mineral soils (equation 3.4.8 in GPG-LULUCF). The formula includes a land use factor (F_{LU}), a management (F_{MG}) and an input factor (F_I) (Table 3.4.5 in GPG-LULUCF). According to expert judgment there has been no change in land use management in the 20 years period. Therefore for areas of grassland remaining grassland, the values for F_{MG}, F_I and F_{LU} are considered to be constant and consequently the calculation shows there is no net change in carbon stocks in soils.

Table 24: Relative change factors for different management activities on grassland (values from GPG-LULUCF table 3.4.5)

Year	F_{LU}	F_{MG}	F_I
1978	1.00	1.00	1.00
1987	1.00	1.00	1.00
1998	1.00	1.00	1.00
2007	1.00	1.00	1.00

$$\Delta C_{CCmineral} = \frac{[(SOC_0 - SOC_{0-T}) * A]/T}{T} = 0 \quad \text{(Equation 16)}$$

$$SOC = SOC_{REF} * F_{LU} * F_{MG} * F_I$$

$\Delta C_{CCmineral}$ – *annual change in carbon stock in mineral soils, t C yr*$^{-1}$

SOC_0 = *soil organic carbon stock in the invebtory year t C ha*$^{-1}$

SOC_{0-T} = *soil organic carbon stock T years prior to the inventory t C ha*$^{-1}$

T - Time (default 20 years)

A – land area in ha

SOC_{REF} – *slovenian national value for organic carbon stock in mineral soil for grassland* (145.7 *t C ha*$^{-1}$)

Changes in carbon stocks of organic soils
Calculations about organic soils in grassland are included elsewhere (chapter 6.4.1.2 in Table 6.3).

Liming
For the calculation the next equation was applied (from IPCC-GPG equation 3.4.11):

$$\Delta C_{lime} = M_{limstone} * EF_{limstone} + M_{dolomite} * EF_{dolomite}$$ (Equation 17)

$\Delta C_{lime} -$ *annual C emissions from agricultural lime application*, $t\ C\ yr^{-1}$

$M -$ *the annual amount of calic limstone or dolomite*, $tonnes\ yr^{-1}$

$EF -$ *emission factor*, $t\ C^{-1}$ (*default value* 0.12)

The data will be reported in the next report. They are in the process of evaluation.

1.5.2 LAND CONVERTED TO GRASSLAND (5 C 2)

This sub category 5.C.2 (Land converted to Grassland) was selected as non -key category (Table 2).

Forestland converted to grassland
The activity data are described in chapter 1.2. The average annual area converted from forest to grassland is for the period from 1998 to 2007 around 2 790 ha. The average annual emission from 1998 to 2007 was 363.90 Gg CO_2.

Cropland converted to grassland
The activity data are described in chapter 1.2. The average annual area converted from perennial cropland to grassland is 1 412 ha and from annual cropland to grassland is 5,067 ha given year period (1998 to 2007).

1.5.2.1 Methodological issues

Changes in living biomass

For the calculation of the annual charge of the carbon stocks in land converted to grassland in living biomass the equation 3.3.8 from GPG-LULUCF was applied:

$$Annual\ change\ in\ biomass = annual\ area\ of\ converted\ land * (L_{conversion} + \Delta C_{growht})$$

$$L_{conversion} = C_{after} - C_{before}$$ (Equation 18)

$C_{after} -$ *carbon stock after conversion is* 0

$\Delta C_{growth} -$ *IPCC default value for annual crops carbon accumulation rate is* 13,5 $t\ C\ ha^{-1} yr^{-1}$ (*GPG* − *LULUCF table* 3.4.9)

$C_{before} -$ *IPCC default value for carbon stock* − (*woody biomass is* 63 $t\ C\ ha^{-1}$, *and for annual cropland is* 5 $t\ C\ ha^{-1}$)

According to our estimation the emissions from changes in carbon stock in living biomass for Cropland converted to Grassland are 258.7 Gg CO_2 per year, emissions from conversion of Forestland to Grassland are 135.5 Gg CO_2 per year.

Changes in carbon stock in soils
Changes in carbon stock of mineral soil were calculated about IPCC Tier 1 method. The equation 3.4.8 in GPG-LULUCF was applied:

$$\Delta C_{CCmineral} = \frac{[(SOC_0 - SOC_{0-T}) * A]}{T} \quad \text{(Equation 19)}$$

$$SOC = SOC_{REF} * F_{LU} * F_{MG} * F_I$$

$\Delta C_{CCmineral}$ – annual change in carbon stock in mineral soils, $t\ C\ yr^{-1}$

SOC_0 = soil organic carbon stock in the invebtory year $t\ C\ ha^{-1}$

SOC_{0-T} = soil organic carbon stock T years prior to the inventory $t\ C\ ha^{-1}$

T - Time (default 20 years)

A – land area in ha

SOC_{REF} – slovenian national value for organic carbon stock in mineral soil

Table 25: Land management factors for grassland, cropland and forestland (from GPG-LULUCF)

	Grassland			Cropland			Forestland		
Year	F_{LU}	F_{MG}	F_I	F_{LU}	F_{MG}	F_I	F_{LU}	F_{MG}	F_I
1978	1.00	1.00	1.00	0.71	1.09	1.11	1.00	1.00	1.00
1987	1.00	1.00	1.00	0.71	1.09	1.11	1.00	1.00	1.00
1998	1.00	1.00	1.00	0.71	1.09	1.11	1.00	1.00	1.00
2007	1.00	1.00	1.00	0.71	1.09	1.11	1.00	1.00	1.00

According to our estimation the removals from Changes in carbon stock in soils for Cropland converted to Grassland are - 27.9 Gg CO_2 per year, removals from conversion of Forestland to Grassland are -2.4 Gg CO_2 per year.

Wetland, settlements and other land converted to grassland
According to results from Agricultural Land Use Map and matrix of LUC (period 1998 – 2007) all conversion Wetland, settlements and other land converted to grassland
to grassland are negligible so they were reported as NO. (see tables 5 and 6).

1.5.3 Uncertainties and time-series consistency

The following uncertainties for 2007 were estimated. They are based on uncertainly values for IPCC default values taken from the IPCC-GPG (for the most sources these default values were used) and on expert judgement.

Variable		Uncertainty (95% CI)
Uncertainty in grassland remaining grassland		
ALUM 2002 (agricultural land use map)		
ALUM 2007		
Uncertainty in biomass accumulation rates		± 75 % (GPG-LULUCF table 3.4.2)
Uncertainty from land converted to grassland		
Carbon stocks in previous land use	Cropland	± 75 % (GPG-LULUCF table 3.3.2)
	Forestland	
Uncertainty total non woody biomass		± 75 % (GPG-LULUCF table 3.4.9)
Estimated uncertainty in land managed factors		± 12 % (GPG-LULUCF table 3.3.4)

1.5.4 Category-specific QA/QC and verification

Quality control activities have been carried out in order to ensure completeness and consistency in time series and correctness in the sum of sub-categories; where possible, activity data comparison among different sources (SORS, FAO database, research project results) has been done.

1.5.5 Category-specific recalculations

Data were recalculated according to new data for ALUM (200, 2007) for the period from 1998 to 2007. Emissions or removals for the period from 1986 to 1998 will be recalculated and reported in next submission.

1.5.6 Source-specific planned improvements

We are in process of preparation of uncertainty analysis for ALUM. We are planning to improve data for liming.

1.6 Wetland (5D)

GPG-LULUCF defines wetlands as "land that is covered or saturated by water for all or part of the year and that does not fall into the forestland, cropland, grassland or settlements categories".It includes reservoirs as managed sub division and natural rivers and lakes as unmanaged sub divisions.

Under this category, activity data from wetlands remaining wetlands are reported. For wetlands (5D) emissions/removals are not estimated duo to leck of informations. Concerning land converted to wetland, during the period 1998-2007, no land has been in transition to wetlands.

Table 26: Activity data of wetland 1998 – 2007 in ha

Year	**5.D Total wetland**	5.D.1 Wetland remaining wetland	Land converted to wetland					
			5.D.2 Land converted to wetland	5.D.2.1 Forest converted to wetland	5.D.2.2 Cropland converted to wetland	5.D.2.3 Grassland converted to grassland	5.D.2.4 Settlements converted to wetland	5.D.2.5 Other land converted to wetland
1998	**14 690**	14 690	NO	NO	NO	NO	NO	NO
1999	**14 595**	14 595	NO	NO	NO	NO	NO	NO
2000	**14 501**	14 501	NO	NO	NO	NO	NO	NO
2001	**14 406**	14 406	NO	NO	NO	NO	NO	NO
2002	**14 312**	14 312	NO	NO	NO	NO	NO	NO
2003	**14 217**	14 217	NO	NO	NO	NO	NO	NO
2004	**14 123**	14 123	NO	NO	NO	NO	NO	NO
2005	**14 028**	14 028	NO	NO	NO	NO	NO	NO
2006	**13 934**	13 934	NO	NO	NO	NO	NO	NO
2007	**13 839**	13 839	NO	NO	NO	NO	NO	NO

Table 27: Emission from wetland management (1998 – 2007) in Gg CO_2

Year	5.D Total wetland	5.D.1 Wetland remaining wetland	Land converted to wetland					
			5.D.2 Land converted to wetland	5.D.2.1 Forest converted to wetland	5.D.2.2 Cropland converted to wetland	5.D.2.3 Grassland converted to grassland	5.D.2.4 Settlements converted to wetland	5.D.2.5 Other lands converted to wetland
1998	**NE, NO**	NE	NO	NO	NO	NO	NO	NO
1999	**NE, NO**	NE	NO	NO	NO	NO	NO	NO
2000	**NE, NO**	NE	NO	NO	NO	NO	NO	NO
2001	**NE, NO**	NE	NO	NO	NO	NO	NO	NO
2002	**NE, NO**	NE	NO	NO	NO	NO	NO	NO
2003	**NE, NO**	NE	NO	NO	NO	NO	NO	NO
2004	**NE, NO**	NE	NO	NO	NO	NO	NO	NO
2005	**NE, NO**	NE	NO	NO	NO	NO	NO	NO
2006	**NE, NO**	NE	NO	NO	NO	NO	NO	NO
2007	**NE, NO**	NE	NO	NO	NO	NO	NO	NO

1.6.1 Methodological issues

Data about area of this land category is described in detail in section 1.2. This category 5.D (Wetlands) was selected as non -key category (Table 2).

A methodology for this category is not covered in GPG-LULUCF but is addressed in Appendix 3A.3 Wetlands remaining wetlands:

Wetland remaining wetland
Slovenia has not reported emissions/removals from wetland because of lack of data.

Land converted to wetland
According to results from Agricultural Land Use Map and matrix of LUC (period 1998 – 2007) all conversion from Forestland, Cropland, Grassland and other land use to wetlands are not occurring.

1.6.2 Uncertainties and time-series consistency

Variable	Uncertainty (95% CI)
Uncertainty in grassland remaining grassland	
ALUM 2002 (agricultural land use map)	
ALUM 2007	

1.6.3 Category-specific QA/QC and verification

Quality control activities have been carried out in order to ensure data for the calculations; where possible, activity data comparison among different sources (SORS, FAO database, research project results) has been done.

1.6.4 Category-specific recalculations

There are no recalculations for this category.

1.6.5 Source-specific planned improvements

No specific improvements are planned for wetland.

1.7 Settlements (5E)

This land use category is described in GPG-LULUCF as including all development land, including transportation infrastructure and human settlements of any size, unless they are already included under other land use categories. Settlement includes trees grown along streets, in public and private gardens, and different kinds of parks and green areas if they are included to urban area.

About 11 000 ha were determin as settlement to the GPG-LULUCF in year 2007. From the year 1998 to 2007 Data shows an annual increase of 3 527 ha of watlands..

1.7.1 Methodological issues

Data about area of this land category is described in detail in section 1.2. This category 5.E (Settlements) was selected as non -key category (Table 2).

Table 28: Area of settlement in ha

Year	5.E Total settlement	Land converted to settlements					
		5.E.2 Land converted to settlement	v5.E.2.1 Forest converted to settlement	5.E.2.2 Cropland converted to settlement	5.E.2.3 Grassland converted to settlement	5.E.2.4 Wetland converted to settlement	5.E.2.5 Other lands converted to settlement
1998	95 693	3 527	NO	NO	3 527	NO	NO
1999	97 197	3 527	NO	NO	3 527	NO	NO
2000	98 702	3 527	NO	NO	3 527	NO	NO
2001	100 207	3 527	NO	NO	3 527	NO	NO
2002	101 712	3 527	NO	NO	3 527	NO	NO
2003	103 216	3 527	NO	NO	3 527	NO	NO
2004	104 721	3 527	NO	NO	3 527	NO	NO
2005	106 226	3 527	NO	NO	3 527	NO	NO
2006	107 731	3 527	NO	NO	3 527	NO	NO
2007	109 236	3 527	NO	NO	3 527	NO	NO

Up to now there is a lack of data concerning urban tree formations. Therefore, it is not possible to estimate the carbon stocks changes in living biomass, dead organic matter and soil for this category. Only activity data have been reported.

Table 29: Emission from settlement management (1998 – 2007) in Gg CO_2

Year	5.E Total settlement	Land converted to settlements					
		5.E.2 Land converted to settlement	v5.E.2.1 Forest converted to settlement	5.E.2.2 Cropland converted to settlement	5.E.2.3 Grassland converted to settlement	5.E.2.4 Wetland converted to settlement	5.E.2.5 Other lands converted to settlement
1998	NE, NO	NE, NO	NO	NO	NE	NO	NO
1999	NE, NO	NE, NO	NO	NO	NE	NO	NO
2000	NE, NO	NE, NO	NO	NO	NE	NO	NO
2001	NE, NO	NE, NO	NO	NO	NE	NO	NO
2002	NE, NO	NE, NO	NO	NO	NE	NO	NO
2003	NE, NO	NE, NO	NO	NO	NE	NO	NO
2004	NE, NO	NE, NO	NO	NO	NE	NO	NO
2005	NE, NO	NE, NO	NO	NO	NE	NO	NO
2006	NE, NO	NE, NO	NO	NO	NE	NO	NO
2007	NE, NO	NE, NO	NO	NO	NE	NO	NO

Settlements remaining settlements

GPG-LULUCF provides a basic method for estimating CO_2 emissions/removals in settlements remaining settlements in Appendix 3A.4. The methods and available default data for this land use are preliminary and based on an estimation of changes in carbon stocks per tree crown cower area or carbon stocks per number of trees as a removal factor. Up to now there is a lack of data concerning urban tree formations for settlements in.

Land converted to settlements

Only grassland converted to settlements is reported in land use change matrix (see tables 5 and 6).

The fundamental equation for estimating change in carbon stocks associated with land use conversions is the same as applied for other areas of land use conversion (land converted to cropland or grassland). The default assumption for Tier 1 estimate are that all living biomass present before conversion to settlement will be lost in the same year as the conversion takes place, and that carbon stocks in living biomass following conversion are equal to zero.

The methods and available default data for this land use are preliminary and based on an estimation of changes in carbon stocks per tree crown cower area or carbon stocks per number of trees as a removal factor. According to lack of data concerning urban tree formations it is not possible to calculate emissions from this activity.

1.7.2 Uncertainties and time-series consistency

Variable	Uncertainty (95% CI)
Uncertainty in settlements remaining settlements	
ALUM 2002 (agricultural land use map)	
ALUM 2007	
Uncertainty from land converted to settlements	

1.7.3 Category-specific QA/QC and verification

Quality control activities have been carried out in order to ensure completeness of data; where possible, activity data comparison among different sources (SORS, FAO database, research project results) has been done.

1.7.4 Category-specific recalculations

There are no recalculations for this category.

1.7.5 Category-specific planed improvements

We are in process of gathering data from research project: Tree inventory in capital town of Ljubljana. Data from this study could be useful for estimation of emissions/removals for this LU category.

1.8 Other land (5F)

Other land as including is defined in GPG-LULUCF the bare soil, rock, ice and all unmanaged land areas which does not fall into any of other land use categories.

1.8.1 Methodological issues

Data about area of this land category is described in detail in section 1.2. This category 5.F (Other land) was selected as non -key category (Table 2).

Table 30: Area of other land in ha

Year	5.F Total Other land	5.F.1 Other land remaining Other land	Land converted to other land					
			5.F.2 Land converted to Other land	5.F.2.1 Forest converted to Other land	5.F.2.2 Cropland converted to Other land	5.F.2.3 Grassland converted to Other land	5.F.2.4 Wetland converted to Other land	5.F.2.5 Settlement converted to Other land
1998	28 548	28 548	NO	NO	NO	NO	NO	NO
1999	26 800	26 800	NO	NO	NO	NO	NO	NO
2000	25 051	25 051	NO	NO	NO	NO	NO	NO
2001	23 302	23 302	NO	NO	NO	NO	NO	NO
2002	21 554	21 554	NO	NO	NO	NO	NO	NO
2003	19 805	19 805	NO	NO	NO	NO	NO	NO
2004	18 056	18 056	NO	NO	NO	NO	NO	NO
2005	16 308	16 308	NO	NO	NO	NO	NO	NO
2006	14 559	14 559	NO	NO	NO	NO	NO	NO
2007	12 810	12 810	NO	NO	NO	NO	NO	NO

Table 31: Emission from other land management 1998 – 2007 in Gg CO_2

Year	5.F Total Other land	5.F.1 Other land remaining Other land	Land converted to other land					
			5.F.2 Land converted to Other land	5.F.2.1 Forest converted to Other land	5.F.2.2 Cropland converted to Other land	5.F.2.3 Grassland converted to Other land	5.F.2.4 Wetland converted to Other land	5.F.2.5 Settlement converted to Other land
1998	NA, NO	NA	NO	NO	NO	NO	NO	NO
1999	NA, NO	NA	NO	NO	NO	NO	NO	NO
2000	NA, NO	NA	NO	NO	NO	NO	NO	NO
2001	NA, NO	NA	NO	NO	NO	NO	NO	NO
2002	NA, NO	NA	NO	NO	NO	NO	NO	NO
2003	NA, NO	NA	NO	NO	NO	NO	NO	NO
2004	NA, NO	NA	NO	NO	NO	NO	NO	NO
2005	NA, NO	NA	NO	NO	NO	NO	NO	NO
2006	NA, NO	NA	NO	NO	NO	NO	NO	NO
2007	NA, NO	NA	NO	NO	NO	NO	NO	NO

Other land remaining other land

Changes in carbon stock and non CO_2 emissions/removals in unmanaged Other land remaining other land do not need to be assessed under GPG-LULUCF.

Land converted to other land

Under this category, CO2 emissions from living biomass, dead organic matter and soils and from land converted in other land should be accounted for; no data are reported since the conversion to other land is not occurring.

1.8.2 Uncertainties and time-series consistency

Variable	Uncertainty (95% CI)
Uncertainty in settlements remaining settlements	
ALUM 2002 (agricultural land use map)	
ALUM 2007	

1.8.3 Category-specific QA/QC and verification

Quality control activities have been carried out in order to ensure completeness and consistency of activity data for this LU category; where possible, activity data comparison among different sources (SORS, FAO database, research project results) has been done.

1.8.4 Category-specific recalculations

There are no recalculations for this category.

1.8.5 Category-specific recalculations

No specific improvements are planned for Other land.

1.9 Direct N2O emissions from N fertilization (5(I))

N2O emissions from N fertilization of cropland and grassland are reported in the agriculture sector; therefore only forest land should be included in this table; no data have been reported, since no fertilizers are applied to forest land.

1.10 N2O emissions from drainage of soils (5(II))

For N2O emissions from N drainage of forest or wetlands no data has been reported, since no drainage is applied to forest or wetlands soils.

1.11 N2O emissions from disturbance associated with land-use conversion to Cropland (5(III))

Data about N2O emissions are included in section 1.4 Cropland (see table 17 and section 1.4.2.1)

1.12 Biomass Burning (5(V)

1.12.1 Source category description

Under this source category, CH_4 and N_2O emissions from forest fires are estimated, in accordance with the IPCC method. Activity data and calculations in this report are included in the section 1.3.3 (see table 12). In CRF tables this data are reported under table 5 (V).

1.12 References

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SORS, Statistical daba base and statistical Year book of Slovenia.

Appendix

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 (see Figure 4).

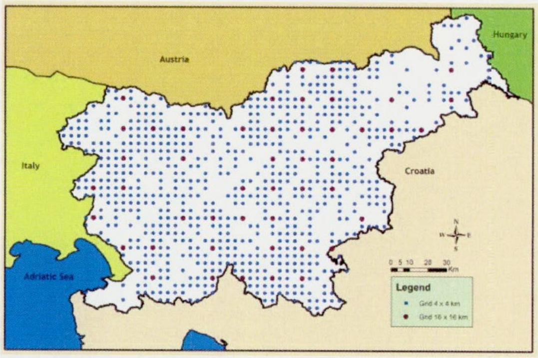

Figure 4: Arrangement of NFI 2007 sample plots on 4 x 4 km sample grid (•) and 16 x 16 km sample grid (•)

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 (see Figure 5). 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 5.

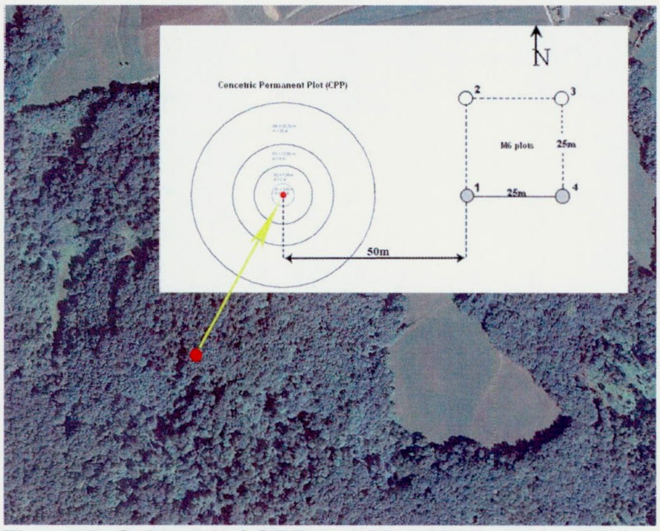

Figure 5: Scheme of CPP (on 16 x 16 km grid – CPP + all four M6 plots; on 4 x 4 grid – CPP + M6 plots nr. 1 and 4)

Table 32: 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 $H \geq 1,3$ 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	$D \geq 10$ cm $H \geq 20$ cm		/	
Snags	$D \geq 10$ cm $H \geq 50$ cm		$D \geq 30$ cm $H \geq 50$ cm	
Coarse woody debris – woody parts of trees (branches, parts of stem etc.)	$D \geq 10$ cm $L \geq 50$ cm		$D \geq 30$ cm $L \geq 50$ 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 Figure 6, 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 (Figure 6, 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 Figure 6 are also considered.

Stump is measured if its centre (see Figure 6, 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.

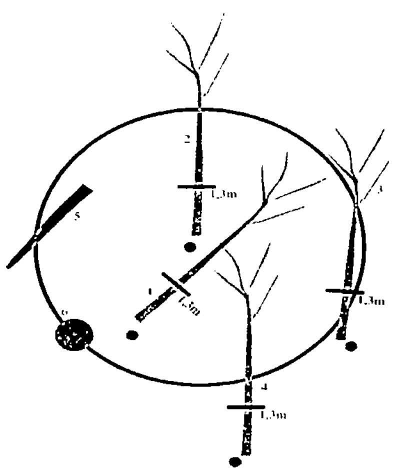

Figure 6: Examples of laying dead trees and stumps

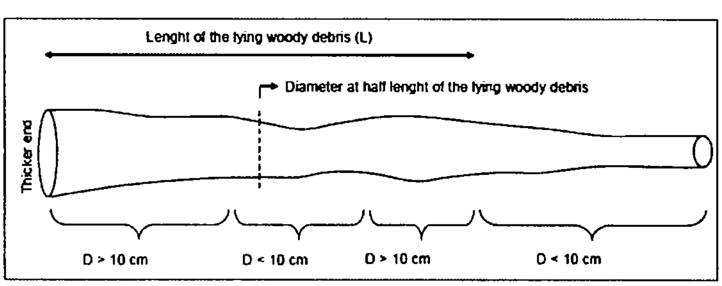

Figure 7: Example of a larger deadwood piece (length is measured from the thicker end to the thinnest end with D ≥ 10 cm)

Basic information about NFI 2007

Slovenian Forestry Institute (SFI) hac 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** (0´-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 33: 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) = $\pi * (D_{1,3} / 2)^2$

V = G * H = $\pi * (D_{1,3} / 2)^2 * H$ (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 pe- 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 s 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 34: 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.