

Supplementary information on land use, land use change and
forestry (LULUCF) activities under Article 3.3 and Article 3.4
of the Kyoto Protocol

Annex to Greenhouse gas emission in Estonia 1990–2006,
National Inventory Report to the UNFCCC

(PRELIMINARY ESTIMATION)

March 2008

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Summary

S1. Background information on reporting greenhouse gases under Article 3.3 and Article 3.4 of the Kyoto Protocol

Estonia reports on voluntary basis (for learning purposes) supplementary information on land use, land use change and forestry (LULUCF) activities under Article 3.3 of the Kyoto Protocol. Preliminary evaluation of estimates was carried out in order to analyze readiness of Estonian datasets required to be taken into account in the estimates under Article 3.3 and to launch activities needed to be implemented in order to provide the estimates with low uncertainty rates. It should be noted that Estonia is in the process of developing datasets required for the full inventory of the LULUCF sector, as only carbon emissions/removals related to 'Forest Land remaining Forest Land' are estimated and are reported in the 2008 submission. Carbon emissions/removals associated with other land use categories are not accounted currently in the framework of the inventory of the LULUCF sector. Thus all activity data, methods applied and results presented in this submission will be tested carefully in the framework of the GHG inventory implementation in the future and absence of data and/or errors of estimates will be corrected also in the future.

In this report, Afforestation (A), Reforestation (R) and Deforestation (D) activities (ARD activities) taking place in Estonia in the period 1990–2006 were considered.

Accounting of CO₂ emissions/removals due to forest management activities under Article 3.4 of the Kyoto Protocol was not chosen for reporting.

S2. Overview of source and sink category emission estimates

Net emissions and removals due to ARD activities in 1990–2006 are presented in Table 1, the data are summarized using the data reported in **Table 5** and **Table 7**.

Table 1. Preliminary data on net accumulated emissions and removals by ARD in 1990–2006, Gg CO₂

	Afforestation/Reforestation (removals)	Deforestation (emissions)
1990	18.1	1,012–2,023
1991	35.0	1,012–2,023
1992	307.7	1,146–2,292
1993	326.6	2,011–4,022
1994	326.6	3,061–6,122
1995	350.4	3,061–6,122
1996	350.4	3,061–6,122
1997	369.5	4,042–8,084
1998	725.0	4,042–8,084
1999	1142.7	4,586–9,171
2000	1430.6	5,272–10,545
2001	1438.4	5,272–10,545
2002	1438.4	5,823–11,646
2003	1668.9	5,823–11,646
2004	1713.5	5,823–11,646
2005	1724.3	7,973–15,946
2006	1724.3	8,739–17,478

1. General information

1.1 Definitions of Forest

Paragraph 1 of the definitions, modalities, rules and guidelines relating to land use, land-use change and forestry activities under the Kyoto Protocol, as contained in the Annex to decision 16/CMP.1 defines ‘forest’ as “a minimum area of land of **0.05–1.0 hectares** with tree crown **cover** (or equivalent stocking level) of more than **10–30** per cent with trees with the potential to reach a minimum height of **2–5 meters at maturity *in situ***. A forest may consist either of closed forest formations where trees of various storeys and undergrowth cover a high portion of the ground or open forest. Young natural stands and all plantations which have yet to reach a crown density of 10–30 per cent or tree height of 2–5 meters are included under forest, as are areas normally forming part of the forest area which are temporarily unstocked as a result of human intervention such as harvesting or natural causes but which are expected to revert to forest.”

The Estonian Forest Act stipulates forest as ‘...any land with an area of **0.1 ha** or more, which is covered with trees higher than **1.3 m** with a **canopy** closure of at least **30%**, and which is managed in order to produce forest products, or in order to preserve forest vegetation for other objectives’.

The definition of forest established by FAO (FRA, 2005) is ‘land spanning more than **0.5 hectares** with trees higher than **5 meters** and a canopy cover of more than **10 percent**, or trees able to reach these thresholds *in situ*. It does not include land that is predominantly under agricultural or urban land use’.

Due to the difference between the current definition of forest stipulated in the Estonian Forest Act and Kyoto forest given in the decision 16/CMP.1, Estonia has established the Estonian ‘definition of forest in the context of the Kyoto Protocol’, which is used under UNFCCC reporting (LULUCF sector), the main parameters of forest determined in the definition is reported in **Table 2**.

Table 2. Parameters for forest definition

Minimum tree cover	30%
Minimum land area	0.1 ha
Minimum tree height	2 m

1.2 Elected activities under Article 3.4

Estonia did not choose to account GHG emissions/removals from activities under Article 3.4 for the first commitment period.

1.3 Implementation of activity definitions under Article 3.3

Article 3.3 of the Kyoto Protocol specifies that “The net changes in greenhouse gas emissions by sources and removals by sinks resulting from direct human-induced land-use change and forestry activities, limited to afforestation, reforestation and deforestation since 1990, measured as verifiable changes in carbon stocks in each commitment period, shall be used to meet the commitments under this Article of each Party included in Annex B. The greenhouse gas emissions by sources and removals by sinks associated with those activities shall be reported in a transparent and verifiable manner and reviewed in accordance with Articles 7 and 8”.

Abandoned agricultural land, grassland is considered to be directly induced by human and thus these lands fall also into accounting under Article 3.3 (BOG report).

Thus, carbon emissions and removals related to afforestation, reforestation and deforestation and abandonment (agricultural, grassland) of lands being in use were estimated under Article 3.3 of the Kyoto Protocol in the present submission.

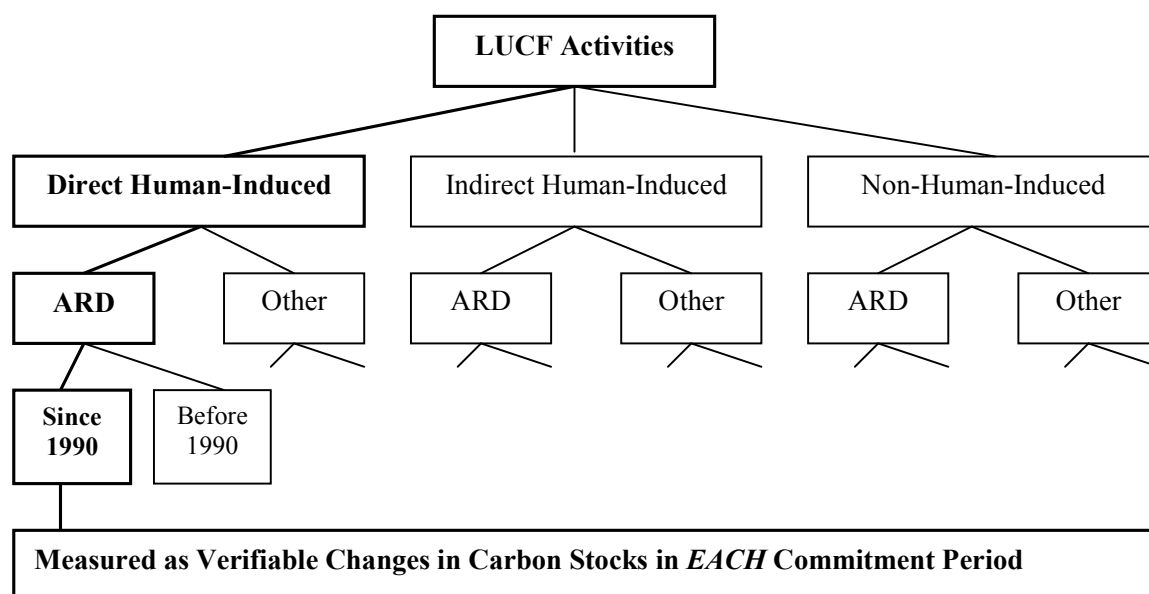


Figure 1. Sentence structure of Article 3.3, with the part that concern Article 3.3 in bold (LULUCF, 2000)

2. Land-related information

There are two sources of the data on ARD activities in Estonia: Estonian Office of Statistics (ESO) and the National Forest Inventory (NFI). Area data on AR activities is collected and reported annually by Estonian Office of Statistics (ESO) and in the process of the NFI based on two different methodologies. The definition of afforested/reforested areas used by ESO differs from the definition¹ established in GPG LULUCF (2003), as ESO reports data on area of forest established on harvested forest areas and lands with low forest value or on damaged forest etc. Data collected in the process of the NFI includes data on afforestation/reforestation of damaged and destroyed forest and non-forest areas, which does not completely fit to the definition in GPG LULUCF (2003). The data on abandoned and deforested areas is not collected and reported separately neither by ESO nor by the NFI.

¹ 'Under the definitions of the Marrakesh Accords, both afforestation and reforestation refer to direct, human-induced conversion of land to forest from another land use. The definitions do not include replanting or regeneration following harvest or natural disturbance, because these temporary losses of forest cover are not considered deforestation. Harvest followed by regeneration is considered a forest management activity. The distinction between the two activities is that afforestation occurs on land that has not been forest for at least 50 years, while reforestation occurs on land that has been forest more recently, though not since 31 December 1989.' (GPG LULUCF, 2003, pp. 4.51)

Approach 2 of the Reporting Method I provided in the IPCC GPG for LULUCF (LULUCF, 2003) to report land units subject to Article 3.3 of the Kyoto Protocol in the present submission (land use matrixes for 1990–2006 are reported in Appendix). The land use matrixes reported in Appendix A were used (approximated based on expert judgment) because of the lack of well-developed and accurate datasets required in the process of the estimation of carbon emissions and removals associated with ARD activities. The time series of data is consistent, however, methods of data collection differ in time-series: Until 1990 land use area data was collected annually by Estonian Land Board (ELB). Since 1991 the Land Reform was started in Estonia, the main goal of which was/is to restore private ownership rights in Estonia. Due to this, only data on lands registered in ELB was collected from 1991. Thus, the data reported for 1991–1999 by ELB are not complete. The data collected in the framework of the NFI did not reflect a picture on land use in Estonia during the same period of time (1991–1999), as until 1999, forest biomass was monitored using the Complete Forest Inventory with ten year taxation cycle. It means that annually about 10% of data on forest land has been updated, other land categories have been not estimated. In 1999, in order to collect complete and accurate data on Estonian forest the NFI using the Statistical Sampling Method (SMI) was established in Estonia, the inventory covers also other land use categories (agricultural land, grassland, wetlands and settlements). Thus, annually updated data has been collected since 1999.

The data on land use in 1991–1998 were interpolated using the data of 1945–1989 and 1999–2006, a matrix specified gains or losses in the area of land category was approximated (Appendix A). It means that uncertainty rates related to the estimates carried out for the noted period are high.

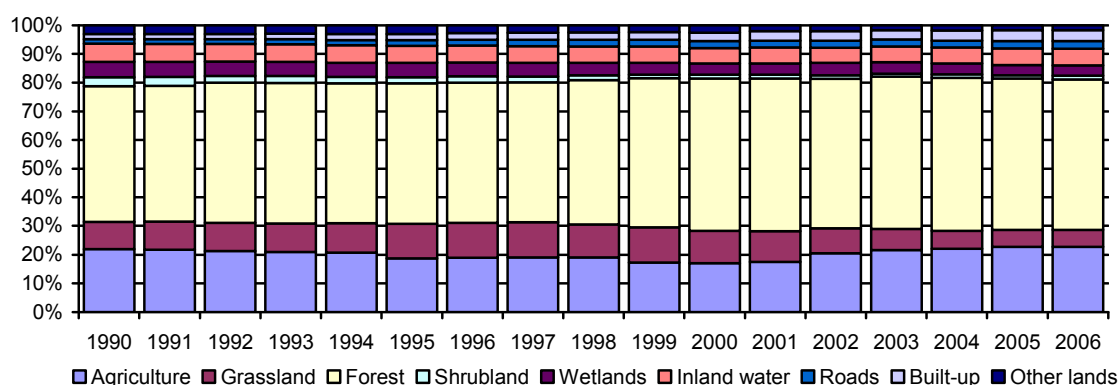


Figure 2. Land use change in Estonia in 1990–2006, %

Afforestation / Reforestation

Data on afforested/reforested areas were evaluated using the data on the net changes of areas of different land-use categories (**Figure 2**). As seen from **Figure 3** (Appendix A), the data on afforested areas are consistent in time-series with exception of year 1998–2000, when areas of new planted forest increased remarkably due to re-growing of abandoned grasslands and wetlands (based on expert judgment). The data reported in **Figure 3** will be checked carefully and improved in the future.

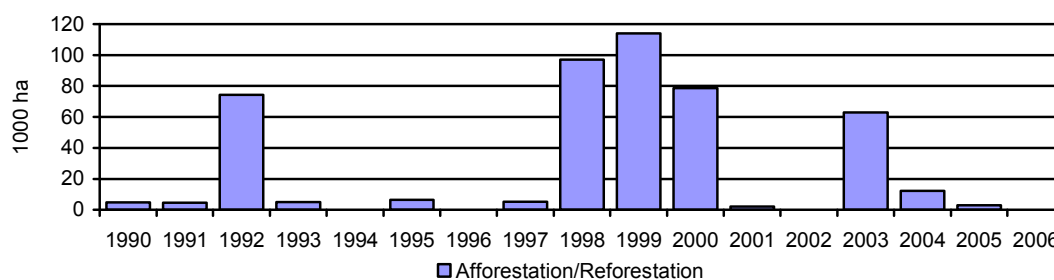


Figure 3. Preliminary data of areas of afforested/reforested land in Estonia in 1990–2006, 1000 ha

Deforestation

As it was mentioned, the data on area deforested is not reported in Estonian statistics. Thus, the data were evaluated using the data on the net changes in areas of different land-use categories (**Figure 2**, Appendix A). The data is consistent in time-series. A sharp increase in deforestation noticed in 2002, when about 50 thousand hectares were converted to cropland areas will be rechecked. The data reported in **Figure 4** will be also checked carefully and improved in the future.

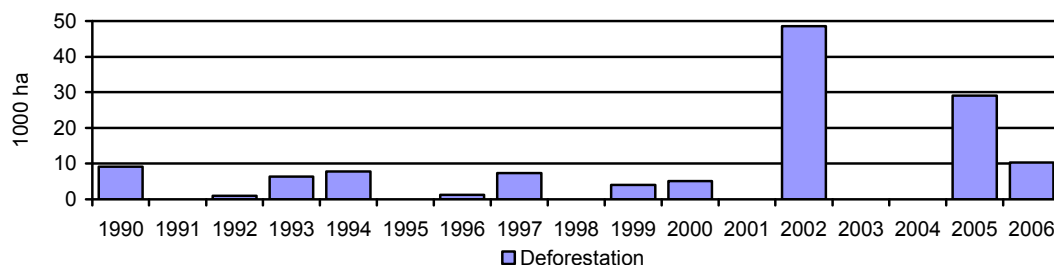


Figure 4. Preliminary data on areas of deforested land in Estonia in 1990–2006, 1000 ha

Main uncertainties and potential error sources for afforestation/reforestation and deforestation for reporting under Article 3.3

The main uncertainties and potential error sources related to activity data employed in the estimates under Article 3.3 of the Kyoto Protocol are listed in **Table 3**.

Table 3. Main uncertainties and potential error sources for ARD activities for reporting under Article 3.3

Uncertainties and potential error sources	Effect	Suggestion for improvements / Improvements done
The difference of Forest definition according to the definition given in the Annex to decision 16/CMP.1 and 'Estonian forest definition in the context of the Kyoto Protocol'	The implementation of 'Estonian forest definition' requires including areas of land use categories defined in the NFI as wetland, grassland. Therefore the estimates of net carbon stock change could be overestimated or underestimated.	Since 2007, the data on forest biomass and area are being reported also in accordance with the FAO forest definition established. Thus, uncertainties related to the definition of forest land will be minimized.
Lack of the data on land abandoned from agricultural use, being grown over with bushes and trees (changes from non-forest area to forest area). Lack of the data on deforested areas in Estonia (changes from forest area to other non-forest area).	The data collected and reported in the process of the NFI does not reflect direct changes among different land use categories, the data only reports current areas. Therefore, due to several assumptions made, ARD areas could be underestimated or overestimated and thus, net changes in carbon stock could be estimated only with high rate of uncertainties.	In order to avoid high uncertainty rates associated with the estimate of Assigned Amount, areas of ARD activities (in accordance with the definitions given in the IPCC Guidelines) should be figured out in the future (in the process of the NFI).
Soil carbon estimation: soil carbon is assumed unchanged for AR	Possibly leads to very small uncertainties in the estimation of sequestration, as carbon sequestration process is taking place slowly.	

3. Activity-specific information

3.1 Methods for evaluation of carbon stock changes and GHG emission and removal estimates

In the Estonian GHG reporting to the UNFCCC the methods used to estimate carbon stock changes in living biomass and soil organic matter are described in the NIR (LULUCF sector). These methods (*Tier 1* of the GPG LULUCF) were also employed in order to estimate carbon stock changes due to annual land use conversions under Article 3.3 of the Kyoto Protocol. In afforested and reforested areas an average growth of tree biomass was estimated employing the default data of the GPG LULUCF (2003). Biomass expansion factors, wood densities and carbon content in wood were also obtained from the GPG LULUCF (2003). In deforested areas, in order to estimate the removed living biomass of trees, mean volume of growing stock was used from the NFI results. Biomass expansion factors, wood density and carbon content of wood were employed as default from GPG LULUCF (2003).

No accumulation of litter and dead wood were assumed in any afforestation land-use categories, due to lack of national empirical data. Estimation of ground vegetation was omitted, the method is being under development. Carbon stock change in mineral and organic soils was not estimated as well due to the lack of data needed.

4. Emissions by sources and removals by sinks

4.1 Estimates of emissions by sources and removals by sinks

Afforestation/Reforestation

The average quantity of CO₂ removed per year by growing biomass due to AR activities in Estonia was 101 Gg per year (Table 4). The data on annual CO₂ sequestration and amounts of accumulated CO₂ removals in 1990–2006 is reported in Table 5.

Table 4. Preliminary data for CO₂ removals related to AR activities under Article 3.3 of the Kyoto Protocol

	Removal by planted forest biomass in 1990–2006, Gg CO ₂ /year
All area converted to forest	101

Table 5. Preliminary data on area [kha] and carbon stock [Gg] of afforested and reforested land since 1990

	Cropland	Grassland	Scrubland	Wetland	Other land	Sum	Accumulated forest area	Carbon stock, Gg C	Accumulated CO ₂ removals, Gg CO ₂
1990	-	-	-	-	3.5	3.5	3.5	4.9	18.1
1991	-	-	0.8	-	2.5	3.3	6.8	4.6	35.0
1992	18.3	-	34.3	17.6	0.9	71.2	77.9	74.4	307.7
1993	8.6	-	1.4	0.5	1.7	12.2	90.2	5.1	326.6
1994	-	-	-	-	-	-	90.2	-	326.6
1995	1.8	-	-	4.1	0.5	6.4	96.6	6.5	350.4
1996	-	-	-	-	-	-	96.6	-	350.4
1997	-	-	-	-	3.7	3.7	100.3	5.2	369.5
1998	-	34.8	5.0	20.0	9.1	68.9	169.1	97.0	725.0
1999	-	-	64.3	14.4	2.2	80.9	250.0	113.9	1142.7
2000	-	55.8	-	-	-	55.8	305.8	78.5	1430.6
2001	-	1.5	-	-	-	1.5	307.3	2.1	1438.4
2002	-	-	-	-	-	-	307.3	-	1438.4
2003	-	11.8	16.9	-	15.9	44.7	352.0	62.9	1668.9
2004	-	8.6	-	-	-	8.6	360.6	12.2	1713.5
2005	-	-	-	2.1	-	2.1	362.7	2.9	1724.3
2006	-	-	-	-	-	-	362.7	-	1724.3

Deforestation

The average quantity per year of CO₂ emitted by harvested forest biomass due to D activities implemented in Estonia was 514–1,028 Gg per year (**Table 6**). Accumulated losses of CO₂ in 1990–2006 are reported in **Table 7**. As seen the data on CO₂ emission estimated are reported using the range due to different assumptions made. However, the latter estimate may be more representative for deforestation reported under Article 3.3.

Table 6. Preliminary data for CO₂ emissions related to deforestation activities under Article 3.3 of the Kyoto Protocol

	Emission from deforestation of living biomass in 1990–2006, Gg CO ₂ /yr
All area converted from forest	514–1,028

Table 7. Preliminary area [kha] and carbon stock losses [Gg] due to D activities since 1990

	Cropland	Grassland	Scrubland	Wetland	Other land	Sum	Accumulated deforested area	Accumulated carbon stock losses, Gg C	Accumulated emissions of CO ₂ , Gg
1990	-	1.6	-	-	7.5	9.2	9.2	276–552	1,012–2,023
1991	-	-	-	-		-	9.2	276–552	1,012–2,023
1992	-	-	-	-	1.0	1.0	10.2	313–625	1,146–2,292
1993	-	-	-	-	6.4	6.4	16.6	548–1,097	2,011–4,022
1994	-	-	-	-	7.8	7.8	24.4	835–1,670	3,061–6,122
1995	-	-	-	-		-	24.4	835–1,670	3,061–6,122
1996	1.2	-	-	-		1.2	25.6	835–1,670	3,061–6,122
1997	-	-	-	-	7.3	7.3	32.9	1,102–2,205	4,042–8,084
1998	-	-	-	-		-	32.9	1,102–2,205	4,042–8,084
1999	-	-	-	-	4.0	4.0	37.0	1,251–2,501	4,586–9,171
2000	-	-	-	-	5.1	5.1	42.1	1,438–2,876	5,272–10,545
2001	-	-	-	-			42.1	1,438–2,876	5,272–10,545
2002	44.4	-	-	-	4.1	48.5	90.6	1,588–3,176	5,823–11,646
2003	-	-	-	-			90.6	1,588–3,176	5,823–11,646
2004	-	-	-	-			90.6	1,588–3,176	5,823–11,646
2005	13.1	-	-	-	16.0	29.1	119.7	2,174–4,349	7,973–15,946
2006	-	-	3.4	1.3	5.7	10.3	130.0	2,383–4,767	8,739–17,478

5. Discussion

A special dataset is required in order to establish the estimates of CO₂ removals/emissions under Article 3.3 of the Kyoto Protocol. All available sources of data including aerial photographs, as well as expert judgment, must be used to fulfill this task. This detailed work will be started in 2008.

The preliminary estimates show that annual emissions of CO₂ due to deforestation activities are higher than annual removals of CO₂ due to afforestation/reforestation activities implemented. However, the estimates will be improved in the future and it can change the picture and more likely that quantities of CO₂ emissions/removals reported will be changed.

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Appendix A

Table A1. Land use in Estonia in 1989–2006, 1000 ha

	Agricultural land	Changes (+/-)	Grassland	Changes (+/-)	Forest land	Changes (+/-)	Bushes	Changes (+/-)	Wetlands	Changes (+/-)	Island water	Changes (+/-)	Roads	Changes (+/-)	Built-up area	Changes (+/-)	Other land	Changes (+/-)
1989	995		428		2141		145		242		284		74		71		142	
1990	992	-3	433	4.6	2136	-5.5	145	-0.2	243	0.8	283	-0.8	77	2.9	75	4.8	139	-3.5
1991	980	-12	446	13.4	2139	3.3	141	-3.9	239	-3.6	280	-2.9	80	2.9	80	4.4	136	-2.5
1992	960	-20	448	1.7	2210	71.0	107	-34.3	229	-10.5	273	-7.1	80	0.5	80	0.5	135	-0.9
1993	945	-15	455	6.4	2215	5.1	106	-1.4	227	-1.8	274	1.3	83	2.6	84	3.8	133	-1.7
1994	935	-10	469	14.4	2207	-7.8	99	-7.0	224	-2.8	272	-2.0	87	4.0	93	8.8	136	2.6
1995	851	-84	544	74.9	2214	6.6	97	-1.4	223	-1.6	270	-2.5	92	4.6	97	4.4	136	-0.5
1996	859	8	550	6.4	2212	-1.4	94	-2.9	221	-2.0	265	-4.3	95	3.8	101	3.6	124	-11.8
1997	864	5	551	1.1	2209	-3.4	91	-3.6	218	-2.9	259	-6.3	102	6.5	108	7.3	120	-3.7
1998	861	-3	520	-31.7	2277	68.3	73	-17.3	202	-16.1	255	-3.9	106	4.2	116	8.1	111	-9.1
1999	781	-80	555	35.8	2355	77.2	54	-19.7	192	-10.2	251	-4.2	108	1.6	119	2.5	109	-2.2
2000	772	-9	508	-47.2	2405	50.8	59	5.3	173	-18.3	245	-6.1	112	4.5	128	8.8	120	11.0
2001	792	20	483	-25.3	2407	1.5	61	1.8	179	5.3	253	8.0	110	-2.6	145	17.1	93	-26.4
2002	928	136	392	-91.3	2358	-48.4	56	-5.2	199	20.7	238	-15.0	111	0.9	146	1.2	95	2.0
2003	974	46	334	-58.1	2404	46.0	46	-9.3	187	-11.9	242	4.3	113	2.1	143	-2.7	79	-15.9
2004	995	21	287	-46.1	2413	8.6	50	3.4	176	-11.7	253	10.6	108	-4.3	155	12.1	85	5.7
2005	1028	33	267	-20.3	2386	-27.1	53	3.7	162	-14.0	261	8.2	119	10.3	170	14.4	76	-8.7
2006	1032	3	263	-4.1	2376	-10.4	58	4.3	163	1.1	261	0.2	119	0.6	172	2.1	79	3.0

Table A2. Land use change matrix for 1990, 1000 ha

	Agricultural land	Grasslands	Forest land	Bushes	Wetlands	Island water	Roads	Build-up	Other lands	Total
Agricultural land		3.0								3.0
Grasslands										
Forest land		1.6					2.7	4.8		9.2
Bushes							0.2			0.2
Wetlands						0.8				0.8
Island water										
Roads										
Build-up										
Other lands			3.5							3.5
Total		4.6	3.5			0.8	2.9	4.8		

Table A3. Land use change matrix for 1991, 1000 ha

	Agricultural land	Grasslands	Forest land	Bushes	Wetlands	Island water	Roads	Build-up	Other lands	Total
Agricultural land		12.0								12.0
Grasslands										
Forest land										
Bushes			0.8				2.9	4.4		8.1
Wetlands		1.4		5.2						6.6
Island water					2.9					2.9
Roads										
Build-up										
Other lands			2.5							2.5
Total		13.4	3.3	5.2	2.9	0.0	2.9	4.4		

Table A4. Land use change matrix for 1992, 1000 ha

	Agricultural land	Grasslands	Forest land	Bushes	Wetlands	Island water	Roads	Build-up	Other lands	Total
Agricultural land		1.7	18.3							20.0
Grasslands										
Forest land							0.5	0.5		1.0
Bushes			34.3							34.3
Wetlands			17.6							17.6
Island water					7.1					7.1
Roads										
Build-up										
Other lands			0.9							0.9
Total		1.7	71.2		7.1		0.5	0.5		

Table A5. Land use change matrix for 1993, 1000 ha

	Agricultural land	Grasslands	Forest land	Bushes	Wetlands	Island water	Roads	Build-up	Other lands	Total
Agricultural land		6.4	8.6							15.0
Grasslands										
Forest land							2.6		3.8	6.4
Bushes			1.4							1.4
Wetlands			0.5			1.3				1.8
Island water										
Roads										
Build-up										
Other lands			1.7							1.7
Total		6.4	12.2			1.3	2.6		3.8	

Table A6. Land use change matrix for 1994, 1000 ha

	Agricultural land	Grasslands	Forest land	Bushes	Wetlands	Island water	Roads	Build-up	Other lands	Total
Agricultural land		10.0								10.0
Grasslands								7.8		7.8
Forest land							4.0	3.4		11.8
Bushes		4.4		4.8						4.8
Wetlands					2.0					2.0
Island water										
Roads										
Build-up										
Other lands										
Total		14.4		4.8	2.0		4.0	11.2		

Table A7. Land use change matrix for 1995, 1000 ha

	Agricultural land	Grasslands	Forest land	Bushes	Wetlands	Island water	Roads	Build-up	Other lands	Total
Agricultural land		74.9	1.8				3.2	4.4		84.3
Grasslands										
Forest land							1.4			1.4
Bushes			4.1							4.1
Wetlands					2.5					2.5
Island water										
Roads										
Build-up										
Other lands			0.5							0.5
Total		74.9	6.4		2.5		4.6	4.4		

Table A8. Land use change matrix for 1996, 1000 ha

	Agricultural land	Grasslands	Forest land	Bushes	Wetlands	Island water	Roads	Build-up	Other lands	Total
Agricultural land										
Grasslands										
Forest land	1.2									1.2
Bushes	2.8	0.2								2.9
Wetlands		6.2								6.2
Island water					4.3					4.3
Roads										
Build-up										
Other lands	4.4						3.8	3.6		11.8
Total	8.4	6.4			4.3		3.8	3.6		

Table A9. Land use change matrix for 1997, 1000 ha

	Agricultural land	Grasslands	Forest land	Bushes	Wetlands	Island water	Roads	Build-up	Other lands	Total
Agricultural land										
Grasslands										
Forest land								7.3		7.3
Bushes	5.1	1.1					6.5			12.7
Wetlands				9.2						9.2
Island water					6.3					6.3
Roads										
Build-up										
Other lands			3.7							3.7
Total	5.1	1.1	3.7	9.2	6.3		6.5	7.3		

Table A10. Land use change matrix for 1998, 1000 ha

	Agricultural land	Grasslands	Forest land	Bushes	Wetlands	Island water	Roads	Build-up	Other lands	Total
Agricultural land		3.1								3.1
Grasslands			34.8							34.8
Forest land										
Bushes			5.0				4.2	8.1		17.3
Wetlands			20.0							20.0
Island water					3.9					3.9
Roads										
Build-up										
Other lands			9.1							9.1
Total		3.1	68.9		3.9		4.2	8.1		

Table A11. Land use change matrix for 1999, 1000 ha

	Agricultural land	Grasslands	Forest land	Bushes	Wetlands	Island water	Roads	Build-up	Other lands	Total
Agricultural land		35.8		44.6						80.4
Grasslands										
Forest land							1.6	2.5		4.0
Bushes			64.3							64.3
Wetlands			14.4							14.4
Island water						4.2				4.2
Roads										
Build-up										
Other lands			2.2							2.2
Total		35.8	80.9	44.6		4.2	1.6	2.5		

Table A12. Land use change matrix for 2000, 1000 ha

	Agricultural land	Grasslands	Forest land	Bushes	Wetlands	Island water	Roads	Build-up	Other lands	Total
Agricultural land		8.6								8.6
Grasslands			55.8							55.8
Forest land									5.1	5.1
Bushes							4.5	8.8	5.9	19.2
Wetlands				24.4						24.4
Island water					6.1					6.1
Roads										
Build-up										
Other lands										
Total		8.6	55.8	24.4	6.1		4.5	8.8	11.0	

Table A13. Land use change matrix for 2001, 1000 ha

	Agricultural land	Grasslands	Forest land	Bushes	Wetlands	Island water	Roads	Build-up	Other lands	Total
Agricultural land										
Grasslands	20.0		1.5	3.8	5.9					31.2
Forest land										
Bushes										
Wetlands										
Island water										
Roads								2.6		2.6
Build-up										
Other lands				3.9		8.0		14.5		26.4
Total	20.0		1.5	7.7	5.9	8.0		17.1		

Table A14. Land use change matrix for 2002, 1000 ha

	Agricultural land	Grasslands	Forest land	Bushes	Wetlands	Island water	Roads	Build-up	Other lands	Total
Agricultural land										
Grasslands	91.3									91.3
Forest land	44.4						0.9	1.2	2.0	48.5
Bushes					5.2					5.2
Wetlands										
Island water					15.0					15.0
Roads										
Build-up										
Other lands										
Total	135.7				20.2		0.9	1.2	2.0	

Table A15. Land use change matrix for 2003, 1000 ha

	Agricultural land	Grasslands	Forest land	Bushes	Wetlands	Island water	Roads	Build-up	Other lands	Total
Agricultural land	46.3		11.8							58.1
Grasslands										
Forest land			16.9							16.9
Bushes				7.6		4.3				11.9
Wetlands										
Island water										
Roads										
Build-up							2.7			2.7
Other lands			15.9							15.9
Total	46.3		44.7	7.6		4.3	2.7			

Table A16. Land use change matrix for 2004, 1000 ha

	Agricultural land	Grasslands	Forest land	Bushes	Wetlands	Island water	Roads	Build-up	Other lands	Total
Agricultural land	20.9		8.6	3.4				12.1	1.0	46.1
Grasslands										
Forest land										
Bushes										
Wetlands						10.6				10.6
Island water										
Roads									4.3	4.3
Build-up										
Other lands										
Total	20.9		8.6	3.4		10.6		12.1	5.3	

Table A17. Land use change matrix for 2005, 1000 ha

	Agricultural land	Grasslands	Forest land	Bushes	Wetlands	Island water	Roads	Build-up	Other lands	Total
Agricultural land	33.4									20.3
Grasslands										29.1
Forest land							1.6	14.4		
Bushes										
Wetlands			2.1	3.7						5.8
Island water					8.2					8.2
Roads										
Build-up										
Other lands							10.3			10.3
Total	33.4		2.1	3.7	8.2		11.9	14.4		

Table A18. Land use change matrix for 2006, 1000 ha

	Agricultural land	Grasslands	Forest land	Bushes	Wetlands	Island water	Roads	Build-up	Other lands	Total
Agricultural land	3.1			1.0	1.3	0.2	0.6	2.1	3.0	4.1
Grasslands				3.4						10.3
Forest land										
Bushes										
Wetlands										0.2
Island water										
Roads										
Build-up										
Other lands										
Total	3.1			4.3	1.3	0.2	0.6	2.1	3.0	