TURKEY Greenhouse Gas Inventory,1990 to 2011

Annual Report Submission under the Framework Convention on Climate Change

National Inventory Report
Land Use, Land Use Change and Forestry

GENERAL DIRECTORATE OF FORESTRY

Ankara, 2013

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Note: The sections pertaining to the related sectors in this report and the CRF tables are prepared by the related organizations described above. LULUCF NIR is prepared by "Ministry of Forest and Water Affairs" and "Ministry of Food, Agriculture and Husbandry."

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List of Abbreviations

AD	Activity Data
BEF	Biomass Expansion Factor
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
COP	Conference of the Parties
CORINE	Coordination of Information on the Environment
CRF	Common Reporting Format
EF	Emission Factor
FAO	Food and Agriculture Organization
GDF	General Directorate of Forestry
GDSWA	General Directorate of State Water Affairs
GHG	Greenhouse Gas
GPG	Good Practice Guidance
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
LULUCF	Land Use and Land Use Change and Forestry
MFWA	Ministry of Forestry and Water Affairs
MFAH	Ministry of Food, Agriculture and Husbandry
MENR	Ministry of Energy and Natural Resources
MOEU	Ministry of Environment and Urbanization
MOTMAC	Ministry of Transport, Maritime Affairs and Communications
NSCR	Non-Selective Catalytic Reduction
OSD	Turkish Automotive Manufacturers Association
PETDER	Petroleum Manufacturers Association of Turkey
QA	Quality Assurance
QC	Quality Control
SPO	State Planning Organization
TCMA	Turkish Cement Manufacturers' Association
TRGM	General Directorate of Agricultural Reform
TTGV	Turkish Technology Development Foundations
TurkStat	Turkish Statistical Institute
UNFCCC	United Nations Framework Convention on Climate Change

Chapter7

7. LULUCF (CRF SECTOR 5)

7.1. Sector Overview

This sector comprises GHG emissions and removals arising from land use, land use change and forestry. The following figure (Figure 7.1) presents net removals from this sector.

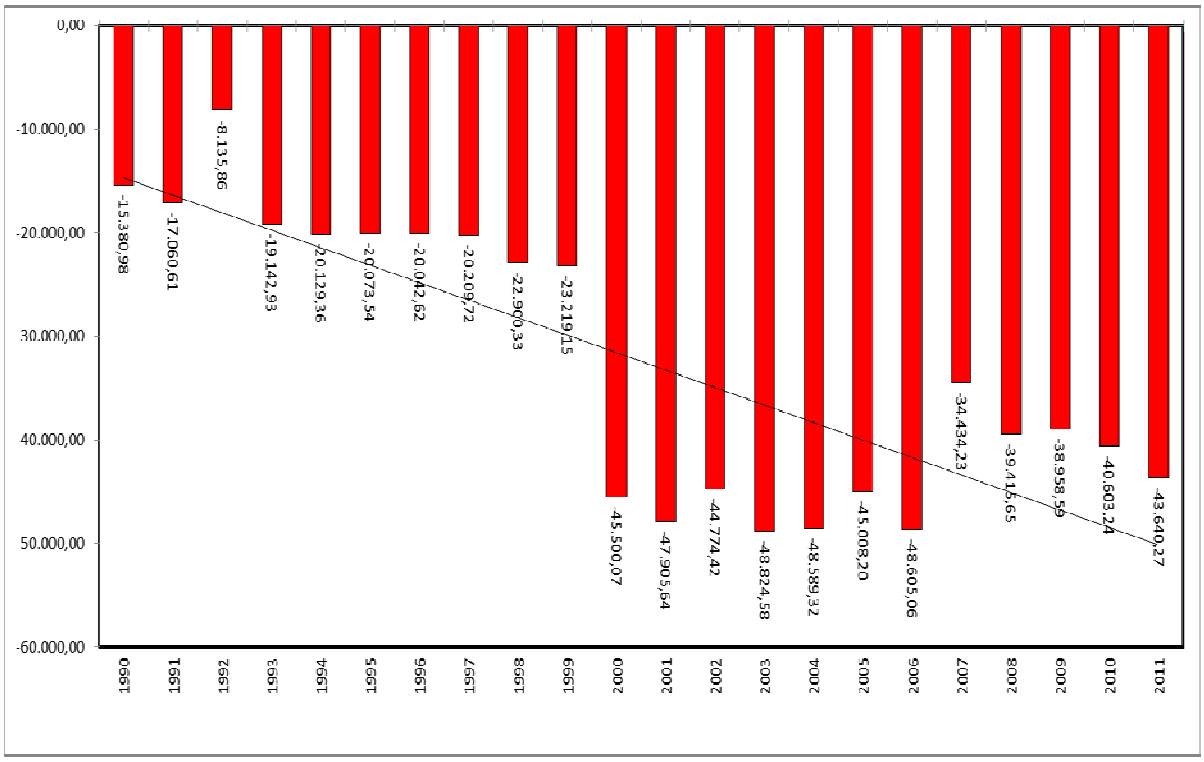

Figure 7.1. Net removals from LULUCF asGg CO_2 equivalents

The figure shows that Land Use, Land Use Change and Forestry sector is a net sink in Turkey. The key driver for the rise in removals is related to improvements in sustainable forest management, afforestation on forest land and conversion of coppice to productive forest in forest land remaining forest land. There has also been an increase of biomass removals in cropland and grassland categories due to good practices. Emissions from Forest land arise from biomass burning as wildfire. Other greenhouse gasses amounts change depending on the burned forest areas and there is no definite and significant trend (Table 7.1 and Figure 7.2).

Table 7.1.Changes in the other greenhouse gasses caused by forest fires between the years of 1990-2011

Years	CH_4 (Gg)	N_2O (Gg)	NO_x (Gg)	CO (Gg)
1990	0,001780	0,000012	0,000442	0,015563
1991	0,001047	0,000007	0,000260	0,009147
1992	0,001580	0,000011	0,000393	0,013848
1993	0,001993	0,000014	0,000495	0,017430
1994	0,004933	0,000034	0,001226	0,043178
1995	0,000993	0,000007	0,000247	0,008692
1996	0,001933	0,000013	0,000480	0,016893
1997	0,000820	0,000006	0,000203	0,007152
1998	0,000873	0,000006	0,000218	0,007653
1999	0,000753	0,000005	0,000187	0,006568
2000	0,003413	0,000023	0,000847	0,029843
2001	0,000960	0,000007	0,000238	0,008377
2002	0,001100	0,000008	0,000274	0,009637
2003	0,000860	0,000006	0,000214	0,007525
2004	0,000633	0,000004	0,000157	0,005518
2005	0,000200	0,000001	0,000051	0,001785
2006	0,001272	0,000009	0,000316	0,011129
2007	0,002065	0,000014	0,000513	0,018066
2008	0,005768	0,000040	0,001433	0,050472
2009	0,000803	0,000006	0,000200	0,007026
2010	0,000469	0,000003	0,000116	0,004100
2011	0,000524	0,004586	0,000004	0,000130

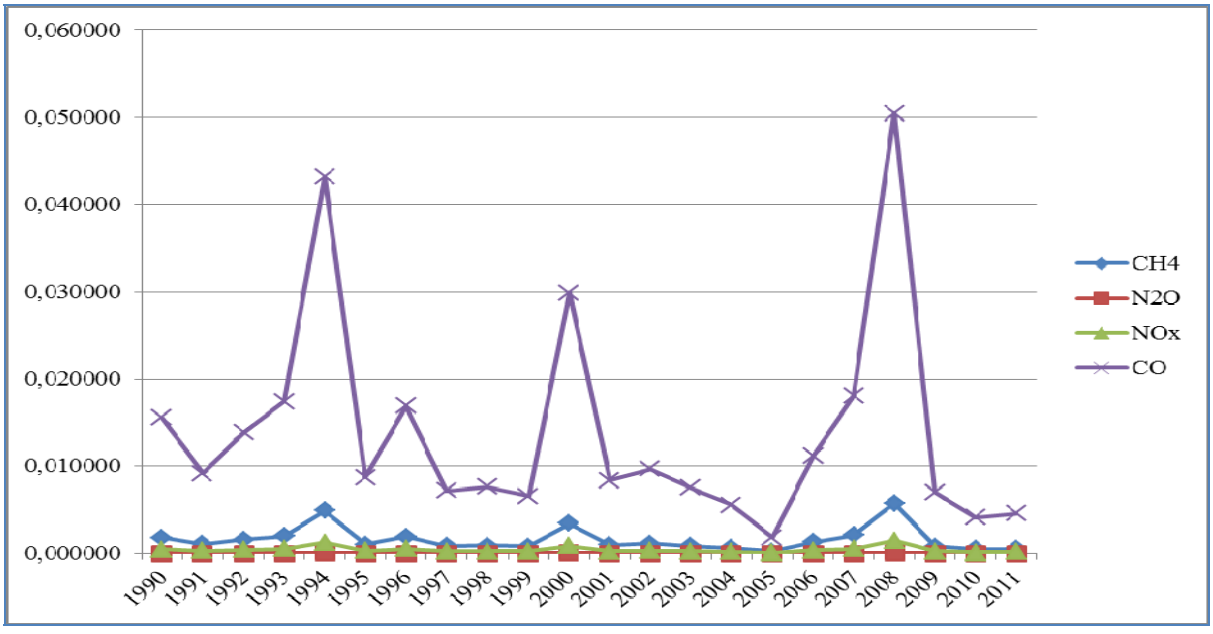

Figure 7.2. Other greenhouse gasses from forest fires between 1990-2011 years

Due to accounted as a carbon lost from forest fires in the total carbon lost, CO_2emissions were not considered here to avoid double counting in the LULUCF inventory.The estimations for 1990-2011 were calculated according toformulas 3.2.19 and 3.2.20 in GPG.The parameters

were chosen appropriate to method described in Section 3.2.1.4.2.1. The parameters have been used from Tables 3.A.1.13. and 3.A.1.14. Country specific data were used for the amount of burning biomass and burning efficiency data changes were entered into Table 5(5).

Table 7.2. Comparison of emissions and removals in 1990-2011 periods in Turkey

Year	Total Greenhouse Gases Emissions (CO_2e)	Removals from LULUCF Sector (CO_2e)	Share of LULUCF Sector in Total Greenhouse Gases Emissions (%)
1990	188.434.231,69	-15.380.983,81	-8,16
1991	200.653.996,23	-17.060.606,10	-8,50
1992	211.729.346,02	-8.135.862,50	-3,84
1993	223.080.217,18	-19.142.929,03	-8,58
1994	218.530.042,59	-20.129.363,17	-9,21
1995	238.820.282,38	-20.073.535,17	-8,41
1996	259.939.040,23	-20.042.620,01	-7,71
1997	273.172.458,11	-20.209.722,34	-7,40
1998	275.314.781,97	-22.900.332,16	-8,32
1999	276.020.859,84	-23.219.146,22	-8,41
2000	298.214.782,07	-45.500.065,82	-15,26
2001	279.245.838,99	-47.905.635,83	-17,16
2002	287.217.567,75	-44.774.424,79	-15,59
2003	303.773.127,76	-48.824.579,42	-16,07
2004	313.271.755,10	-48.589.318,48	-15,51
2005	330.982.422,92	-45.008.203,89	-13,60
2006	350.738.842,69	-48.605.057,28	-13,86
2007	380.947.574,10	-34.434.230,97	-9,04
2008	367.207.267,35	-39.415.651,18	-10,73
2009	370.012.054,84	-38.958.589,03	-10,53
2010	402.102.746,47	-40.603.243,80	-10,10
2011	422.415.824,92	-43.640.268,44	-10,33

As shown in Table 7.2., however there was an increasing course in total GHG emissions, the average percentage of net removals from LULUCF was 10,74%during the 1990-2011 periods. The methodology advised in the IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry, 2003 was followed to estimate removals/emissions from LULUCF. According to the Guidance, a climate map of Turkey was firstly prepared and used a base for all land use category (Figure 7.3.).

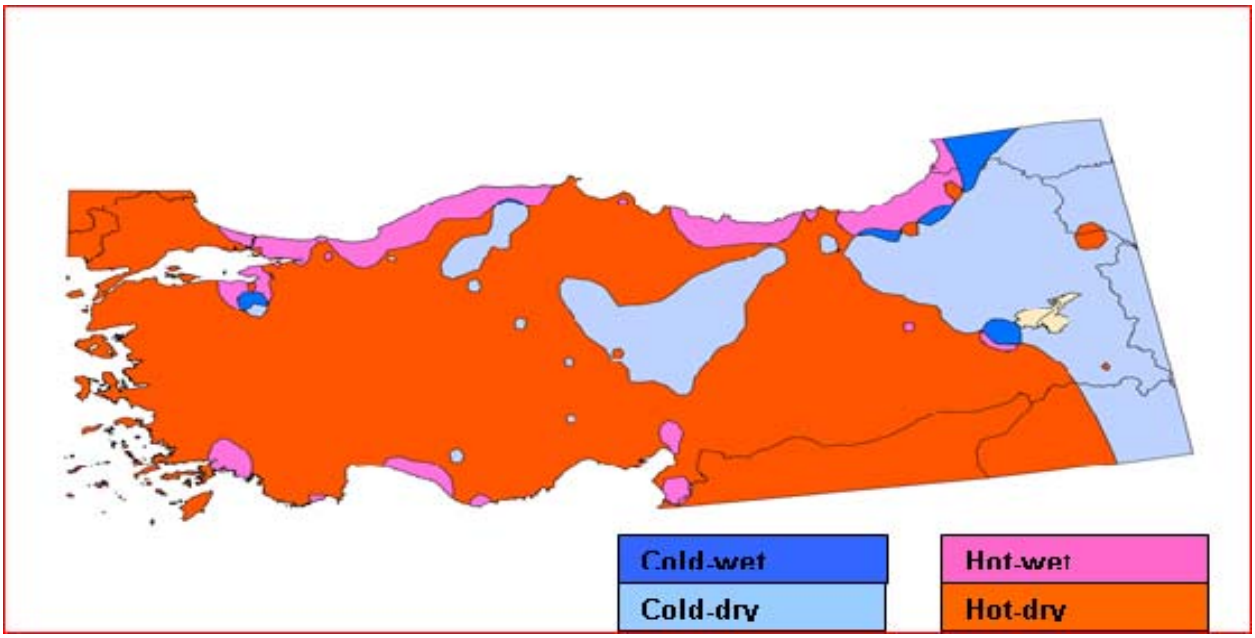

Figure 7.3. The climate map of Turkey

Activity Data

The land uses and land use changes for Forestland category is provided from ENVANIS database since 2004. The lands other than Forestland have been determined via Corine land use maps belonging to years 1990, 2000, 2006. These maps have been produced by different agencies of the government at different time frames but have the same legend and approach. The 1990 map was produced last year and has been used in this inventory for the first time. This enabled us to determine land uses and land use changes more consistent. In the previous inventory we could not determine the land uses and land use changes for all LULUCF land use types. The land use changes in these periods are given in Table 7.23. Linear interpolation was performed for the years between and linear extrapolation for the years after 2006. This procedure has been explained in 7.6.

Uncertainty

The uncertainty levels of the LULUCF inventory are stated in each land use section.

Completeness

As regards the inventory completeness, sinks and sources that could not be reported in the CRF tables are charted as follows:

Sink/source category	GHG	Explanation
Forest lands, soils	CO_2	Lack of adequate data on the carbon stocks in the soil organic matter
Forest lands, litter	CO_2	Lack of adequate data on the carbon stocks in the litter
Forest lands, soils	N_2O	N fertilization does not occur in the forestry activities
Forest lands, drained soils	Non-CO_2	Drainage does not occur in the forests
Drained wetlands	"	No available data
Limestone application in croplands and grasslands	CO_2	Limestone application does not occur in the agricultural lands and grasslands.
Croplands, grasslands, wetlands and settlements, biomass burning	CO_2, CH_4 and N_2O	No available data
Croplands, disturbance associated with land use conversion to cropland	N_2O	No available data
Settlements	CO_2	No available data after 2000 year

7.2. Forest Land- Category 5A

The inventory studies in this category have been done by the LULUCF Working Group of GDF (Çağlar BAŞSÜLLÜ, Forest Engineer, M.Sc.).

7.2.1. Definition of Forest Area

In Turkey forest areas are protected by constitution. According to the legislation (Forest Law No: 6831) (GDF, 1956),all natural woody and shrub areas and all plantations are accepted as forest with their lands. But, reed fields; steppes; bramble patches; parks; woody and shrub areas in cemeteries; areas which are in private ownership and covered with exotic tree species; wherever the areas in or next to or out of forest lands, all woody and shrub areas in private ownership which are using for agriculture; all the woody areas having less than 3 ha magnitudes; wherever the areas in or next to or out of forest lands, all fruit tree and shrub areas which are in the use of private ownership including alder trees, chestnut trees, stone pine trees and Turkish oak trees; olive groves in private ownership, wild olive groves separated from forests, areas covered with pistachio trees (*Pistaciavera* L.), mastic (*Pistacialentiscus* L.) and carob trees (*Ceratoniasiliqua* L.); scrubs and maquis are not accepted as forests.

In addition to that, according to IPCC GPG for LULUCF, 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. Forests are not defined for reporting under the Convention. The IPCC Guidelines encourage countries to use detailed ecosystem classifications in the calculations and in reporting broad specified categories to ensure consistency and comparability of national data across countries.

7.2.2. Source/Sink Category Description

According to the figures given by the Forest Management Planning Department of the General Directorate of Forestry, Turkey has 21,67million ha forest area approximately with regard to its own forestry legislative. Since all the woody areas having more than 3 ha magnitudes are accepted in forest regime disregarding their crown closure, this figure differs with the figure given in FAO's resources. FAO's figures cover the woody areas having more than 40% crown closure only. Because of the forcing situation initiating from the protective rules of constitution and forestry regulations current in Turkey, the figures given by forestry

organization were accepted and used during the estimation of net annual amount of carbon uptake or release in the forests of Turkey. The figures concerning forest resources in Turkey for 2011 year are given in table 7.3.

Table 7.3. Forest inventory results of Turkey at the end of 2011
Table 7.3.A. Area (GDF, 2012a)

	Pure High Forests (ha)		Mixed High Forests (ha)	Total High Forests (ha)	Coppices (ha)	Total Forest Area (ha)
	Coniferous	Deciduous				
Productive	6.792.336	2.156.746	1.332.646	**10.281.728**	**1.276.940**	**11.558.668**
Degraded	4.983.059	950.319	1.045.486	**6.978.864**	**3.140.602**	**10.119.466**
Total	**11.775.395**	**3.107.066**	**2.378.131**	**17.260.592**	**4.417.542**	**21.678.134**

Table 7.3.B. Growing stock (GDF, 2012a)

	Pure High Forests (ha)		Mixed High Forests (ha)	Total High Forests (ha)	Coppices (ha)	Total Forest Area (ha)
	Coniferous	Deciduous				
Productive	825.750.787	313.485.436	225.950.016	**1.365.186.239**	**52.296.445**	**1.417.482.684**
Degraded	41.541.895	8.342.796	9.435.004	**59.319.695**	**17.652.159**	**76971854**
Total	**867.292.682**	**321.828.232**	**235.385.020**	**1.424.505.934**	**69.948.604**	**1.494.454.538**

Table 7.3.C. Annual volume increment (GDF, 2012a)

	Pure High Forests (ha)		Mixed High Forests (ha)	Total High Forests (ha)	Coppices (ha)	Total Forest Area (ha)
	Coniferous	Deciduous				
Productive	22.937.367	8.616.137	5.747.210	**37.300.713**	**2.719.466**	**40.020.179**
Degraded	1.003.235	196.433	211.972	**1.411.640**	**747.296**	**2.158.936**
Total	**23.940.602**	**8.812.570**	**5.959.182**	**38.712.353**	**3.466.762**	**42.179.115**

Source: Forest Management Planning Department of General Directorate of Forestry.
1. Crown closure between 0,11-1,00.
2. Crown closure between 0,01-0,10.
3. 0,75 coefficient was used in order to convert the ster volume into m^3 volume.

Pinusbrutia, Pinusnigra and, Pinussylvestris are the most important coniferous species among the other coniferous such as 4 kinds of *Abies, Piceaorientalis, Cedruslibani* etc. In portion of these three pine species is more than 80% as in totally volume of growing stock. *Fagusorientalis* and 22 *Quercus spp.* have 80% ratio in total volume of the deciduous trees such as *Tilia, Ulmus, Alnus, Castanea* species.

Since 2004, ENVANIS System, a forest resources inventory based on forest management units is used. In this system total forest area changes, total annual increment changes and total growing stock changes can be calculated year by year. Therefore, comparison of forest area, annual increment and growing stock between two subsequent years has been possible since 2004. The comparison of removals by forestry sector, according to forest area, annual increment and growing stock changes since 2004 is given in Table 7.4.

Table 7.4.Forest Area Changes between 2004 and 2011 (GDF, 2004; 2005; 2006; 2007; 2008a; 2009b; 2010a; 2011; 2012a)

Forest Area									
Year	High Forests				Coppices				Total
	Normal (ha)	%	Degraded (ha)	%	Normal (ha)	%	Degraded (ha)	%	
2004	8.940.215,00	42,19	6.499.380,00	30,67	1.681.006,00	7,93	4.068.146,00	19,20	21.188.747,00
2005	9.031.446,97	42,50	6.579.111,67	30,96	1.641.230,50	7,72	3.985.516,43	18,76	21.248.495,00
2006	9.122.678,93	42,84	6.658.843,33	31,27	1.601.455,00	7,52	3.902.886,87	18,33	21.295.170,00
2007	9.213.910,90	43,19	6.738.575,00	31,59	1.561.679,50	7,32	3.820.257,30	17,91	21.334.422,70
2008	9.325.437,90	43,65	6.797.197,10	31,82	1.529.771,50	7,16	3.710.808,30	17,37	21.363.214,80
2009	9.494.322,40	44,39	6.810.887,70	31,84	1.478.186,50	6,91	3.606.386,30	16,86	21.389.782,90
2010	9.782.513,60	45,42	6.879.866,00	31,94	1.420.323,60	6,59	3.454.388,10	16,04	21.537.091,30
2011	10.281.728,00	47,43	6.978.864,20	32,19	1.276.940,40	5,89	3.140.601,90	14,49	21.678.134,50

It can be seen from Table 7.4. totally489.387,50 ha areas have been converted to forest land between 2004 and 2011. Based on these data, the forest area is interpolated to be increasing by 61,17kha per year since 2004. The key driver for the rise in land converted to forest land is afforestation activities. Especially, in 2008, National Afforestation and Erosion Control Action Plan havebeen initiated in order to increase forest areas of Turkey. Various forestry activities (afforestation, reforestation, rehabilitation, etc.) have done over 2,4Mha areas in the concept of National Afforestation and Erosion Control Action Plan between 2008 and 2012.

7.2.3. Databases to Identify Forests

There are only two documents concerning the national forest inventory results in Turkey. The first document showing the 1972 situation was presented in 1980, and the second was prepared at the end of 2004. Because of the absence of regular national forest inventory works in Turkey, both of the results were obtained based on the summaries of management plans data renewed in every 10 years' time interval. Forest data given in first document is shown in Tables 7.5 and 7.6.

Table 7.5. Forest inventory results of Turkey at the end of 1972
Table 7.5.A. Areas (GDF, 2006; 2011; 2012a)

Type	Normal		Degraded		Total	
	ha	%	ha	%	ha	%
High Forest	6.176.899,00	30,58	4.757.708,00	23,55	10.934.607,00	54,13
Coppice	2.679.558,00	13,27	6.585.131,00	32,60	9.264.689,00	45,87
Total	8.856.457,00	43,85	11.342.839,00	56,15	20.199.296,00	100,00

Table 7.5.B. Growing stock (GDF, 2006; 2011; 2012a)

Type	Normal		Degraded		Total	
	m^3	%	m^3	%	m^3	%
High Forest	758.732.197,00	81,10	54.349.847,00	5,81	813.082.044,00	86,91
Coppice	88.300.818,00	9,44	34.129.288,00	3,65	122.430.106,00	13,09
Total	847.033.015,00	90,54	88.479.135,00	9,46	935.512.150,00	100,00

Table 7.5.C. Annual volume increment (GDF, 2006; 2011; 2012a)

Type	Normal		Degraded		Total	
	m^3	%	m^3	%	m^3	%
High Forest	20.791.672,00	74,09	1.343.744,00	4,79	22.135.416,00	78,88
Coppice	4.813.197,00	17,15	1.114.592,00	3,97	5.927.789,00	21,12
Total	25.604.869,00	91,24	2.458.336,00	8,76	28.063.205,00	100,00

Source: Forest Inventory of Turkey-Ankara, 1980 Bulletin.
1) Crown closure between 0,11–1,00.
2) Crown closure between 0,01–0,10.
3) 0,75 coefficient was used in order to convert the ster volume into m^3 volume.

Table7.6. Forest inventory results of Turkey at the end of 2004
Table 7.6.A. Areas (GDF, 2006; 2011; 2012a)

Type	Normal		Degraded		Total	
	ha	%	ha	%	ha	%
High Forest	8.940.215,00	42,19	6.499.380,00	30,67	15.439.595,00	72,87
Coppice	1.681.006,00	7,93	4.068.146,00	19,20	5.749.152,00	27,13
Total	10.621.221,00	50,13	10.567.526,00	49,87	21.188.747,00	100,00

Table 7.6.B. Growing stock (GDF, 2006; 2011; 2012a)

Type	Normal		Degraded		Total	
	m^3	%	m^3	%	m^3	%
High Forest	1.128.570.285,00	87,61	65.436.741,00	5,08	1.194.007.026,00	92,69
Coppice	70.463.902,00	5,47	23.653.844,00	1,84	94.117.746,00	7,31
Total	1.199.034.187,00	93,08	89.090.585,00	6,92	1.288.124.772,00	100,00

Table 7.6.C. Annual volume increment (GDF, 2006; 2011; 2012a)

Type	Normal		Degraded		Total	
	m^3	%	m^3	%	m^3	%
High Forest	29.908.701,00	82,43	1.518.086,00	4,18	31.426.787,00	86,62
Coppice	3.926.196,00	10,82	929308,00	2,56	4.855.504,00	13,38
Total	33.834.897,00	93,25	2.447.394,00	6,75	36.282.291,00	100,00

Source: Forest Management Planning Department of General Directorate of Forestry.
1) Crown closure between 0,11–1,00.
2) Crown closure between 0,01–0,10.
3) 0,75 coefficient was used in order to convert the ster volume into m^3volume.

The changes and plus/minus differences among the forest forms and tree species between the years of 1972 and 2004 are outlined in Table 7.7.

Table7.7. Differences between forest inventory results of Turkey for the years of 1972 and 2004

Table 7.7.A. Area changes among the forest forms and tree species (*10^6)

Tree Species	High Forests (Ha)			Coppices (Ha)			Total (Ha)		
	Normal[1]	Degraded[2]	Total	Normal	Degraded	Total	Normal	Degraded	Total
Coniferous	2,023	1,464	3,487				2,023	1,464	**3,487**
Deciduous	0,740	0,278	1,018	-0,998	-2,517	-3,515	-0,258	-2,239	**-2,497**
Total	**2,763**	**1,742**	**4,505**	**-0,998**	**-2,517**	**-3,515**	**1,765**	**-0,775**	**0,990**

Table 7.7.B. Growing stock changes among the forest forms and tree species (*10^6)

Tree Species	High Forests (m^3)			Coppices (m^3)[3]			Total (m^3)		
	Normal	Degraded	Total	Normal	Degraded	Total	Normal	Degraded	Total
Coniferous	269,998	6,653	276,519				269,998	6,653	**276,519**
Deciduous	99,980	4,425	104,406	-23,783	-13,967	-37,750	76,198	-9,542	**66,656**
Total	**369,978**	**11,078**	**380,925**	**-23,783**	**-13,967**	**-37,750**	**346,196**	**-2,889**	**343,175**

Table 7.7.C. Annual volume increment changes among the forest forms and tree species (*10^6)

Tree Species	High Forests (m^3)			Coppices (m^3)[3]			Total (m^3)		
	Normal	Degraded	Total	Normal	Degraded	Total	Normal	Degraded	Total
Coniferous	6,642	0,072	6,714				6,642	0,072	**6,714**
Deciduous	2,475	0,102	2,577	-1,183	-0,247	-1,430	1,292	-0,145	**1,147**
Total	**9,117**	**0,174**	**9,291**	**-1,183**	**-0,247**	**-1,430**	**7,934**	**-0,073**	**7,861**

Source: Forest Management Planning Department of General Directorate of Forestry.
1) Crown closure between 0,11–1,00.
2) Crown closure between 0,01–0,10.
3) 0,75 coefficientwas used in order to convert the ster volume into m^3volume.

The last columns of Tables 7.7.A., B, and C are compiled in Table 7.8.in order to find the average changes annually.

Table 7.8. Total and average changes on forest resources between the years of 1972 and 2004

Tree Species	Change on Area (Ha)(*10^6)		Change on Growing Stock (m^3) (*10^6)		Change on Annual Increment (m^3) (*10^6)	
	Total	Average	Total	Average	Total	Average
Coniferous	3,487	0,109	276,519	8,641	6,714	0,210
Deciduous	-2,497	-0,078	66,656	2,083	1,147	0,036
Total	**0,990**	**0,031**	**343,175**	**10,724**	**7,861**	**0,246**

Evaluation of Table 7.7.and 7.8.can be outlined as below:

1. Total amount of areas, growing stocks and volume increments of the coppice forests reduced while high forests were increasing. Highest amount of decrease occurred in degraded coppices.

2. Total amount of growing stocks and annual volume increment of the coniferous and deciduous tree species increased. More than 80% of the increase occurred on coniferous tree species.
3. Total increase on area is 0,99Mha; on growing stock and volume increment are 343,175 and 7,861 Mm^3 respectively.
4. Although the reduction on the areas of deciduous tree species, total growing stock and current annual increment accrued because of conversion the coppices into high forests, and leaving of tree cuttings on some olden managed forests for nature protection.

According to the results of these two inventories, forest areas increased (0,99/20,199)= 5% while the growing stock volume (343,175/976,191) =35%, and annual volume increment (7,861/30,039) = 29% were getting high during the 32 years' time period between the years of 1972-2004.

Considerable reasons of these changes are:

1. Moving to province centers from the rural areas,
2. Giving up old fashion goat breeding and cattle grazing in the forests and the meadows adjacent to forests,
3. Abandonment of some forest lands occupying on steep slopes and having non-economic management conditions,
4. Changing considerations on forestry applications towards multi-functional use of forest resources in the framework of sustainable forest management concept,
5. Converting of coppices into high forests,
6. Afforestation activities on the bare lands and degraded forests accomplished by the Forestry Service.
7. National Afforestation and Erosion Control Action Plan has been initiated since 2008. In the scope of this action plan GDF has made afforestation, rehabilitation, erosion control activities, and artificial regeneration in degraded forests. By doing these activities GDF was aimed at sequestrating more carbon in the forests and converting degraded forests into high forests.

All the factors focused here played affecting roles on these increases. Almost whole of the Turkey's forests are natural forests and categorized under the temperate climate zone. In this zone, there are 4 sub-climate type are identified (Figure 7.3).

7.2.4. Assessment of Land Converted to Forest Land

According to forest inventory results 1972, 2011 and 2012a of GDF, forest areas of Turkey have increased 1.478.838,5 ha since 1972. All these areas have been converted from other lands. Especially, annual changes from lands to forests can be monitor by ENVANIS system. 1.088.502,5ha of these areas are considered as land converted to forest land since 1992.

7.2.5. Evaluation of Normal and Degraded Forests of Turkey between 2004 and 2011

According to forest inventory data of GDF 2011 and 2012a, 11.558.668 ha (53,32%) of forests are considered as normal forests and 10.119.466 ha (46,68%) of forests are considered as degraded forests. Despite the almost approximate distribution of normal and degraded forest land, growing stock and annual increment values are differs from forest area distribution.

Table 7.9. Growing stock changes of Turkey's forests between 2004 and 2011

Growing Stock									
Year	High Forests				Coppices				Total
	Normal (m^3)	%	Degraded (m^3)	%	Normal (m^3)	%	Degraded (m^3)	%	
2004	1.128.570.285,00	87,61	65.436.741,00	5,08	70.463.902,00	5,47	23.653.844,00	1,84	1.288.124.772,00
2005	1.139.882.061,23	87,93	64.691.084,67	4,99	68.848.853,79	5,31	22.908.187,67	1,77	1.296.330.187,35
2006	1.162.360.579,85	88,35	63.945.428,33	4,86	67.233.805,58	5,11	22.162.531,33	1,68	1.315.702.345,10
2007	1.172.288.504,20	88,58	63.199.772,00	4,78	65.618.757,38	4,96	22.321.371,38	1,69	1.323.428.404,95
2008	1.196.130.714,20	88,91	63.835.812,00	4,74	63.858.113,63	4,75	21.519.757,50	1,60	1.345.344.397,33
2009	1.228.748.234,10	89,41	63.163.647,00	4,60	61.701.880,88	4,49	20.627.164,13	1,50	1.374.240.926,10
2010	1.288.358.850,10	90,19	61.636.504,00	4,31	59.094.721,88	4,14	19.414.640,63	1,36	1.428.504.716,60
2011	1.365.186.239,28	91,35	59.319.694,90	3,97	52.296.445,13	3,50	17.652.158,63	1,18	1.494.454.537,93

In Table 7.9.it can be seen that in 2011, 94.85% of growing stock belongs to normal forests. Only, 5.15% of growing stock belongs to degraded forests. According to Table 7.10., annual increment values are the same as well as growing stock values. 94.90% of annual increment belongs to normal forests. Only, 5.10% of annual increment belongs to degraded forests.

Table 7.10. Annual increment of Turkey's forests between 2004 and 2011

Annual Increment									
Year	High Forests				Coppices				Total
	Normal (m^3)	%	Degraded (m^3)	%	Normal (m^3)	%	Degraded (m^3)	%	
2004	29.908.701,00	82,43	1.518.086,00	4,18	3.926.196,00	10,82	929.308,00	2,56	36.282.291,00
2005	30.349.123,93	83,01	1.507.326,95	4,12	3.787.284,26	10,36	917.958,04	2,51	36.561.693,18
2006	31.131.956,43	83,73	1.496.567,90	4,02	3.648.372,52	9,81	906.608,07	2,44	37.183.504,93
2007	31.514.552,69	84,25	1.485.808,85	3,97	3.509.460,78	9,38	895.258,11	2,39	37.405.080,43
2008	31.713.020,90	84,76	1.480.764,00	3,96	3.364.704,53	8,99	855.555,75	2,29	37.414.045,18
2009	32.904.372,90	85,57	1.481.335,00	3,85	3.252.615,53	8,46	816.591,75	2,12	38.454.915,18
2010	34.711.597,55	86,65	1.468.070,00	3,66	3.089.048,78	7,71	792.878,25	1,98	40.061.594,58
2011	37.300.713,05	88,43	1.411.640,00	3,35	2.719.465,80	6,45	747.296,25	1,77	42.179.115,10

Carbon stock changes in normal forests and in degraded forests of Turkey are estimated separately since 2004 in Tables 7.11 and 7.12.

Table 7.11. Carbon stock changes of Turkey's normal forests between 2004 and 2011

Years	Carbon Increases		Carbon Losses			Net carbon sequestration	CO_2 Equivalent
	Living biomass	Dead organic matter	Commercial Cutting	Fuel Wood Gathering	Other *(Forest Fires)		
	Ton/year *(1000)	Ton/year *(1000)	Ton/year *(1000)	Ton/year *(1000)	Ton/year *(1000)	Ton/year *(1000)	Gg/year *(1000)
2004	18.115,73	828,46	4.047,67	1.369,12	30,07	13.517,91	-49.565,68
2005	17.000,10	798,69	3.897,60	1.392,47	9,50	12.499,22	-45.830,46
2006	17.638,48	839,10	4.091,83	1.204,64	60,43	13.120,69	-48.109,19
2007	18.057,11	963,86	4.262,95	1.292,70	98,09	13.367,23	-49.013,18
2008	18.095,74	2.223,02	4.686,33	865,14	291,48	14.475,80	-53.077,93

2009	17.996,43	2.302,74	4.768,64	1.058,25	38,92	14.433,37	-52.922,34
2010	18.533,20	2.402,20	5.009,91	1.040,84	21,01	14.863,63	-54.499,98
2011	19.379,88	2.490,08	5.161,51	950,85	24,21	15.733,39	-57.689,08

Table 7.12. Carbon stock changes of Turkey's degraded forests between 2004 and 2011

Years	Carbon Increases		Carbon Losses			Net carbon sequestration	CO_2 Equivalent
	Living biomass	Dead organic matter	Commercial Cutting	Fuel Wood Gathering	Other *(Forest Fires)		
	Ton/year	Ton/year	Ton/year	Ton/year	Ton/year	Ton/year	Gg/year
	*(1000)	*(1000)	*(1000)	*(1000)	*(1000)	*(1000)	*(1000)
2004	1.310,37	59,93	0,00	99,03	9,49	1.241,20	-4.551,07
2005	1.538,72	72,29	0,00	126,04	3,00	1.481,98	-5.433,92
2006	1.573,46	74,85	0,00	107,46	19,07	1.521,78	-5.579,85
2007	1.227,59	65,53	0,00	87,88	30,97	1.174,26	-4.305,63
2008	1.205,25	148,06	0,00	57,62	69,03	1.226,66	-4.497,74
2009	1.143,75	146,35	0,00	67,26	11,27	1.211,57	-4.442,42
2010	1.108,52	143,68	0,00	62,26	8,27	1.181,67	-4.332,78
2011	1.045,47	134,33	0,00	51,29	8,55	1.119,96	-4.106,51

For estimating carbon stocks in the forest areas, this category was divided into category 5.A.1. Forest remaining Forest Land and Category 5.A.2 Land converted to Forest Land. Each sub-categorize was separated into coniferous and deciduous and then managed and unmanaged forests. The distribution of Turkey's forests due to climate and management types and tree species in 2011 is presented in Table 7.13:

Table 7.13. The distribution of Turkey's forests in 2011

Subcategories in 2011	Management Unit	Area of forest land (ha)	Carbon Stock Change (CO_2e)
Hot-dry managed coniferous	2.976	10.257.656,30	28.487.501,42
Hot-dry managed deciduous	1.263	4.417.996,30	11.293.754,17
Hot-dry unmanaged coniferous	309	505.746,00	0,00
Hot-dry unmanaged deciduous	75	112.521,20	0,00
Sub-Total	**4.623**	**15.293.919,80**	**39.781.255,59**
Hot-wet managed coniferous	898	1.776.884,20	7.240.831,22
Hot-wet managed deciduous	977	1.669.526,90	8.773.359,81
Hot-wet unmanaged coniferous	104	125.143,70	0,00
Hot-wet unmanaged deciduous	71	55.136,10	0,00
Sub-Total	**2.050**	**3.626.690,90**	**16.014.191,03**
Cold -dry managed coniferous	409	1.365.882,60	3.917.940,20
Cold -dry managed deciduous	182	834.180,70	1.188.185,40
Cold -dry unmanaged coniferous	23	43.147,10	0,00
Cold -dry unmanaged deciduous	5	1.609,20	0,00
Sub-Total	**619**	**2.244.819,60**	**5.106.125,61**
Cold –wet managed coniferous	46	142.913,20	530.077,69
Cold –wet managed deciduous	35	355.435,90	363.938,15
Cold –wet unmanaged coniferous	8	8.788,10	0,00
Cold –wet unmanaged deciduous	2	5.567,00	0,00

Sub-Total	**91**	**512.704,20**	**894.015,84**
Managed coniferous	4.329	13.543.336,30	40.176.350,53
Managed deciduous	2.457	7.277.139,80	21.619.237,54
Unmanaged coniferous	444	682.824,90	0,00
Unmanaged deciduous	153	174.833,50	0,00
Coniferous	4.773	14.226.161,20	40.176.350,53
Decidoous	2.610	7.451.973,30	21.619.237,54
Grand total	**7.383**	**21.678.134,50**	**61.795.588,07**

All forest statistics were obtained from the General Directorate of Forestry under the Ministry of Forestry and Water Affairs.

7.2.6. Data on Forest Fires

The information about the forest fires was received from the Department of Fighting Forest Fires of General Directorate of Forestry and written on the table 7.14.

Table 7.14. Forest fires in 2011 (GDF, 2012b)

Fire Number	Total area (ha)	Fire Types	
		Ground Vegetation (ha)	Crown (ha)
1.954	3.612,00	1.604,96	2.007,042

These statistics contain forest area exposed to fire, fire type and standing volume with bark removed from forest because of the fire. Non-CO_2 greenhouse gasses emitted by wildfire were calculated based on the biomass burned with 45% burning productivity. This rate was taken from IPCC Guidance table 3A.1.12.

Existing document concerning the forest resources and forestry activities permitted to second level communication (Tier 2 methods) mainly during the calculation of carbon uptake and the other greenhouse gasses inventory. Since there was no adequate and baseline data on land use changes concerning the olden time, first level communication (Tier 1 methods) was applied for the estimation of carbon sequestrations and greenhouse gasses emissions between the years 1990–2011.

The required data on the dead organic matter cover the dead trees and felling residues (harvesting waste) for the forests older than 20 years old. Litter amounts were not included into calculations because of the absence of specific researches in this scope. Carbon contents in the forest soils were not considered too due to same reason. Thus, both of these carbon pools were not taken into account because of the lack of document suitable for these purposes. Due to the extraordinary peculiarities among the geographical regions in Turkey (southern and western parts of the country have Mediterranean forest conditions while the northern part looks like typical west European forests) default values for these pools given in the Guidance annexes tables could not be used.

7.2.7. Methodology

Carbon stock change in living biomass and net carbon stock change in dead organic matter in forest areas were evaluated as two categories divided into 5.A.1 Forest remaining Forest Land and 5.A.2 Land Converted to Forest Land (Table 7.15).

Table 7.15. Annual changes carbon stocks in forest areas of Turkey in 2011

Greenhouse Gas Source and Sink Categories	Activity Data	Changes in Carbon Stock				Net CO_2 emissions/ removals
Land-Use Category	Area (kha)	Carbon stock change in living biomass			Net carbon stock change in dead organic matter	
		Gains	Losses	Net change		
		(Gg C)				(Gg)
Total Forest Land	21.678,13	20.425,35	-6.196,42	14.228,93	2.624,41	61.795,59
1. Forest Land remaining Forest Land	20.589,63	19.393,58	-6.021,19	13.372,40	2.515,14	58.254,32
2. Land converted to Forest Land	1.088,50	1.031,77	-175,24	856,53	109,27	3.541,26

In Table 7.16.annual changes of net carbon stocks in the forest areas according to management types in Turkey are shown.

Table 7.16. Annual changes of net carbon stocks in the forest areas of Turkey with regard to sub-categories, 2011

Tree Species	Change of Carbon Stocks in the Pools of Forest Lands Remaining Forest Lands				Change of Carbon Stocks in the Pools of Other Lands Converted to Forest Lands			
	Areas kha	In Living Biomass Gg	In Dead Organic Matter Gg	In Forest Soil Gg	Areas kha	In Living Biomass Gg	In Dead Organic Matter Gg	In Forest Soil Gg
Managed Coniferous	12.701,41	8.213,38	1.929,25	0,00	841,93	705,28	109,27	0,00
Managed Deciduous	7.064,07	5.159,02	585,89	0,00	213,07	151,25	0,00	0,00
Managed Total	**19.765,48**	**13.372,40**	**2.515,14**	**0,00**	**1.055,00**	**856,53**	**109,27**	**0,00**
Unmanaged Coniferous	650,62	0,00	0,00	0,00	32,21	0,00	0,00	0,00
Unmanaged Deciduous	173,54	0,00	0,00	0,00	1,30	0,00	0,00	0,00
Unmanaged Total	**824,16**	**0,00**	**0,00**	**0,00**	**33,50**	**0,00**	**0,00**	**0,00**
TOTAL	**20.589,63**	**13.372,40**	**2.515,14**	**0,00**	**1.088,50**	**856,53**	**109,27**	**0,00**

In Table 7.17.annual changes of net carbon stocks in different carbon pools in the forest areas in Turkey are shown.

Table 7.17. Annual changes of net carbon stocks and CO_2 equivalents in the whole forests of Turkey, 2011

Tree Species	Areas kha	In Living Biomass Gg	In Dead Organic Matter Gg	In Forest Soil Gg	Commercial Cutting Gg	Fuel Wood Gathering Gg	Forest Fires Gg	TOTAL Gg	CO_2 Equivalent (Removal) Gg
Managed Coniferous	13.543,34	12.481,20	2.038,52	0,00	-3.181,96	-362,41	-18,17	10.957,19	40.176,35
Managed Deciduous	7.277,14	7.944,15	585,89	0,00	-1.979,55	-639,74	-14,59	5.896,16	21.619,24
Managed Total	**20.820,48**	**20.425,35**	**2.624,41**	**0,00**	**-5.161,51**	**-1.002,15**	**-32,76**	**16.853,34**	**61.795,59**
Unmanaged Coniferous	682,82	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Unmanaged Deciduous	174,83	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Unmanaged Total	**857,66**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
TOTAL	**21.678,13**	**20.425,35**	**2.624,41**	**0,00**	**-5.161,51**	**-1.002,15**	**-32,76**	**16.853,34**	**61.795,59**

*Annual change of net carbon stocks and CO_2 equivalents in unmanaged forest were not calculated.

Net carbon sequestration and removals between the years 1990-2011 in the forests of Turkey are outlined in Table 7.18 and shown in Figure 7.4.

Table 7.18. Net carbon sequestration and removals between the years 1990-2011 in the forests of Turkey

Years	Carbon Increases		Carbon Lost			Net carbon sequestration	CO_2 Equivalent
	Living biomass	Dead organic matter	Commercial Cutting	Fuel Wood Gathering	Other *(Forest Fires)		
	Ton/year	Ton/year	Ton/year	Ton/year	Ton/year	Ton/year	Gg/year
	*(1000)	*(1000)	*(1000)	*(1000)	*(1000)	*(1000)	*(1000)
1990	17.175,12	966,59	4.324,88	1.468,15	111,25	12.237,43	**-44.870,57**
1991	17.329,52	934,88	4.181,32	1.468,15	65,44	12.549,48	**-46.014,77**
1992	17.484,86	930,37	4.166,65	1.468,15	98,75	12.681,69	**-46.499,52**
1993	17.641,16	935,40	4.197,12	1.468,15	124,56	12.786,74	**-46.884,70**
1994	17.798,43	811,29	3.615,79	1.468,15	308,31	13.217,47	**-48.464,07**
1995	17.956,68	945,45	4.258,06	1.468,15	62,06	13.113,86	**-48.084,17**
1996	18.115,91	946,14	4.268,00	1.468,15	120,81	13.205,09	**-48.418,68**
1997	18.276,13	868,87	3.908,57	1.468,15	51,25	13.717,03	**-50.295,78**
1998	18.437,35	837,28	3.765,57	1.468,15	54,56	13.986,35	**-51.283,27**
1999	18.599,57	822,96	3.704,37	1.468,15	47,06	14.202,95	**-52.077,49**
2000	18.762,82	824,51	3.732,98	1.468,15	213,31	14.172,89	**-51.967,26**
2001	18.927,08	780,33	3.515,76	1.468,15	60,00	14.663,50	**-53.766,17**
2002	19.092,38	851,66	3.860,34	1.468,15	68,75	14.546,80	**-53.338,26**
2003	19.258,72	828,90	3.759,20	1.468,15	53,75	14.806,52	**-54.290,58**
2004	19.426,10	888,39	4.047,67	1.468,15	39,56	14.759,11	**-54.116,75**
2005	18.538,82	870,99	3.897,60	1.518,51	12,50	13.981,19	**-51.264,38**
2006	19.211,94	913,95	4.091,83	1.312,10	79,50	14.642,47	**-53.689,04**
2007	19.284,70	1.029,38	4.262,95	1.380,58	129,06	14.541,49	**-53.318,81**
2008	19.300,99	2.371,08	4.686,33	922,76	360,52	15.702,46	**-57.575,67**
2009	19.140,18	2.449,09	4.768,64	1.125,51	50,19	15.644,93	**-57.364,76**
2010	19.641,72	2.545,88	5.009,91	1.103,10	29,29	16.045,30	**-58.832,76**
2011	20.425,35	2.624,41	5.161,51	1.002,15	32,76	16.853,34	**-61.795,59**

*Other carbon lost from insect and fungus disturbances are not included.
**Fuel wood gathering data was taken from the GD of Forestry's Strategic plan for 2010-2014 (GDF, 2009a; 2010b).

Net carbon uptake was calculated by taking commercial cutting, fuel wood gathering and biomass lost from forest fires out the aboveground and belowground living biomass.

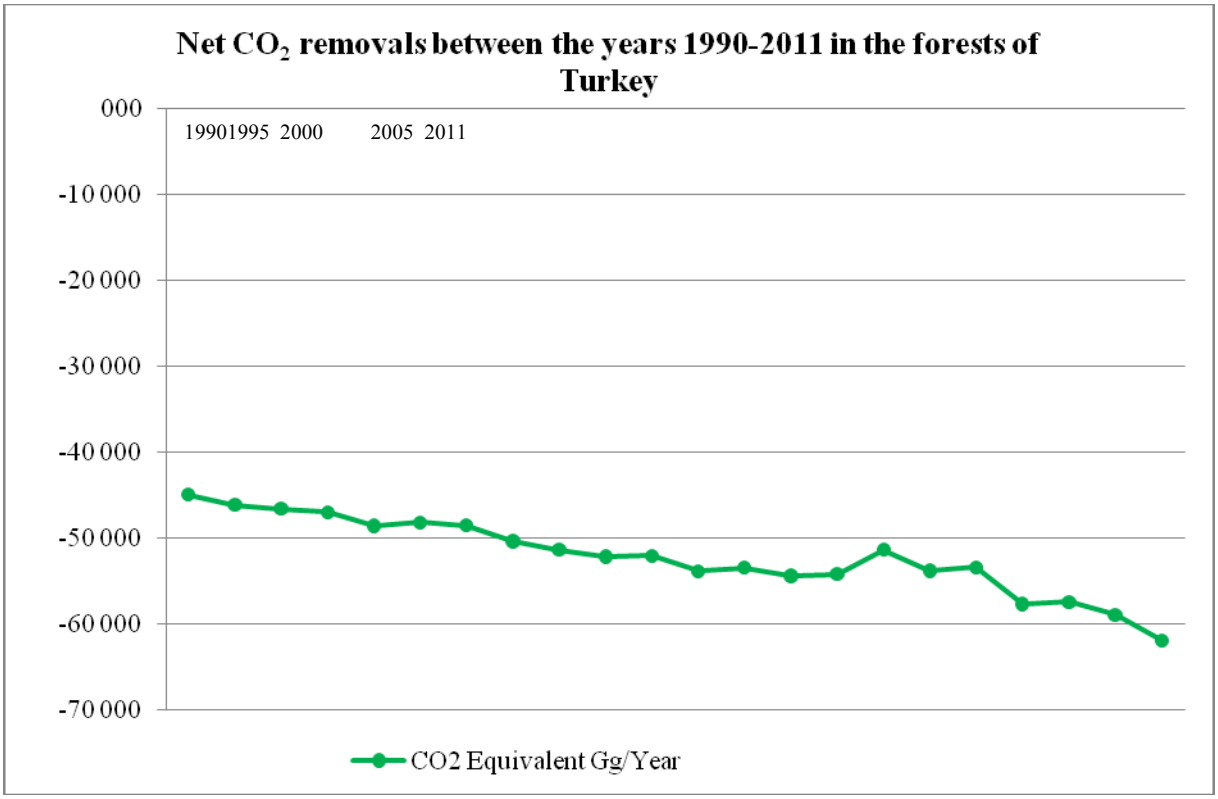

Figure 7.4. Net CO_2 removals between 1990 and 2011 in the forests of Turkey

Annual removals and emissions fromforest land remaining forest land were calculated by the following Equation 3.2.1 of IPCC GPG 2003.

Equation 3.2.1. $\Delta C_{FF} = (\Delta C_{FFLB} + \Delta C_{FFDOM} + \Delta C_{FFSoils})$

Annual Change in Carbon Stocks in Living Biomass in Forest Land Remaining Forest Land (Stock Change Method)

Removals (average annual increase in carbon stocks due to biomass growth) were calculated according to the following Equation 3.2.3 and 3.2.5 of IPCC GPG 2003.

Equation 3.2.3. $\Delta C_{FFLB} = (C_{t2} - C_{t1}) / (t_2 - t_1)$
$C=[V*D*BEF_2] * (1+R)*CF$

Average Annual Increment In Biomass

Equation 3.2.5. $G_{TOTAL} = G_W * (1+R)$
$G_W = I_V * D * BEF_1$
$G_{TOTAL} = [(I_V * D* BEF_1) * (1+R)]$

For annual increase in carbon stocks, both the national and default data were used. National forestry data was mainly come from the General Directorate of Forestry.

- Area of forest land: It exists for each management class in the forest management plans (Tier 2).
- Average annual net increment in volume suitable for industrial processing (IV): It exists for each management class in the forest management plans (Tier 2).

▪ Basic wood density (D): It was determined for all fundamental tree species which form a stand in the Turkey's forests (Table 7.17)(Tier 2). This coefficient was determined as :

-0,496 for largely coniferous mixed forests,

-0,638 for largely deciduous mixed forests.

Table 7.19. The oven dry weight of Turkey's fundamental tree species

Coniferous		**Oven dry weight (g/cm^3)**	**Deciduous**		**Oven dry weight (g/cm^3)**
Pinusbrutia	Turkish Pine	0,53	*Fagusorientalis*	The Oriental Beech	0.640
Pinusnigra	European Black Pine	0,516	*Quercusrobur*	The English Oak	0.650
Pinussylvetris	Scots Pine	0,496	*Carpinusbetulus*	European Hornbeam	0.790
Abiesbornmülleriana	Uludağ Fir	0,4	*Alnusbarbata*	Black Alder	0.490
Piceaorientalis	Oriental Spruce	0,401	*Populusnigra*	The Black Poplar	0.410
Cedruslibani	Taurus Cedar	0,48	*Castanea sativa*	Sweet Chestnut	0.590
Juniperusexcelsa	Greek Juniper	0,508	*Fraxinus excelsior*	The Ash	0,65
Pinuspinea	Stone Pine	0,465	*Tiliagrandiflora*	Linden	0.490
Cupressussempervirens	The Mediterranean Cypress	0,48	*Platanusorientalis*	The Oriental plane	0.580
Pinushalepensis	Aleppo Pine	0,514	*Eucalyptus rostrata*	Red Gum	0.547
Pinusmaritima	The Maritime Pine	0,43	*Liquidambar orientalis*	Turkish Sweetgum	0.680
Pinusradiata	The Monterey Pine	0,38	*Robiniapseudoacaccia*	The Black Locust	0.720

Source: As,*et al.*,2001.

Biomass expansion factor for conversion of annual net increment (including bark) to aboveground tree biomass increment (BEF_1 and BEF_2): Calculated for both coniferous and deciduous species separately (Tier 2).

Table 7.20. Comparison of BEF1 and BEF2 coefficients between LULUCF Guidance and those calculated for Turkey to use for the natural and plantation forest located in the temperate zone

Tree Species	**Data resource**	**BEF_2**	**Uncertainty %**	**BEF_1**	**Uncertainty %**
Coniferous	In LULUCF Guidance	1,30 (1,15-3,40)	-	1,15 (1,05-1,20)	-
	Calculated for Turkey	1,24 (1,08-1,39)	12,27	1,22 (1,15-1,29)	14,72
Deciduous	In LULUCF Guidance	1,40 (1,15-3,40)	-	1,20 (1,10-1,30)	-
	Calculated for Turkey	1,26 (1,08-1,40)	10,94	1,24 (1,06-1,42)	5,69

Source: Asan, 2006.

- Root-to-shoot ratio (R): Default data used for temperate zone in the Guidance (Table 3A) and accounted distinctly for each management class based on the growing stock in hectare.
- Carbon fraction of dry matter (CF): Default value of Guidance (0.5) was used for carbon fraction of dry matter (CF).

Annual Decrease in Carbon Stocks Due to Biomass Loss in Forest Land Remaining Forest Land

Annual biomass loss is a sum of losses from commercial round wood fellings, fuel wood gathering and other losses in forest land was calculated by using the following Equation 3.2.6 of LULUCF Guidance. In the estimations, biomass gains and biomass losses are calculated separately. For example, commercial round wood felling is being calculated in a different column as well as fuel wood gathering and other losses according to the Equation 3.2.6, Equation 3.2.7. and Equation 3.2.8, respectively. The calculations of biomass losses are consistent with the IPCC GPG for LULUCF.

Equation 3.2.6. $\Delta C_{FFL} = L_{fellings} + L_{fuelwood} + L_{other\ losses}$

Annual Carbon Loss Due to Commercial Fellings

Equation 3.2.7. $L_{fellings} = H \bullet D \bullet BEF_2 \bullet (1 - f_{BL}) \bullet CF$

H: Wood harvesting data includes whole harvested woods as industrial harvesting including planned harvests (Tier 2).

Annual Carbon Loss Due to Fuelwood Gathering

Equation 3.2.8. $L_{fuelwood} = FG \bullet D \bullet BEF_2 \bullet CF$

FG:Fuel wood gathering and illegal cutting data obtained from the General Directorate of Forestry and 8th Five Years Development Plan was used here (Tier 1).

Annual Other Losses of Carbon

Equation 3.2.9. $L_{other\ losses} = A_{disturbance} \bullet B_W \bullet (1 - f_{BL}) \bullet CF$

$A_{disturbance}$= Forest areas burnt by fires were taken into account (Tear 1).
B_W= It was estimated that average biomass in the fired areas could be burned with 45% percent of burning productivity. This biomass did not cover the litter. Relevant burning rate was fixed to the Guidance (Tables 3A.1.12) (Tear 1).

Annual Change in Carbon Stocks in Dead Organic Matter in Forest Land Remaining Forest Land

Equation 3.2.10. $\Delta C_{FFDOM} = \Delta C_{FFDW} + \Delta C_{FFLT}$

Dead organic matter as a carbon pool divided into dead wood and litter. Dead wood data in the "Forest Land Remaining Forest Land" was reached from forest management plans and added to the felling residues data.But there was no sufficient data on the litter in the Turkey's forests, the carbon stock change in the litter was assumed as zero according to the Guidance.

Annual Change in Carbon Stocks in Dead Wood in Forest Land Remaining Forest Land

Equation 3.2.11. $\Delta C_{FFDW} = [A \bullet (B_{into} - B_{out})] \bullet CF$

A = area of managed forest land remaining forest land, ha
B_{into} = Calculated from the forest management plans and the felling residues was added to it.
B_{out} = Decay period of dead wood in theforest was assumed as an average of 10 years. 1/10 of dead wood was decreased in each year.
CF = carbon fraction of dry matter (default = 0.5), tonnes C (tonned.m.)$^{-1}$

Estimation of Non-CO_2 Emissions from C Released

Equation 3.2.19.

CH_4 Emissions= (carbon released) ● (emission ratio) ● 16/12
CO Emissions= (carbon released) ● (emission ratio) ● 28/12
N_2O Emissions= (carbon released) ● (N/C ratio) ● (emission ratio) ● 44/28
NO_x Emissions= (carbon released) ● (N/C ratio) ● (emission ratio) ● 46/14

Estimation of GHGs Directly Released in Fires

Equation 3.2.20. $L_{fire} = A \bullet B \bullet C \bullet D \bullet 10^{-6}$

Where:
L_{fire} = quantity of GHG released due to fire, tonnes of GHG
A= area burnt, ha
B= mass of "available" fuel, kg d.m. ha^{-1}
C= combustion efficiency (or fraction of the biomass combusted), dimensionless.
D= emission factor, g (kg d.m.)$^{-1}$

Calculations are made separately for each greenhouse gas, using the appropriate emission factor.

Annual removals and emissions from land converted to forest land were calculated by the following Equation 3.2.21 of IPCC GPG 2003.

Equation 3.2.21. $\Delta C_{LF} = (\Delta C_{LFLB} + \Delta C_{LFDOM} + \Delta C_{LFSoils})$

Annual Change in Carbon Stocks in Living Biomass in Land Converted to Forest Land

Equation 3.2.22. $\Delta C_{LFLB} = \Delta C_{LFGROWTH} - \Delta C_{LFLOSS}$

Equation 3.2.3. $\Delta C_{LFLB} = (C_{t2} - C_{t1}) / (t_2 - t_1)$
$C=[V*D*BEF_2] * (1+R)*CF$

Average Annual Increment In Biomass

Equation 3.2.5. $G_{TOTAL} = G_W * (1+R)$
$G_W = I_V * D * BEF_1$
$G_{TOTAL} = [(I_V * D* BEF_1) * (1+R)]$

For annual increase in carbon stocks, both the national and default data were used. National forestry data was mainly come from the General Directorate of Forestry.

- Area of forest land: It exists for each management class in the forest management plans (Tier 2).
- Average annual net increment in volume suitable for industrial processing (IV): It exists for each management class in the forest management plans (Tier 2).
- Basic wood density (D): It was determined for all fundamental tree species which form a stand in the Turkey's forests (Table 7.19)(Tier 2). This coefficient was determined as :

  -0,496 for largely coniferous mixed forests,

  -0,638 for largely deciduous mixed forests.

Table 7.19. The oven dry weight of Turkey's fundamental tree species

Coniferous		Oven dry weight (g/cm^3)	Deciduous		Oven dry weight (g/cm^3)
Pinusbrutia	Turkish Pine	0,53	*Fagusorientalis*	The Oriental Beech	0.640
Pinusnigra	European Black Pine	0,516	*Quercusrobur*	The English Oak	0.650
Pinussylvetris	Scots Pine	0,496	*Carpinusbetulus*	European Hornbeam	0.790
Abiesbornmülleriana	Uludağ Fir	0,4	*Alnusbarbata*	Black Alder	0.490
Piceaorientalis	Oriental Spruce	0,401	*Populusnigra*	The Black Poplar	0.410
Cedruslibani	Taurus Cedar	0,48	*Castanea sativa*	Sweet Chestnut	0.590
Juniperusexcelsa	Greek Juniper	0,508	*Fraxinus excelsior*	The Ash	0,65
Pinuspinea	Stone Pine	0,465	*Tiliagrandiflora*	Linden	0.490
Cupressussempervirens	The Mediterranean Cypress	0,48	*Platanusorientalis*	The Oriental plane	0.580
Pinushalepensis	Aleppo Pine	0,514	*Eucalyptus rostrata*	Red Gum	0.547
Pinusmaritima	The Maritime Pine	0,43	*Liquidambar orientalis*	Turkish Sweetgum	0.680
Pinusradiata	The Monterey Pine	0,38	*Robiniapseudoacaccia*	The Black Locust	0.720

Source: As,*et al.*,2001.

Biomass expansion factor for conversion of annual net increment (including bark) to aboveground tree biomass increment (BEF_1 and BEF_2): Calculated for both coniferous and deciduous species separately (Tier 2) in Table 7.20.

Table 7.20. Comparison of BEF1 and BEF2 coefficients between LULUCF Guidance and those calculated for Turkey to use for the natural and plantation forest located in the temperate zone

Tree Species	Data resource	BEF_2	Uncertainty %	BEF_1	Uncertainty %
Coniferous	In LULUCF	1,30 (1,15-3,40)	-	1,15 (1,05-1,20)	-
	Calculated for Turkey	1,24 (1,08-1,39)	12,27	1,22 (1,15-1,29)	14,72
Deciduous	In LULUCF	1,40 (1,15-3,40)	-	1,20 (1,10-1,30)	-
	Calculated for Turkey	1,26 (1,08-1,40)	10,94	1,24 (1,06-1,42)	5,69

Source: Asan, 2006.

- Root-to-shoot ratio (R): Default data used for temperate zone in the Guidance (Table 3A) and accounted distinctly for each management class based on the growing stock in hectare.

- Carbon fraction of dry matter (CF): Default value of Guidance (0.5) was used for carbon fraction of dry matter (CF).

Annual Decrease in Carbon Stocks Due to Biomass Losses in Land Converted to Forest Land

Annual biomass loss is a sum of losses from commercial round wood fellings, fuel wood gathering and other losses in forest land was calculated by using the following Equation 3.2.24 of LULUCF Guidance. In the estimations, biomass gains and biomass losses are calculated separately. For example, losses from forest fires are being calculated in a different column as according to the Equation 3.2.24 and Equation 3.2.9, respectively. The calculations of biomass losses are consistent with the IPCC GPG for LULUCF.

Equation 3.2.24. $\Delta C_{LFLOSS} = L_{fellings} + L_{fuelwood} + L_{other\ losses}$

Annual Other Losses of Carbon

Equation 3.2.9. $L_{other\ losses} = A_{disturbance} \bullet B_W \bullet (1 - f_{BL}) \bullet CF$

$A_{disturbance}$= Forest areas burnt by fires were taken into account (Tear 1).
B_W= It was estimated that average biomass in the fired areas could be burned with 45% percent of burning productivity. This biomass did not cover the litter. Relevant burning rate was fixed to the Guidance (Tables 3A.1.12) (Tear 1).

Annual Change in Carbon Stocks in Dead Organic Matter in Land Converted to Forest Land

Equation 3.2.10. $\Delta C_{LFDOM} = \Delta C_{LFDW} + \Delta C_{LFLT}$

Dead organic matter as a carbon pool divided into dead wood and litter. Dead wood data in the "Land Converted to Forest Land" was reached from forest management plans and added to the felling residues data. But there was no sufficient data on the litter in the Turkey's forests, the carbon stock change in the litter was assumed as zero according to the Guidance.

Annual Change in Carbon Stocks in Dead Wood in Forest Land Remaining Forest Land

Equation 3.2.28. $\Delta C_{LFDW} = [(B_2 - B_1)/T] \bullet CF$

7.2.8. Uncertainty and Time Series Consistency

To estimate the uncertainty levels in parameters and formulas, LULUCF Guidance recommends using the 5.2.1 and 5.2.2 equations:

Equation 5.2.1. $U_{toplam} = \sqrt{U_1^2 + U_2^2 + ... + U_n^2}$

Equation 5.2.2. $U_E = \dfrac{\sqrt{(U_1 \bullet E_1)^2 + (U_2 \bullet E_2)^2 + ... + (U_n \bullet E_n)^2}}{|E_1 + E_2 + ... + E_n|}$

Whole calculated uncertainty levels are expressed as follow in Table 7.21:

Table 7.21.Uncertainty estimates of parameters

Parameters	Uncertainty (%)
Oven dry weight -Coniferous -Deciduous	 20 26
-BEF1 Coniferous Deciduous -BEF2 Coniferous Deciduous	 15 6 12 11
f_{BL}	43
Dead wood	44
Root the shoot (R)	30
CF	2
Aboveground biomass -Coniferous -Deciduous	 40 41

Uncertainty According to the Expert View

For parameters related the forest areas from the GDF source …….0,03%
For parameters related the volume " " " ……..10%
For parameters related the volume increment " " ……..10%
For parameters related the commercial wood volume from SPO ..……5%
For parameters related the fuel wood gathering " " 15%
For parameters related the burned forest areas " " ..……10%

Table 7.22. Uncertainty of equations

Equations	Uncertainty (%)
Forest remaining forest land -Annual living biomass increment -Coniferous -Deciduous	 40 41
-Annual living biomass lost -Coniferous -Deciduous	 73 69
-Dead organic matter	44
-Forest fires	87

Time Series Consistency

Since there are two forest inventory carried out by the General Directorate of Forestry for 1972 and 2004 years, the data on the forest areas, growing stocks and annual volume increments during 1990-2004 period were calculated by interpolation between these two inventory data. Thus, the annual increase of forest areas were assumed as linear as well growing stocks and volume increments were accepted to increase with the compound interest basis. The data for the 2005-2011 were obtained annually from the Management and Planning Department of General Directorate of Forestry.

The statistics on the forest fires and commercial round wood production for the same period were taken from the same Directorate. Also, fuel wood gathering data was reached from utilizing the State Planning Organization's source and it was accepted as the same quantity for each year.

7.2.9. Planned Improvements

It was seen during the preparation of GHG inventory of LULUCF, there is a need to improve the forest resources inventory studies, the quality assurance of relevant data and increase the researches to obtain the country specific data. For this aim, a project has been prepared to set carbon stocks changes in the forest soils and litter by the Turkish Western Blacksea Forestry Research Directorate.Also planned activities are:

- In the concept of improving the capacity of the LULUCF Working Group; GDF has already updated the members of LULUCF Working Group in order to study climate change issues in November 2012 and established Climate Change and Sink Areas Expertise Committee in order to improve greenhouse gases inventory, in February 2013.
- Integrated Approach to Management of Forests in Turkey, With Demonstration in High Conservation Value Forests in the Mediterranean Region Project will be initiated in 2013. With this project sustainable forest management, establishment of policy and institutional framework GHG inventory estimation and carbon sequestration of forests issues will be studied more in detail.
- Establishing a remote sensed and web based "Land Use and Land Use Change Monitoring System" in order to monitor the changes between the six land categories which were defined in IPCC good practice guidance for LULUCF and better estimation of GHG inventory for LULUCF.
- Finalizing the country-specific QA/QC Plan within the LULUCF sector as well as other sectors by the end of this year.
- Making the last adjustments and finalizing the computer based greenhouse gases estimating system with TurkStat by the end of this year.

7.3 Croplands (5B)

7.3.1 Description

Cropland remaining Cropland and Land converted to Cropland has been reported under this category.

CSC in aboveground, belowground, organic and mineral soil pools have been calculated and reported. The Cropland category used to be a sink in the previous submissions but it has become a source with the addition of conversions within the category of Cropland remaining cropland and Land converted to cropland.

The Cropland covers all perennial and annual crops in agriculture lands. Orchards and poplars are included in this category.

7.3.2 Information on approaches used for representing land areas and on land-use databasesused for the inventory preparation

As explained in the Activity data section database we use to calculate land uses and land use changes has been modified with the recently added Corine 1990 land use map. With this improvement we have calculated land use changes based on 3 temporal time points: 1990, 2000 and 2006. We had a more compatible and consistent monitoring system with this methodology. In Turkey the cropland areas are decreasing since 1990 as seen in Figure ***.

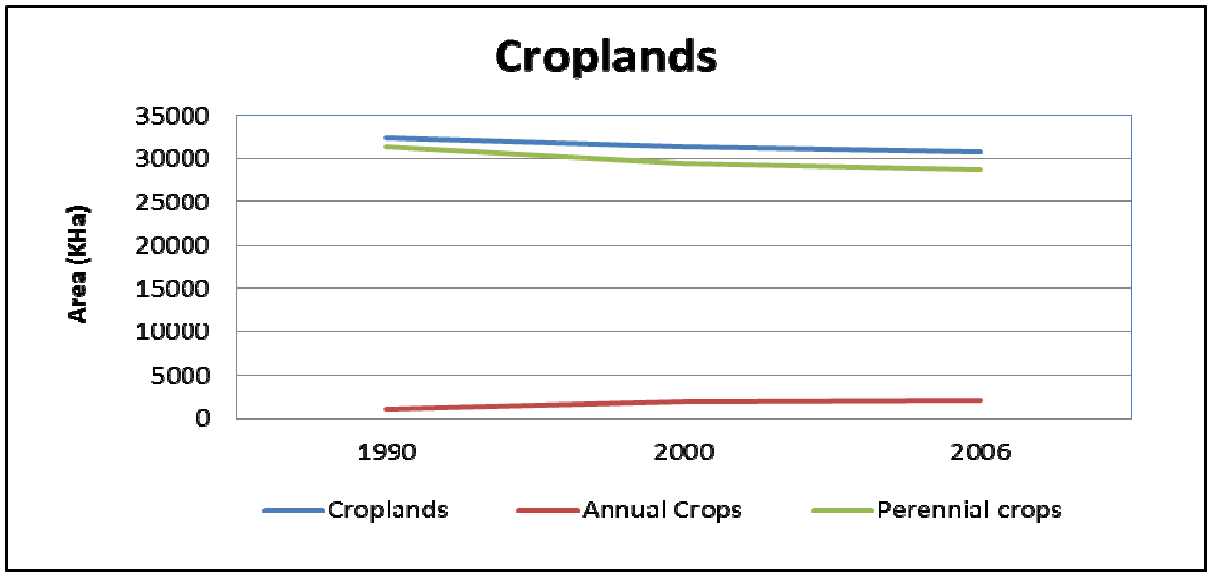

Figure 7.5 The temporal change in croplands in Turkey between 1990 and 2006.

The annual crops has a decreasing trend while the aerial distribution of perennial crops increases. The AD given in CRF table 5B is the cropland areas that are subject to changes in management. The total area of croplands in Turkey was 28774.21 ha in 2006. In 1990 it was 31259.93 ha.

7.3.3 Land-use definitions and the classification systems used and their correspondence tothe LULUCF categories

Cropland areas have been determined as annual crops and perennial woody crops and disaggregated for IPCC climate and soil types.

Table 7.23. Land use changes between 1990-2000 and 2000-2006 in Turkey

1990-2000										
ha	FROM	Croplands		Wetlands	Grasslands			Settlements	Otherlands	
TO		perennial	Annual	Artificial	Green areas	Pastures	Natural grasslands	Settlements	Otherland	mine areas
Croplands	Perennial	856.689,75	198.708,98	1.582,76	381,92	2.602,32	22.432,36	14.531,96	5.060,92	387,34
	Annual	882.001,72	26.373.335,18	90.693,18	7.764,88	450.369,22	1.972.403,18	385.765,80	789.549,73	15.162,68
Wetlands	Artificial	2.243,78	54.479,14	1.029.089,77	142,72	10.059,02	19.257,97	864,16	22.341,42	217,05
Grasslands	Green areas	658,73	6.790,47	33,13	11.725,76	560,16	493,71	10.818,87	572,20	1,58
	Pastures	18.346,79	364.130,83	5.724,40	491,70	581.855,28	505.711,75	32.396,84	71.741,68	3.099,09
	Natural gr.	54.448,54	945.734,20	4.899,12	1.250,23	754.991,52	4.982.048,22	25.695,68	908.251,74	5.407,31
Settlements	Settlements	8.607,61	137.248,45	332,76	1.296,28	4.805,81	10.198,36	697.911,13	7.967,80	1.273,54
Otherlands	Otherland	49.599,06	961.362,32	35.568,48	1.737,02	162.085,98	4.225.350,71	15.073,51	6.726.439,73	162.085,98
	Mine areas	551,90	12.470,79	1.575,40	367,00	5.729,20	2.944,23	18.376,83	7.034,63	24.593,83
2000-2006										
ha	FROM	Croplands		Wetlands	Grasslands			Settlements	Otherland	
TO		Perennial	Annual	Artificial	Green areas	Pastures	Natural grasslands	Settlements	Otherland	mine areas
Croplands	Perennial	853.417,33	877.972,31	2.275,62	2.706,39	14.993,51	56.268,59	12.054,36	49.113,43	1.741,38
	Annual	194.964,97	26.409.623,93	60.823,36	16.048,75	293.639,93	918.949,16	182.381,16	972.775,63	24.675,68
Wetlands	Artificial	160,41	17.178,87	1.132.367,75	67,03	1.643,64	1.480,69	451,23	17.899,54	677,45
Grasslands	Green areas	115,10	3.042,01	152,22	19.443,06	364,74	554,22	1.844,51	653,34	105,16
	Pastures	3.013,27	444.832,40	10.136,40	863,34	579.302,02	754.034,96	7.246,59	165.544,75	6.993,94
	Natural gr.	22.790,82	1.952.478,31	21.970,61	1.501,85	471.268,97	5.024.595,84	13.500,88	4.267.192,71	7.485,20
Settlements	Settlements	8.028,72	251.153,66	1.194,59	16.634,28	10.607,17	15.129,10	896.344,56	13.993,14	6.569,71
Otherlands	Otherland	4.418,77	767.649,99	20.883,51	2.200,32	62.428,44	879.351,63	9.840,46	6.823.610,72	13.296,10
	Mine areas	212,31	7.297,33	567,26	736,16	1.115,56	3.403,70	4.276,76	9.336,89	43.130,07

7.3.4 Methodological issues

Cropland remaining Cropland

Cropland category includes all annual and perennial crops including orchards and poplar plantations; the change in biomass growth has been estimated only for perennial 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 crops.

The CSC in Cropland remaining Croplands have been estimated for the following pools;

- Biomass growth of perennial crops including Poplar plantations,
- Biomass gain/loss for conversions between annual and perennial croplands,
- CSC in mineral soils for conversions between annual and perennial croplands,
- Emissions from organic soils in croplands.

A combination of Tier 1 and 2 has been applied to calculate biomass increase for perennial croplands with Gain-Loss method. The areas of perennial woody cropland were multiplied by a net estimate of biomass accumulation from growth and subtract losses associated with harvest or gathering or disturbance (according to Equation 2.7 in Chapter 2 in IPCC).

A Tier 2 approach was used for the conversions between perennial and annual croplands. Tier 2 methods were used for CSC in organic and mineral soils (spatially explicit classification of these lands).

Concerning woody crops, estimates of carbon stocks changes in living biomass were applied to aboveground biomass (belowground was estimated just for poplars), according to the 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 combination of Tier 1 and Tier 2 based on disaggregated aerial data for climate and soil types has been used; therefore a combination of default and country specific factors have been applied.

Biomass accumulation and harvesting

The gain-loss method of GPG 2003 was used (Eq 3.1.1). Biomass accumulation rate for perennial crops on Cropland remaining croplands have been taken as 2.1 tonnes C $ha^{-1}yr^{-1}$ based on Table 3.3.2. of IPCC GPG.

We further assumed that 1/3 percent of the biomass carbon stocks are removed by pruning every year. This is an average value for the pruning intensity of agricultural perennial species.

For the estimation of CSC in polar plantations we used a database that covers the period 2003-2010. These values were extrapolated to 2011 and to the period before 2003. The poplar plantations were disaggregated for soil and default IPCC climate types.

The properties that were used to calculate CSC in poplars were a follows;

Table 7.24. Properties of poplar species planted in Turkey (Gülbaba, 2010, Birler, 2010, Zabek and Prescott, 2006).

Tree	BWD g/cm3	Plantation Pattern	# of trees per ha	Volume increment m3/ha yr	Rotation period (years)	BEF	R
Common poplar species average (*P. tremula, P. nigra*)	0,40	5x6	333	28	12	1,24	0,21

BWD: Basic wood density, BEF: Biomass expansion factor, R: Root to shoot ratio.

In the calculation procedure we assumed that 12 percent of the poplar plantations are harvested every year considering the rotation period as 12 years.

Conversions between Perennial and Annual Croplands

We used spatially explicit data to calculate conversions between perennial and annual croplands (Table 7.25).

Table 7.25.Conversions between annual and perennial crops within cropland category for soil and climate types.

		Annual to Perennial			Perennial to Annual		
	Ha	1990	2000	2006	1990	2000	2006
HAC	W-D	17.661,76	9.8952,79	51.135,00	69.373,00	24.767,68	51.006,00
	W-W	606,35	11.374,78	5.040,40	8.136,99	851,78	5.137,20
	C-D	221,27	3.274,87	1.478,60	2.301,12	303,30	1.478,50
	C-W	52,47	72,85	60,90	51,00	74,96	60,90
LAC	W-D	667,37	2.625,85	1.473,80	1.838,30	901,69	1.452,60
	W-W	248,18	6.144,22	2.676,00	4.399,80	354,54	2.734,10
	C-D	1,38	0,00	0,80	0,00	1,98	0,80
	C-W	0,00	0,68	0,30	0,48	0,00	0,30
SANDY	W-D	366,78	2.901,40	1.410,40	2.045,47	531,45	1.422,00
	W-W	0,00	0,00	0,00	0,00	0,00	0,00
	C-D	0,00	0,15	0,10	0,00	0,00	0,00
	C-W	0,00	0,00	0,00	0,00	0,00	0,00
WET	W-D	45,33	77,00	58,40	53,91	64,76	58,40
	W-W	0,00	0,00	0,00	0,00	0,00	0,00
	C-D	0,00	0,00	0,00	0,00	0,00	0,00
	C-W	0,00	0,00	0,00	0,00	0,00	0,00

For the estimation of C stocks in biomass of perennial crops we used country specific values. We selected olives, pistachio, and nut as the perennial species with the largest areal cover in the country (Table 7.26) to represent perennial crops. The three orchards reach up to 60 percent of the whole perennial crops in Turkey as the areal cover.

Table 7.26. The aerial distribution of perennial crops (%) in Turkey (TUIK, 2012)

Products	**Area %**
Apple	3,9
Apricot	4,9
Cherry	2,7
Citrus fruits	3,4
Nut	**28,7**
Pistacio	**8,5**
Olive	**22,4**

The average ages of these tree species were calculated based on the Table 7.27 below.

Table 7.27. Age distribution of perennial products in Turkey (%)

Perennial products		**Age**					
	Total	**1-4**	**5-9**	**10-14**	**15-19**	**20-49**	**50+**
Apple	100,0	12,4	14,4	16,8	14,4	38,6	3,4
Pear	100,0	15,4	14,8	15,8	16,6	35,2	2,2
Apricot	100,0	4,6	10,9	22,5	26,2	34,5	1,4
Cherry	100,0	24,4	22,5	22	14	16,3	0,8
Peach	100,0	21	32,3	27,6	10,9	7,7	,.5
Vineyards	100,0	7,5	10,4	13	11,8	40,7	16,6
Citrus fruits	100,0	6	12,4	17,7	16,8	44,9	2.2
Pistachio	**100,0**	**1,6**	**0,9**	**2,6**	**5,8**	**46,70**	**42.40**
Nut	**100,0**	**3,1**	**4,1**	**6,5**	**8,5**	**59,10**	**18,70**
Walnut	100,0	19,7	17,2	17,1	12,6	28,10	5,30
Olive	**100,0**	**7**	**4,7**	**5,4**	**6,1**	**35,90**	**40,90**

The calculated ages of 3 major orchards are;

Orchard	Average tree age	# of trees per ha
Pistachio	43	230
Nut	34	500
Olive	39	157

The average ages of three orchards were 38.7 years. Default C accumulation rate of 2.1 Mg/C were used as there were no available data on the C stocks of individual tree species. We plan to use country specific accumulation rates in the next submissions as we have the data on number of individuals per hectare.

When average ages of the orchards were calculated as 38,7 years then the C stock per hectare becomes;

38,7 * 2,1 = 81,2 Mg C/ha (IPCC GPG default is 30 years age and 63 MgC/ha)

The default 5 MgC/ha was used for the CSC for annual products.

The conversions between annual and perennial products and vice versa were calculated based on these CSC values.

We used IPCC GPG default EFs to estimate CSC in mineral and organic soils (GPG Table 3.3.5). In case of emissions from organic soils we assumed that all croplands are managed (conservative approach).

Land Converted to Cropland

Grassland converted to Cropland

CSC in biomass and soil pools have been calculated in this category. CSC estimations for

- Grasslands converted to Perennial croplands
- Grasslands converted to Annual croplands

were estimated. We used gain-loss method of GPG 2003 (Eq 3.1.1).

The default C stock value of 5 Mg C/ha in aboveground biomass were used for annual crops while 81,2 Mg C/ha was taken for perennial crops.
The aboveground C stock for grasslands have been taken as 0,735 Mg C/ha, and belowground 2,94 Mg C/ha (Aydın and Uzun, 2005; Fırıncıoğlu et al., 2009; Sinoga et al., 2012).
In case of emissions from organic soils we assumed that all grasslands are managed (conservative approach).

7.4. Grasslands (5C)

7.4.1 Description

Grasslands are all lands with non woody vegetation subject to grazing.

Grassland remaining Grassland

CSC in grasslands is assumed to be not changing if management is not changed. Actually, there are grassland rehabilitation projects implemented in the country but conservatively we assumed no change in biomass. We plan to report these projects as the grassland monitoring system becomes available in the next submission.

Emissions from organic soils are reported assuming that all grasslands are managed. Default EFs are used in this procedure but the AD is disaggregated for climate types.

Croplands converted to grassland

CSC in biomass and soils are reported in this category.

CSC due to conversions from perennial and annual croplands are estimated in living biomass. The same C stocks determined for perennial (country specific) and annual crops (default value) were used.

7.5. Wetlands (5D)

7.5.1 Description

All human made reservoirs are included in the wetlands category. CSC in biomass due to conversions from croplands and grasslands has been reported in this category.

Croplands converted to Wetlands

All perennial and annual croplands converted to wetlands have been reported. Gain-loss method of GPG 2003 (Eq 3.1.1) was used. The same C stock values were used as Croplands section.

Grasslands converted to Wetlands

Emissions from above and below ground biomass have been reported in this category. Gain-loss method of GPG 2003 (Eq 3.1.1) was used. The same C stock values were used as Grasslands section.

7.6. Uncertainty and time series consistency

Data for some years or periods had to be interpolated or extrapolated to have a complete inventory that covers the whole reporting period. To extrapolate the data we used linear equations derived from cumulative values.

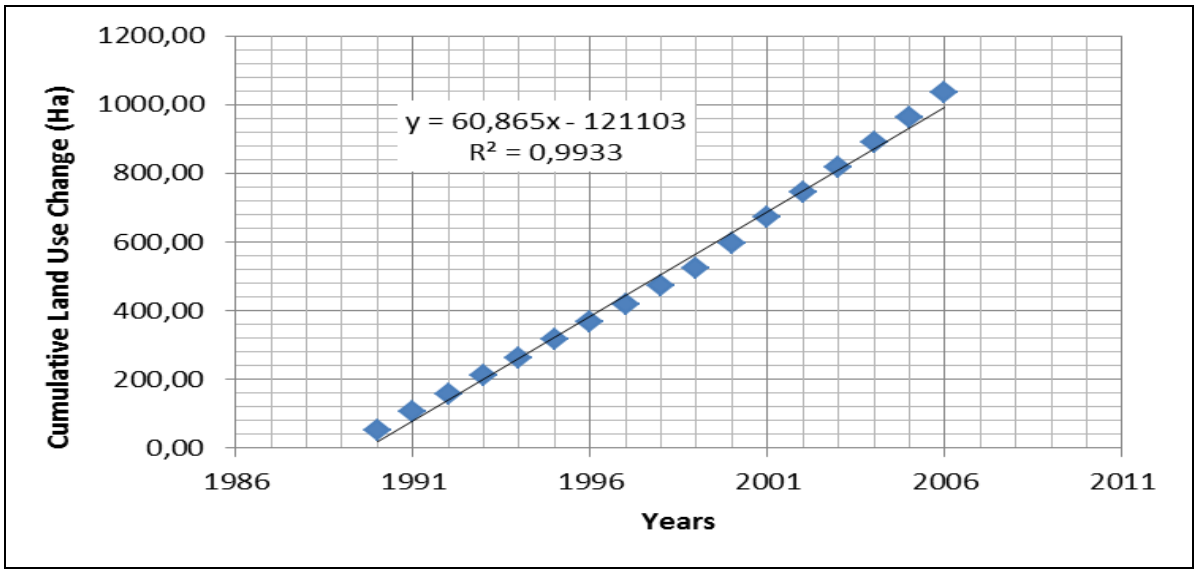

Figure 7.6. Interpolation and extrapolation approach for land use change data. Cumulative values are plotted and the trend line was extrapolated based on the linear equation.

Uncertainty estimates for the period 1990–2011 has been assessed based on IPCC GPG as explained below.

Table 3.3.2.in IPCC GPG was used to estimate biomass growth. The error range has been given as ±75% in the table.

TABLE 3.3.2
DEFAULT COEFFICIENTS FOR ABOVEGROUND WOODY BIOMASS AND HARVEST CYCLES IN CROPPING SYSTEMS CONTAINING PERENNIAL SPECIES

Climate region	Aboveground biomass carbon stock at harvest (tonnes C ha^{-1})	Harvest /Maturity cycle (yr)	Biomass accumulation rate (G) (tonnes C ha^{-1} yr^{-1})	Biomass carbon loss (L) (tonnes C ha^{-1})	Error range[1]
Temperate (all moisture regimes)	63	30	2.1	63	± 75%
Tropical, dry	9	5	1.8	9	± 75%
Tropical, moist	21	8	2.6	21	± 75%
Tropical, wet	50	5	10.0	50	± 75%

Note: Values are derived from the literature survey and synthesis published by Schroeder (1994).

[1] Represents a nominal estimate of error, equivalent to two times standard deviation, as a percentage of the mean.

The percentage uncertainty is equal to 75% as;

The uncertainty of the activity data is around 50% according to expert judgment considering that 3 different Land Use Maps have been used.

The overall uncertainty is calculated as;

$$Utotal = \sqrt{U1^2 + U1^2}$$

$$Utotal = \sqrt{75^2 + 50^2} = 90\%$$

7.7. Category-specific QA/QC and verification

A QA/QC mechanism has been established in the LULUCF working unit established under Ministry of Food, Agriculture and Livestock. The unit is responsible of complying, reporting, quality control, improving and quality assurance of the inventory. The responsibility of the unit is limited to 5 land use categories other than Forestland.

7.8. Category-specific recalculations

The database has been changed from 3 different map types (Land Use 1980, Corine 2000, Corine 2006, Statip 2010) to just Corine (1990, 2000, 2006). The time series has been more consistent and reliable in this way.

All IPCC land use types and conversions have been determined in this way. All values for Cropland remaining cropland have been recalculated based on the new spatial information.

The completeness was one of the major objectives in this submission as we could only report very limited portion of the LULUCF categories in the previous submissions. The recalculations resulted in emissions for all land use categories except Forestland. In this submission we also used national literature data to improve the level of reporting to Tier 2.

7.9. Category-specific planned improvements

All major planned improvements have been realized in this submission. The emphasis was given to completeness, consistency, comparability and transparency in this submission. In the next submissions we aim to increase the accuracy of the inventory by using more country specific data.

The preparation of new Corine map for 2012 has been initiated but may not be available in the next submission. With that map we shall have a very reliable land use database.

Last year a scientific study to determine C stocks in settlements has been initiated. The research project is supported by the Scientific and Technical Research Council of Turkey (TUBITAK) with a project number of 112Y096. We plan to use the outputs of this project if we get enough data until next submission. In this way we shall be able to report CSC during conversions from and to settlements. We consider this issue as very significant as urbanization and sprawl are common in many places of the country especially around Istanbul.

The General Directorate of Agriculture reform has started a GIS based land characterization project with the title of TARBIL (Agriculture Database System). We expect to use more accurate land and land use data especially on land use practices as this project advances.

We are still working on software to improve reporting in the LULUCF sectors but has not been finalized yet.

Finally there is a compatibility issue between Forestlands and other land uses. The forestlands (Forestland remaining Forestland and Lands Converted to Forestland) are reported based on National Forest Inventory Database but other 5 land uses are reported based on Corine Land Use maps. These 2 databases are not consistent. We are aware of the issue but has not solved that yet.

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