TURKEY Greenhouse Gas Inventory,1990 to 2010

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, 2012

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

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List of Abbreviations

AD	Activity Data
BEF	Biomass Expansion Factor
CO_2	Carbon dioxide
CO_2eq	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

Chapter 7

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 presents net removals from this sector.

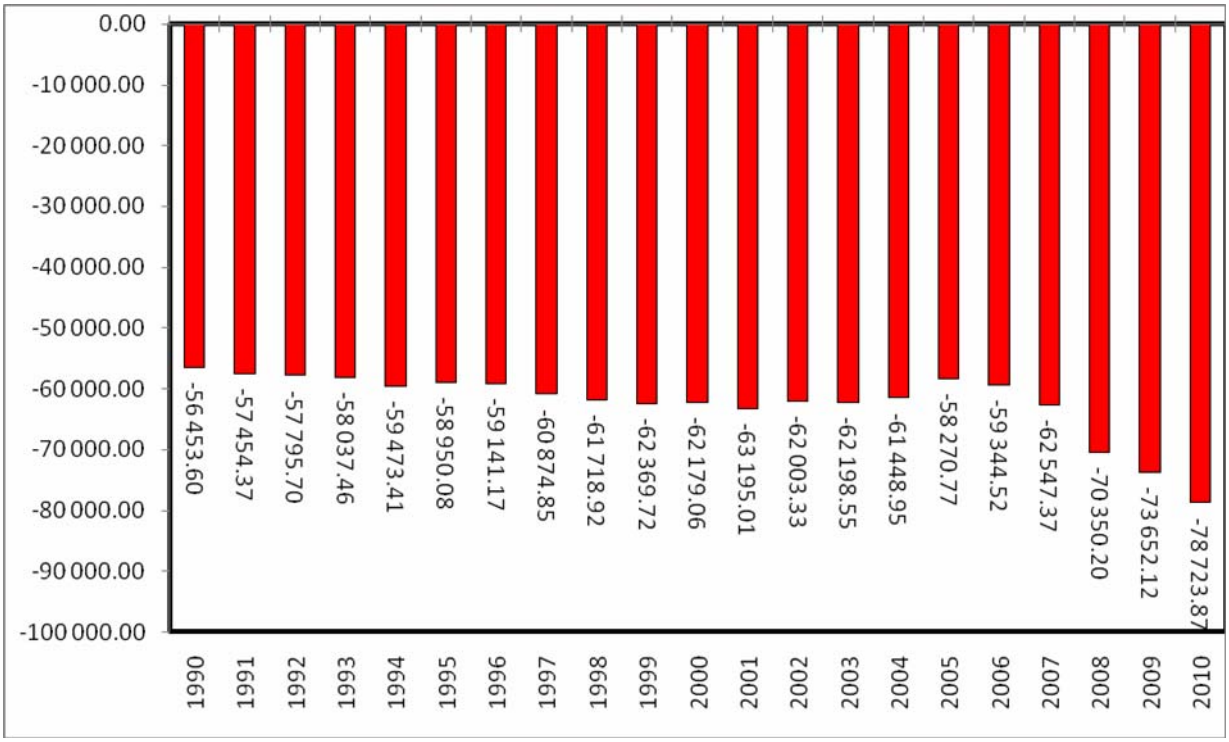

Figure 7.1. Net removals from sector 5 LULUCF in Gg CO_2 equivalents.

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, afforestration 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 due to land abandonment and a decrease in grazing.Emissions from Sector 5 LULUCF by subcategory that forest land arise from biomassburning in the forest lands. Other greenhouse gasses amounts change depending on the burned forest areas and there is no definite and significant trend for the other gasses (Table 7.1 and Figure 7.2).

Table 7.1.Changes in the other greenhouse gasses caused by forest fires between the years of 1990-2010.

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

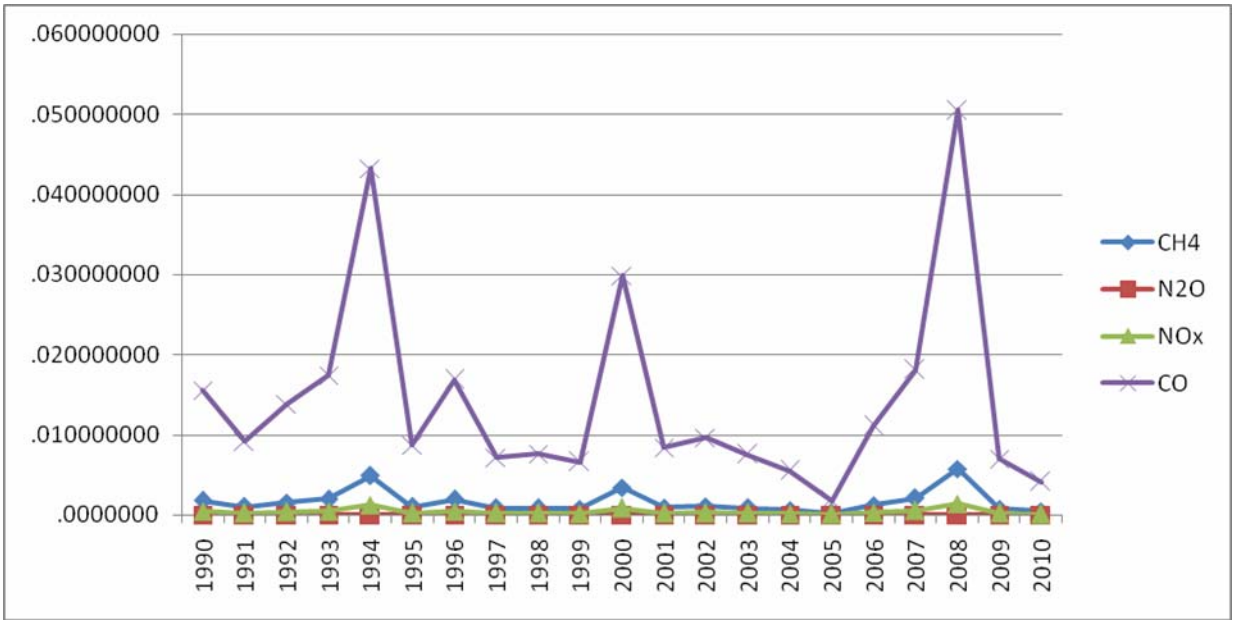

Figure 7.2. Other greenhouse gasses from forest fires between 1990-2010 years

Due to accounted as a carbon lost from forest fires in the total carbon lost, CO_2 missions were not considered here to avoid double counting in the LULUCF inventory.

Miscalculations related to forest fires were recalculated as mentioned by the expert review team during the in-country inventory review. Therefore, non-CO_2 emission estimations changed completely. The calculations for 1990-2010 were recalculated. 3.2.19 and 3.2.20 formulas were used for this period. The parameters were chosen appropriate to method described in Section 3.2.1.4.2.1. The parameters have been used from 3.A.1.13. and 3.A.1.14 tables. Country specific data were used for the amount of burning biomass and burning efficiency data changes were entered in to table 5(5). Since 2007, estimations have been calculated with correct method as mentioned above.

Table 7.2. Comparison of emissions and removals in 1990-2010periods in Turkey

Yıl	Toplam Sera Gazı Emisyon Miktarları (CO_2e-Mton)	AKAKDO Sektörü Uzaklaştırmaları (CO_2e-Mton)	AKAKDO Sektörünün Toplam Sera Gazı Emisyonları İçindeki Payı (%)
1990	187.029,26	-56.453,60	-30,18
1991	199.127,55	-57.454,37	-28,85
1992	210.229,42	-57.795,70	-27,49
1993	221.662,43	-58.037,46	-26,18
1994	217.150,73	-59.473,41	-27,39
1995	237.507,29	-58.950,08	-24,82
1996	258.620,77	-59.141,17	-22,87
1997	271.882,43	-60.874,85	-22,39
1998	274.046,13	-61.718,92	-22,52
1999	274.777,63	-62.369,72	-22,70
2000	297.005,53	-62.179,06	-20,94
2001	278.112,07	-63.195,01	-22,72
2002	286.203,60	-62.003,33	-21,66
2003	302.753,45	-62.198,55	-20,54
2004	312.261,28	-61.448,95	-19,68
2005	329.897,20	-58.270,77	-17,66
2006	349.642,44	-59.344,52	-16,97
2007	379.975,61	-62.547,37	-16,46
2008	366.502,15	-70.350,20	-19,20
2009	369.647,82	-73.652,12	-19,92
2010	401.924,89	-78.723,87	-19,59

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 22.42%during the 1990-2010 periods.The methodology advised in the IPCC Good Practice Guidance for Land Use, Land UseChange 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 basefor all land use category (Figure 7.3.).

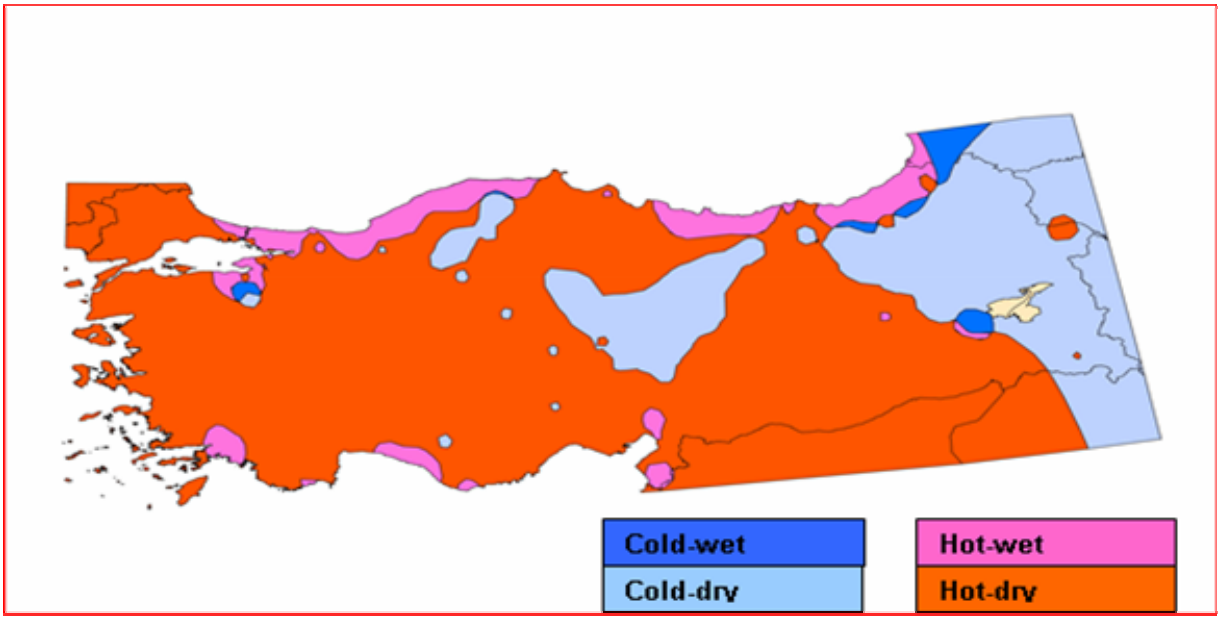

Figure 7.3. The climate map of Turkey

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
Wetlands	CO_2	No available data after the 2002 year
Settlements	CO_2	No available data after 2000 year

7.2. Forest Land- Category 5A

The inventory studies related forest lands were accomplished by the Ministry of Forestry and Water Affairs, the Department of Research and Development, Forest Research Directorates and İstanbul UniversityFaculty of Forestry (Prof. Dr. Ünal ASAN) and especially Climate Change and Bioenergy Working Group of GDF.

7.2.1. Definition of Forest Area

In Turkey forest areas are protected by constitution. According to the legislation (Forest Law No: 6831),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, areasnormally forming part of the forest area which are temporarily unstocked as a result of human intervention suchas 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 countriesto use detailed ecosystem classifications in the calculations and in reporting broad specified categories to ensureconsistency and comparability of national data across countries.

Also in forest lands, areas which have a tree cover between 11-100 percent are accepted as productive (normal) forests. Other forest areas which have a tree cover between 0-10 percent are accepted as degraded forests. According to forest inventory, Turkey has 10.33 million ha degraded forests in 2010.

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 21.53million 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 (10,225 Mill. Ha. for the year of 2000) 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 2010 year are given in table 7.3.

Table 7.3. Forest inventory results of Turkey at the end of 2010 (x1000)
Table 7.3.A. Areas

Tree Species	High Forests (Ha)			Coppices (Ha)			TOTAL (Ha)		
	Normal[1]	Degraded[2]	Total	Normal	Degraded	Total	Normal	Degraded	Total
Coniferous	7.395,64	5.763,13	13.158,77	0,00	0,00	0,00	7.395,64	5.763,13	**13.158,77**
Deciduous	2.386,87	1.116,73	3.503,61	1.420,32	3.454,39	4.874,71	3.807,20	4.571,12	**8.378,32**
Total	**9.782,51**	**6.879,87**	**16.662,38**	**1.420,32**	**3.454,39**	**4.874,71**	**11.202,84**	**10.334,25**	**21.537,09**

Table 7.3.B. Growing stock

Tree Species	High Forests (m^3)			Coppices(m^3)			TOTAL (m^3)		
	Normal	Degraded	Total	Normal	Degraded	Total	Normal	Degraded	Total
Coniferous	910.971,54	49.447,54	960.419,08	0,00	0,00	0,00	910.971,54	49.447,54	**960.419,08**
Deciduous	377.387,31	12.188,97	389.576,28	59.094,72	19.414,64	78.509,36	436.482,03	31.603,61	**468.085,64**
Total	**1.288.358,85**	**61.636,50**	**1.349.995,35**	**59.094,72**	**19.414,64**	**78.509,36**	**1.347.453,57**	**81.051,15**	**1.428.504,72**

Table 7.3.C. Annual volume increment

Tree Species	High Forests (m^3)			Coppices (m^3)[3]			TOTAL (m^3)		
	Normal	Degraded	Total	Normal	Degraded	Total	Normal	Degraded	Total
Coniferous	25.050,38	1.171,04	26.221,42	0,00	0,00	0,00	25.050,38	1.171,04	**26.221,42**
Deciduous	9.661,22	297,03	9.958,25	3.089,05	792,88	3.881,93	12.750,26	1.089,91	**13.840,17**
Total	**34.711,60**	**1.468,07**	**36.179,67**	**3.089,05**	**792,88**	**3.881,93**	**37.800,65**	**2.260,95**	**40.061,59**

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, has been usingand in this system total forest are changes, total annual increment changes, total growing stock changes can be calculated year by year. Therefore, compare of forest area, annual increment and growing stock between two subsequent years has been possible since 2004. Compare 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. Compare of removals by forestry sector, according to forest area, annual increment and growing stock changes since 2004

Years	Removals in CO_2e Gg/Year	Forest Area (ha)	Compare of Forest Area Between Two Subsequent Years (ha)	Growing Stock (m^3)*1000	Compare of Growing Stock Between Two Subsequent Years (m^3)*1000	Annual Increment (m^3)	Compare of Annual Increment Between Two Subsequent Years (m^3)
2004	-54.116,75	21.188.750,00	30.920,35	1.288.124,77	10.653,99	36.282.291,38	370.899,50
2005	-51.264,38	21.248.490,00	59.740,00	1.296.330,19	8.205,42	36.561.693,18	279.401,80
2006	-53.689,04	21.248.500,00	10,00	1.315.702,35	19.372,16	37.183.504,93	621.811,75
2007	-53.318,81	21.334.430,00	85.930,00	1.326.321,52	10.619,18	37.405.080,43	221.575,50
2008	-57.575,67	21.363.214,80	28.784,80	1.368.568,48	42.246,96	37.414.045,18	8.964,75
2009	-57.364,76	21.389.783,00	26.568,20	1.374.240,93	5.672,45	38.454.915,18	1.040.870,00
2010	-58.832,76	21.537.091,30	147.308,30	1.428.504,72	54.263,79	40.061.594,58	1.606.679,40

It can be seen from Table 7.4. totally 379.261,65 ha areas have converted to forest land between 2004-2010. Based on these data, the forest area is interpolated to be increasing by 54.18 kha per year. The key driver for the rise in land converted to forest land is afforestration activities. Especially, in 2008, National Afforestration and Erosion Control Action Plan have initiated in order to increase forest areas of Turkey.

Olden Data Concerning the Forest Resources

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 basing on the summaries of management plans data renewed in each 10 years' time interval. Forest data given in first document is shown in Table 7.5.

Table 7.5. Forest inventory results of Turkey at the end of 1972
Table 7.5.A. Areas (*1000000)

Tree Species	High Forests (Ha)			Coppices (Ha)			TOTAL (Ha)		
	Normal[1]	Degraded[2]	Total	Normal	Degraded	Total	Normal	Degraded	Total
Coniferous	5,170	4,260	9,430				5,170	4,260	**9,430**
Deciduous	1,007	0,498	1,505	2,679	6,585	9,265	3,686	7,083	**10,769**
Total	**6,177**	**4,758**	**10,935**	**2,679**	**6,585**	**9,265**	**8,856**	**11,343**	**20,199**

Table 7.5.B. Growing stock (*1000000)

Tree Species	High Forests (m^3)			Coppices (m^3)[3]			TOTAL (m^3)		
	Normal	Degraded	Total	Normal	Degraded	Total	Normal	Degraded	Total
Coniferous	548,559	44,417	592,976				548,559	44,417	**592,976**
Deciduous	210,033	9,942	219,975	117,734	45,506	163,240	327,768	55,448	**383,215**
Total	**758,592**	**54,359**	**812,951**	**117,734**	**45,506**	**163,240**	**876,326**	**99,865**	**976,191**

Table 7.5.C. Annual volume increment (*1000000)

Tree Species	High Forests (m^3)			Coppices (m^3)[3]			TOTAL (m^3)		
	Normal	Degraded	Total	Normal	Degraded	Total	Normal	Degraded	Total
Coniferous	15,593	1,093	16,686				15,593	1,093	**16,686**
Deciduous	5,199	0,251	5,450	6,418	1,486	7,904	11,616	1,737	**13,353**
Total	**20,792**	**1,344**	**22,135**	**6,418**	**1,486**	**7,904**	**27,209**	**2,830**	**30,039**

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 (*1000000)

Tree Species	High Forests (Ha)			Coppices (Ha)			TOTAL (Ha)		
	Normal[1]	Degraded[2]	Total	Normal	Degraded	Total	Normal	Degraded	Total
Coniferous	7,083	5,689	12,772				7,083	5,689	**12,772**
Deciduous	1,857	0,810	2,667	1,681	4,068	5,749	3,538	4,878	**8,416**
Total	**8,940**	**6,499**	**15,439**	**1,681**	**4,068**	**5,749**	**10,621**	**10,567**	**21,188**

Table 7.6.B. Growing stock (*1000000)

Tree Species	High Forests (m^3)			Coppices (m^3)[3]			TOTAL (m^3)		
	Normal	Degraded	Total	Normal	Degraded	Total	Normal	Degraded	Total
Coniferous	818,556	51,070	869,626				818,556	51,070	**869,626**
Deciduous	310,014	14,367	324,381	70,464	23,654	94,118	380,478	38,021	**418,499**
Total	**1128,570**	**65,437**	**1194,007**	**70,464**	**23,654**	**94,118**	**1199,034**	**89,091**	**1288,125**

Table 7.6.C. Annual volume increment (*1000000)

Tree Species	High Forests (m^3)			Coppices (m^3)[3]			TOTAL (m^3)		
	Normal	Degraded	Total	Normal	Degraded	Total	Normal	Degraded	Total
Coniferous	22,235	1,165	23,400				22,235	1,165	**23,400**
Deciduous	7,674	0,353	8,027	3,926	0,929	4,855	11,600	1,282	**12,882**
Total	**29,909**	**1,518**	**31,427**	**3,926**	**0,929**	**4,855**	**33,835**	**2,447**	**36,282**

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 (*1000000)

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 (*1000000)

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 (*1000000)

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)(*1000000)		Change on Growing Stock (m^3) (*1000000)		Change on Annual Increment (m^3) (*1000000)	
	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 0.99 Mill. Ha; on growing stock and volume increment are 343,175 and 7,861 Mill m^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. Afforestration activities on the bare lands and degraded forests accomplished by the Forestry Service.
7. National Afforestration and Erosion Control Action Plan has been initiated since 2008. In the scope of this action plan GDF has made afforestration, 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).

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 managementtypes and tree species in 2010 is presented hereunder:

Table 7.9. The distribution of Turkey's forests in 2010

Subcategories in 2010	Management Units	Area of forest land (ha)
Hot-dry managed coniferous	2.771	11.037.916,30
Hot-dry managed deciduous	1.228	4.469.365,00
Hot-dry unmanaged coniferous	290	594.508,80
Hot-dry unmanaged deciduous	61	69.679,80
Sub-Total	**4.350**	**16.171.469,90**
Hot-wet managed coniferous	656	1.366.285,90
Hot-wet managed deciduous	906	1.589.467,50
Hot-wet unmanaged coniferous	58	79.912,50
Hot-wet unmanaged deciduous	45	35.777,60
Sub-Total	**1.665**	**3.071.443,50**
Cold -dry managed coniferous	260	1.090.844,40
Cold -dry managed deciduous	114	631.403,70
Cold -dry unmanaged coniferous	15	45.551,00
Cold -dry unmanaged deciduous	1	180,50
Sub-Total	**390**	**1.767.979,60**
Cold –wet managed coniferous	51	143.028,40
Cold –wet managed deciduous	42	368.616,30
Cold –wet unmanaged coniferous	10	8.986,60
Cold –wet unmanaged deciduous	2	5.567,00
Sub-Total	**105**	**526.198,30**
Managed coniferous	3.738	13.638.075,00
Managed deciduous	2.290	7.058.852,50
Unmanaged coniferous	373	728.958,90
Unmanaged deciduous	109	111.204,90
Coniferous	4.111	14.367.033,90
Deciduous	2.399	7.170.057,40
Grand total	**6.510**	**21.537.091,30**

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

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 7.10.

Table 7.10. Forest fires in 2010

Fire Number	Total area (Ha)	Fire Types	
		Ground Vegetation	Crown
1.861	3.316,552	1.557,356	1.759,196

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 1990–2010.

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.

7.2.3. 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 7.11).

Table 7.11. Annual changes carbon stocks in forest areas of Turkey in 2010

GHG 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	21.537,09	19.641,72	-6.142,30	13.499,42	2.545,88	58.832,76
1. Forest Land remaining Forest Land	20.755,87	18.895,77	-6.009,32	12.886,45	2.462,96	56.281,17
2. Land converted to Forest Land	781,23	745,95	-132,98	612,97	82,92	2.551,59

In Table 7.12.annual changes of net carbon stocks in the forest areas according to management types in Turkey are shown.

Table 7.12. Annual changes of net carbon stocks in the forest areas of Turkey with regard to sub-categories, 2010

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	13.000,87	8.169,15	1.844,54	0,00	637,20	528,58	82,92	0,00
Managed Deciduous	6.939,87	4.717,30	618,42	0,00	118,98	84,40	0,00	0,00
Managed Total	**19.940,74**	**12.886,45**	**2.462,96**	**0,00**	**756,19**	**612,97**	**82,92**	**0,00**
Unmanaged Coniferous	704,52	0,00	0,00	0,00	24,44	0,00	0,00	0,00
Unmanaged Deciduous	110,61	0,00	0,00	0,00	0,60	0,00	0,00	0,00
Unmanaged Total	**815,12**	**0,00**	**0,00**	**0,00**	**25,04**	**0,00**	**0,00**	**0,00**
TOTAL	**20.755,87**	**12.886,45**	**2.462,96**	**0,00**	**781,23**	**612,97**	**82,92**	**0,00**

In Table 7.13.annual changes of net carbon stocks in different carbon pools in the forest areas in Turkey are shown.

Table 7.13. Annual changes of net carbon stocks and CO_2 equivalents in the whole forests of Turkey, 2010

Tree Species	Areas kha	In Living Biomass Gg	In Dead Organic Matter Gg	In Forest Soil Gg	Forest Fires Gg	TOTAL Gg	CO_2 Equivalent (Removal) Gg
Managed Coniferous	13.638,08	8.697,72	1.927,46	0,00	-29,29	10.625,18	-38.958,98
Managed Deciduous	7.058,85	4.801,70	618,42	0,00	0	5.420,12	-19.873,79
Managed Total	**20.696,93**	**13.499,42**	**2.545,88**	**0,00**	**-29,29**	**16.045,30**	**-58.832,76**
Unmanaged Coniferous	728,96	0,00	0,00	0,00	0,00	0,00	0,00
Unmanaged Deciduous	111,20	0,00	0,00	0,00	0,00	0,00	0,00
Unmanaged Total	**840,16**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**	**0,00**
TOTAL	**21.537,09**	**13.499,42**	**2.545,88**	**0,00**	**-29,29**	**16.045,30**	**-58.832,76**

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

Net carbon sequestration and removals between the years 1990-2010 in the forests of Turkey are outlined in Table 7.14 and shown in Figure 7.4.

Table 7.14. Net carbon sequestration and removals between the years 1990-2010 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**

*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 2008-2010.

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.

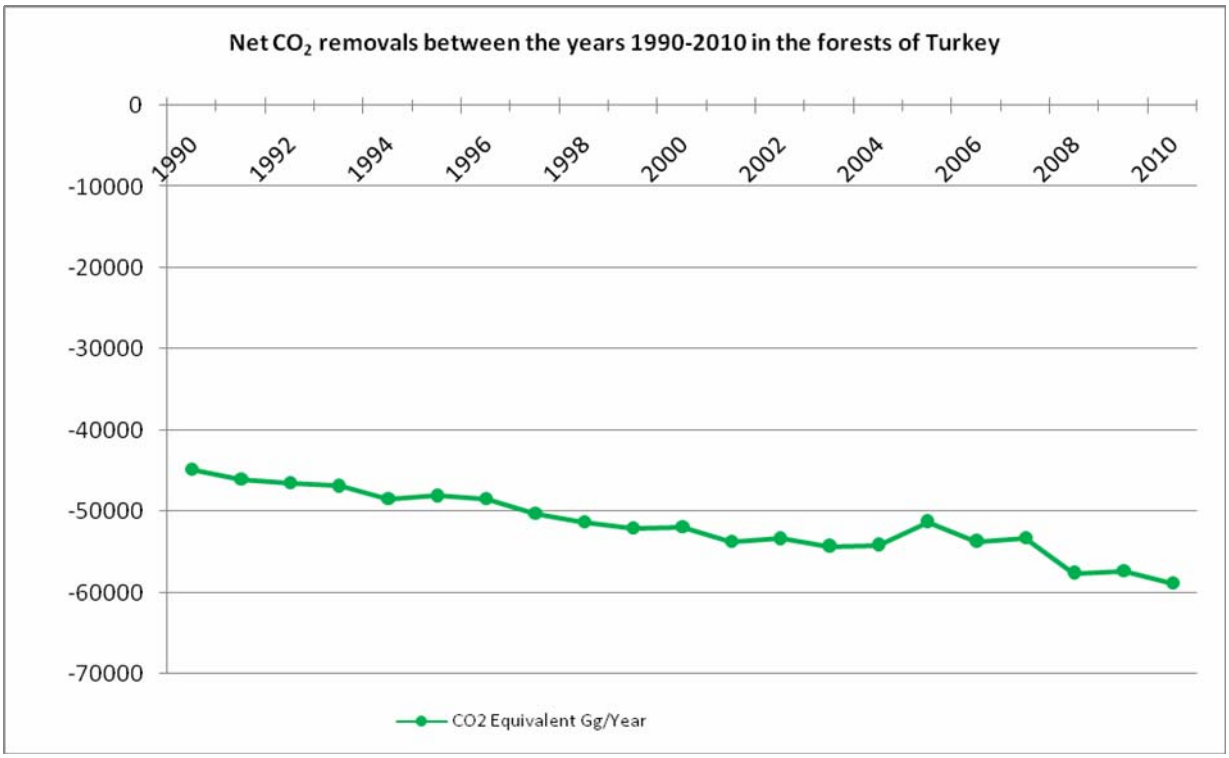

Figure 7.4. Net CO_2 removals between the years 1990-2010 in the forests of Turkey

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 (Annual Increase in Carbon Stocks due to Biomass Increment in Forest Land)

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

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

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 7.14)(Tier 2). This coefficient was determined as :

  -0,496 for largely coniferous mixed forests,

  -0,638 for largely deciduous mixed forests.

Table 7.15. The oven dryweight 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 7.16. Comparison of BEF1 and BEF2 coefficients between LULUCF Guidance and those calculated for Turkey to use for the natural and plantation forest locatedin 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

Annual biomass loss is a sum of losses from commercial roundwoodfellings, fuelwood 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 roundwood felling is being calculated in a different column as well as fuelwood 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

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

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 wasdecreased 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.

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

Whole calculated uncertainty levels are expressed as follow:

Table 7.17.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%
" " " the volume " " " ……..10%
" " " the volume increment " " ……..10%
" " " the commercial wood volume from SPO ..……5%
" " " the fuel wood gathering " " 15%
" " " the burned forest areas " " ..……10%

Table 7.18. 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 aslinear as well growing stocks and volume

increments were accepted to increase with the compound interest basis. The data for the 2005 and 2006 years also were obtained annually from the General Directorate of Forestry.

The statistics on the forest fires and commercialround 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.

7.2.4. 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 relevantdata 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:

- Establishment of the permanent team to work for the LULUCF studies and improvingthe capacity of the concerned staffs and institutions.
- A project to establish carbon accounting system and to monitor the carbon stocks in the Turkey's forests.
- A Project to establish National Forest Inventory. When the Project is completed the data which used the preparation of GHG Inventory in the forestry sector will be obtained from NFI system.
- 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 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.
- Integrating the Coordination of Information on the Environment (CORINE) data sources into ENVANIS system.

7.3. Cropland (5B)

7.3.1. Description

Under this category, CO_2 removals from living biomass from cropland remaining cropland have been reported. Lands converted to cropland have not been calculated due to methodological issues explained below.

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

In this submission the spatial data source has been changed with a more precise data source. In 2009 submission, the data was estimated for the years between 2007-2009 by extrapolation. In 2010, a new database called STATIP was used. The STATIP is most recent project output of The

General Directorate of Agricultural Reform that produces land use maps at a scale of 1/25 000. This is a higher resolution spatial data compared to Corine system of 1/100 000 resolution. The complete set of activity data and CO_2 numbers were re-calculated by using this data.

To compute the land use area as the activity data we utilized from 3 different data sources. The earliest data source we used was Digitized Land Cover Map of 1980. Other data sources were Corine2000 and 2006, and STATIP 2010 databases. Since Corine 1990 was not ready at the time of inventory preparation we had to use 1980 Land Cover Map as the start point. The methodology of 1980 Map is quite different than Corine system and thus causes large differences and errors in land area and land use conversions. We intend to replace Corine 1990 with 1980 Land Cover Map in the next submission.

Land use conversions could not be estimated because of compatibility issues between these sources. The land areas were not consistent and land use types were dissimilar. However, since there is no consistent periodic spatial data source of the country, the sources have to be combined.

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

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

7.3.4. Methodological issues

Cropland remaining Cropland

Cropland category includes all annual and perennial crops; the change in biomass 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.

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).

Perennial–woody crops

Concerning woody crops, estimates of carbon stocks changes are applied to aboveground biomass only, 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 Tier 1 based on highly aggregated area estimates for generic perennial woody crops, has been used; therefore default factors of aboveground biomass carbon stock at harvest, biomass accumulation rate, for the temperate climatic region have been applied.

The biomass clearing is relatively unusual. Biomass carbon losses have been estimated, taking into account the pruning of woody cropland.

Table 7.19. Cropland and grassland areas according to 1980 Land Use Map

	Annual Croplands kHa				**Perennial Croplands kHa**				**Grasslands kHa**			
Climate Type	***HAC***	***LAC***	***Sandy***	***Wet***	***HAC***	***LAC***	***Sandy***	***Wet***	***HAC***	***LAC***	***Sandy***	***Wet***
Warm-moist	474.02	42.68	0.00	0.00	299.52	404.04	0.00	0.00	245.64	18.70	0.00	1.10
Warm-dry	19181.35	253.06	174.09	34.78	1666.25	35.38	24.70	0.65	12436.70	119.51	117.59	217.61
Cold-moist	58.46	0.21	0.18	0.00	5.96	0.00	0.00	0.00	145.29	1.10	0.19	0.00
Cold-dry	4222.71	0.54	57.37	3.92	98.98	0.03	0.08	0.23	7835.80	0.37	57.82	52.78
TOTAL	23936.54	296.49	231.64	38.70	2070.72	439.45	24.78	0.88	20663.43	139.68	175.60	271.49

Table 7.20. Cropland and grassland areas according to 2000 Corine Land Use Map

	Annual Croplands kHa				**Perennial Croplands kHa**				**Grasslands kHa**			
Climate Type	HAC	LAC	Sandy	Wet	HAC	LAC	Sandy	Wet	HAC	LAC	Sandy	Wet
Warm-moist	486.33	121.85	0.06	0.12	152.94	71.28	0.00	0.00	584.22	208.97	0.00	0.01
Warm-dry	17623.20	213.80	267.15	59.69	1624.76	38.34	44.58	0.91	22550.92	1135.38	179.03	41.39
Cold-moist	32.38	0.05	0.64	0.00	0.68	0.02	0.00	0.00	372.97	7.35	0.30	0.00
Cold-dry	3297.25	0.28	51.07	19.57	43.51	0.00	0.00	0.00	7664.68	3.27	57.47	14.33
TOTAL	21439.16	335.98	318.93	79.38	1821.89	109.65	44.58	0.91	31172.78	1354.97	236.80	55.74

Table 7.21. Cropland and grassland areas according to 2006 Corine Land Use Map

	Annual Croplands kHa				**Perennial Croplands kHa**				**Grasslands kHa**			
Climate Type	HAC	LAC	Sandy	Wet	HAC	LAC	Sandy	Wet	HAC	LAC	Sandy	Wet
Warm-moist	501.61	116.71	0.06	0.17	35.17	9.73	0.00	0.00	733.70	279.07	0.00	0.10
Warm-dry	18006.51	199.14	239.86	60.99	947.80	21.96	24.39	0.76	24250.29	1114.45	0.00	63.23
Cold-moist	53.35	0.11	0.62	0.00	0.59	0.14	0.00	0.00	307.17	3.29	1.39	0.00
Cold-dry	3781.16	0.62	67.04	18.82	21.03	0.02	0.00	0.00	10099.07	3.47	40.66	23.60
TOTAL	22342.61	316.58	307.58	79.98	1004.59	31.86	24.39	0.76	35390.24	1400.28	42.05	86.92

Table 7.22. Cropland and grassland areas according to STATIP 2010 Land Use Map

	Annual Croplands kHa				**Perennial Croplands kHa**				**Grasslands kHa**			
Climate Type	HAC	LAC	Sandy	Wet	HAC	LAC	Sandy	Wet	HAC	LAC	Sandy	Wet
Warm-moist	374.80	40.34	0.06	0.05	324.12	255.19	0.00	0.07	270.27	39.84	0.00	0.93
Warm-dry	17939.11	256.99	266.27	45.18	2964.58	68.82	63.26	17.14	10590.35	362.74	106.86	59.29
Cold-moist	42.17	0.24	0.63	0.00	3.40	0.00	0.00	0.00	211.26	6.76	0.11	0.00
Cold-dry	3863.18	0.19	51.41	15.64	148.12	0.00	1.74	3.15	4365.43	1.46	41.04	14.91
TOTAL	22219.26	297.76	318.36	60.87	3440.21	324.00	64.99	20.37	15437.30	410.80	148.01	75.13

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. The maturity cycle has been accepted as 30 years from the same table.

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. We did not consider any other emissions other than pruning because conversion from perennial crops to annual crops or clearing of perennial crops is very low according to expert judgement. In Turkey because of migration to big cities conversion of annual crops to perennial crops is very common, while some croplands are left unmanaged.

The area of annual crops and perennial crops are identified for climate and soil groups but the conversions could not be calculated due incompatibility of land areas.

7.3.5. Uncertainty and time series consistency

Uncertainty estimates for the period 1990–2009 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;

$$\% \text{ uncertainty} = \frac{\frac{1}{2}(4\sigma)}{\mu} \times 100 = \frac{2\sigma}{\mu} \times 100$$

The uncertainty of the activity data is around 50% according to expert judgment considering that 3 different databases (Statip, Corine 2000, Corine 2006 and 1980 Land Use Map) have been used.

The overall uncertainty is calculated as;

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

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

The whole data series for the activity data was replaced by the new activity data and carbon emissions/removals were recalculated. Recalculated area and CO_2 removals have been;

Table 7.23. Net carbon sequestration between the years 1990-2010

Years	Gg CO_2	Area (kHa)
1990	-11.583,03	2256.43
1991	-11.439,60	2228.49
1992	-11.296,18	2200.56
1993	-11.152,76	2172.62
1994	-11.009,34	2144.68
1995	-10.865,92	2116.74
1996	-10.722,50	2088.80
1997	-10.579,07	2060.86
1998	-10.435,65	2032.92
1999	-10.292,23	2004.98
2000	-10.211,81	1977.04
2001	-9.428,84	1824.47
2002	-8.665,08	1671.89
2003	-7.907,97	1519.32
2004	-7.332,20	1366.75
2005	-7.006,39	1214.17
2006	-5.655,48	1061.60
2007	-9.228,56	1757.99
2008	-12.774,53	2454.39
2009	-16.287,37	3150.78
2010	-19.891,10	3847.18

The changing trends are due to changing land area of Cropland remaining Cropland.

7.3.6. Category-specific QA/QC and verification

A new LULUCF working unit has just been established under Ministry of Nutrition, Agriculture and Livestock. This unit will be organized to have a QA/QC mechanism.

7.3.7. Category-specific recalculations

All values for Cropland remaining cropland have been recalculated based on the new spatial information.

7.3.8. Category-specific planned improvements

Activity data and methods used had not been provided for croplands remaining croplands in the last year's submission (2009). This year we tried to perform a basic but reasonable reporting. The reason is that the methodology has not been very well established yet. But in the next submission we work on to realize all criteria of reporting (TACCC).

The next submission will base on all land use changes of 6 land uses. The conversion to Croplands and all other land uses will be calculated. The 1980 land use map will be replaced by the finished Corine 1990 land use map. Therefore the land use database is going to be more consistent. There have been some inconsistencies between Corine system and STATIP system due to different land use classifications. This issue will be solved to have a more consistent land use change database.

We could not report flooded land in this submission because the land use prior to flooding was not known. We shall be able to account and report it in the next submission based on Corine and STATIP data. Even though not very significant for our country, emissions and removals from Peatland management will also be available in the next submission, too.

In the next submission range rehabilitation data and fertilization data will be available to calculate emissions and removals from soil stocks.

Finally, computation software is in the preparation phase for the next submission to standardize the accounting process.

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