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Review Report on Current Situation, Development Potential, Gap and Key Category Analysis

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AESA CONSORTIUM

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Abbreviations

AD: Activity Data

ARD: Afforestation/Reforestation/Deforestation

BR : Biennial Report

NC : National Communication

CBCCAM. Coordination Board on Climate Change and Air Management Development Organization

CO_2-eq: Carbon Dioxide Equivalent

COP: Conference of the Parties

CRF: Common Reporting Format

EF: Emission Factor

EU: European Union

FM: Forest Management

GDAR: General Directorate of Agriculture Reform

GDF: General Directorate of Forestry

GHG: Greenhouse Gas

IPCC: Intergovernmental Panel on Climate Change

KP: Kyoto Protocol

LULUCF: Land Use, Land-Use Change and Forestry

MoFW: Ministry of Forest and Water

MoEU: Ministry of Environment and Urbanization

MFAL: Ministry of Food, Agriculture and Livestock

MoSIT: Ministry of Science, Industry and Technology

MoTMC: Ministry of Transport, Maritime Affairs and Communications

MRV: Measurable, Reportable, Verifiable

NCCAP: National Climate Change Action Plan

NCCSD: National Climate Change Strategy Document

NIR: National Inventory Report

TurkStat: Turkish Statistical Institute

UNFCCC: United Nations Framework Convention on Climate Change

1. INTRODUCTION

LULUCF sector is one of the key sectors in fighting climate change in terms of both decay and conformity. Ecosystems have mechanisms for affecting the carbon dioxide (CO_2) content on earth and atmosphere which can be considered as one of the most important causes of climate change by means of structural elements such as plants, litter, dead wood and forest soils they contain.

Carbon storage status in forests and other ecosystems is largely determined by net primary production (NPP). The land use change in forest lands in the world for agricultural purposes causes a large amount of carbon is released into the atmosphere such as average $2x10^{15}$ gr (Richter et al., 1999). The fact that use of cropland accelerates organic matter decaying process may be considered as the reason for that. On the global scale, 81% of terrestrial carbon is stored in soil and the remaining 19% accumulate in above-ground and below-ground biomasses of the forest (Ravindranath and Ostwald, 2008). Due to these features, both forest ecosystems and soils have important functions in reducing the impacts of global warming. Carbon is retained in the soil in the form of humus and organic compounds. Although there is high level carbon input in mineral soil of the forest, carbon retention is limited especially in coarse textured soils and under low activity clay mineralization due to quick decay (Richter et al., 1999). Transformation duration of soil organic matter in above-ground vegetation is not as quick as the change in carbon levels in the soil. This situation has made measuring the change in soil carbon levels an important tool in determining the impacts of land use changes on climate change (Figure 1). In this process, the productivity of the soil may change the amount of carbon in the soils because of the reasons such as removal due to plant nutrition production and erosion, etc. According to SRES (IPCC 2000) report, it was emphasized that the carbon content in soil carbon pool has become stable 20 years later as a result of land use impacts. According to the same report, it was emphasized that the main reason of 136 Gt carbon emission between 1850 and 1998 was land use change. According to Le Quéré et al., (2016), global atmospheric CO_2 concentration has reached 399.4±0.1 ppm (1 ppm=2.12 GtC) by the end of 2015. The amount of carbon in the cycle may change between systems and atmosphere naturally as a result of the photosynthesis of plants, respiration of biotic beings, degradation on the soil levels and burning of elements containing carbon. The most important unnatural impact is that land use changes by people for various reasons cause that the amount of carbon accumulated in pools are changed with unnatural impacts. Le Quéré et al., (2016) emphasize that the increase was perceivable after the 1940’s in which the impacts of urbanization and industrialization was largely felt in parallel with the development of technology.

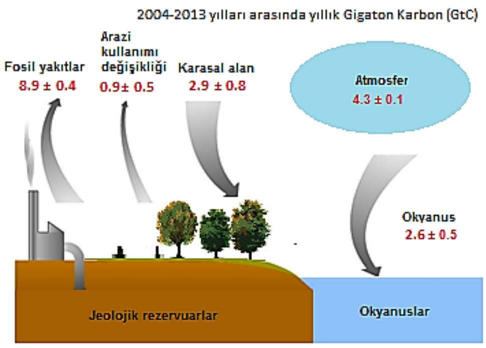

Figure 1. Carbon emission amounts caused by land use changes along with other factors (Sources: CDIAC, NOAA-ESRL, Le Quere *et al.*, 2016, Glbal Carbon Budget 2016: http://www.globalcarbonproject.org/carbonbudget/16/presentation.htm)

Especially when the situation of emissions caused by fossil fuels and industry is taken into consideration, the situation in CO_2 emission as of late 1940's can be seen in Figure 2. It was determined that there was a slight decrease in CO_2 emissions caused by land use changes as of late 1950's.

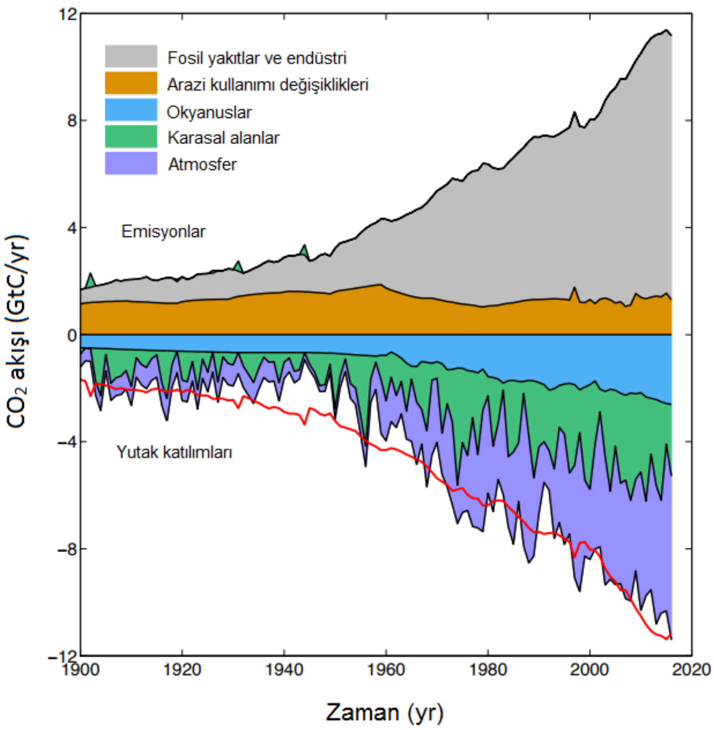

Figure 2. Global carbon budget (Le Quéré et al., 2016)

When years 2007-2016 are examined, it was stated that the share of fossil fuels and industry in CO_2 emission is 88%. The share of land use change is 12%. Although the amount of CO_2 in the atmosphere is 46% in the world, it was concluded that it is retained in terrestrial sinks at the rate of 30% and in seas and oceans at the rate of 24% (Le Quéré et al., 2016).

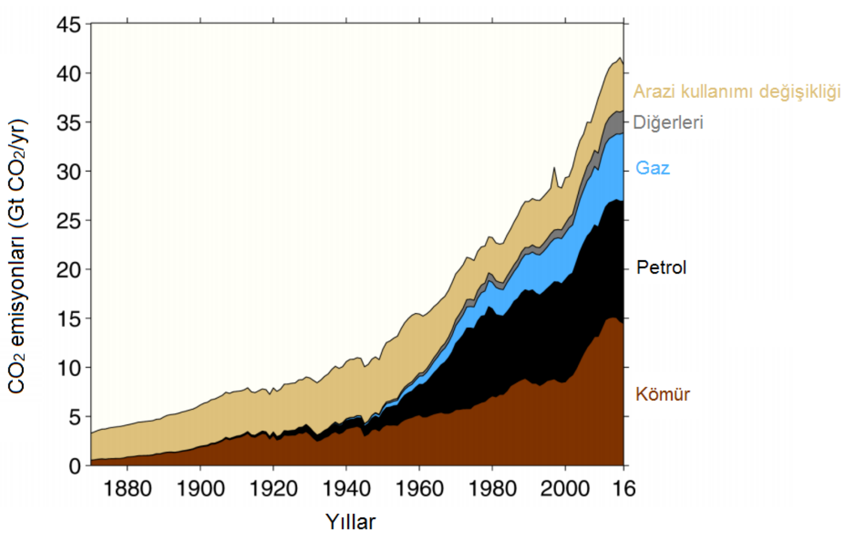

Figure 3. Emissions caused by land use change and fossil fuel use (Le Quéré et al., 2016)

It is seen that CO_2 emissions caused by land use change were more dominant than CO_2 emissions caused by fossil fuel use until 1990's (Figure 3).

Between 1873 – 2016, in the CO_2 emissions the share of land use was 31%, the share of coal was 32%, the share of petrol was 25%, the share of gas was 10% and the share of other emission sources was 3% (Le Quéré et al., 2016).

The amount of global carbon emission in atmosphere, oceans and terrestrial areas is calculated according to the following equation (Le Quéré et al., 2016):

$$E_{FF}+E_{LUC}=G_{ATM}+S_{OCEAN}+S_{LAND} \quad (1)$$

Here, E_{FF} = Emission as a result of fossil fuel use and cement production, E_{LUC}= Emission caused by land use change, G_{ATM} = Global atmospheric CO_2 concentration, S_{OCEAN} = Ocean sink, S_{LAND}= Terrestrial vegetation and soil sink. LUC sourced emissions reported in 2014 Carbon budget report include deforestation, afforestation, production (forest destruction and harvest activity), agricultural change (forest cutting cycle fore agriculture and then abandoning the area) and regrow of forests after forest harvest or CO_2 flows caused by abandoning croplands (Le Quéré et al., 2016). Therefore, E_{LUC} is the net sum of all anthropogenic activities taken into consideration.

According to the equation, it is seen that emission values caused by fossil resources and land use changes are offset with the CO_2 gas concentration in the atmosphere and CO_2 concentration retained in the sinks in terrestrial/ocean areas. Vegetation contains less carbon compared to 750 GT C amount in the atmosphere (approximately 600 Gt C) and it equals approximately to 60% of the carbon on surface ocean (1000 Gt) layers (Sarmiento and Gruber, 2002).

The determinant of the level of being impacted from the change in carbon flow is greenhouse effect which occurs especially as a result of the increase in CO_2 content in the atmosphere, which is the most important greenhouse gas accumulated in the atmosphere, along with other greenhouse gases. For example, forest fires are considered as important sources contributing in greenhouse effect as a result of both the decrease in the amount of carbon that can be stored due to decrease in sinks and the gases emitted during fire. Narayan et al. (2007) analyse the potential of prescribed burning techniques to reduce carbon dioxide (CO_2) emissions caused by forest fires and try to show quantitatively that it can be a tool for reducing net carbon emissions in the context of Kyoto Protocol.

McKechnie et al. (2014) Since it will be used in most of Annex-I countries during the next Kyoto Protocol Undertaking, special attention is paid to forest management reference level (FMRL). It was found that bioenergy generation reduces removal of forest carbon, but total cost may not be calculated and thus it may not cause emission in relation to an accountable AFOLU as long as the total forest harvest remains on the defined level below FMRL baseline in accordance with the FMRL approach. In AFOLU emissions calculated using gross-net approach, it was seen that previous method and natural disturbance were clearer compared to previous impacts.

Cole et al., (1997) have estimated that agriculture sector reduces average 1.15-3.3 Gt carbon equivalent per year. The same researchers have identified that approximately 32% of this reduction is from the reduction in CO_2 emissions, 15% from biofuel production, 16% from reduced methane (CH_4) gases and 10% from the reduction in N_2O emission. However, despite these reduction values, 77% of the terrestrial carbon is stored in forest lands and this rate is recorded roughly as twice the value in the atmosphere (Mantlana et al., 2009).

Serengil and Bouyer (2016) have estimated the amount of carbon retained in the Harvested Wood Products (HWP) category in National Greenhouse Gas Inventory according to LULUCF guidelines for the first time in Turkey. The calculation was made at the Tier 2. Using United Nations Economic Commission for Europe's (UNECE) HWP categories (sawnwood and wood-based panels) data for 1964-2013 period, 1976-2013 data and industrial roundwood production data of the General Directorate of Forestry were compared. A difference was found between the values obtained according to these two data. According to GDF's calculation, UNECE values were found +16% higher in average. The reason for that can be seen as the fact that UNECE data show unbarked values and GDF data show barked values and private sector is included in the data assessment system in UNECE data. Another important result of the study has presented that HWP pool may provide additional 3.14 Gg CO_2-eq $year^{-1}$ removal to LULUCF sector and Turkey's greenhouse gas inventory. In the study, it is estimated that emission values in 2020 as a result of two different cutting scenarios will be increased to 13.70 Mt CO_2-eq $year^{-1}$ (intensive cutting) and 10.99 Mt CO_2-eq $year^{-1}$ (extensive cutting).

Sivrikaya and Bozali (2012) have calculated the carbon based on below-ground and above-ground biomass in 1991 and 2002 at Kahramanmaraş province Türkoğlu Forest Sub-district Directorate using the method specified in FRA 2010 Guidelines (Anonymous, 2009). Total biomass amount was calculated as 272436.9 m^3 in 1991 and 324458.5 m^3 in 2002. It is thought that the reason of this increase is especially ecosystem based and multipurpose forest arrangement planning approach and Effective Sustainable Forest Management Applications.

1.1. LULUCF SECTOR CALCULATION ALGORITHMS

2006 IPCC Guidelines is drawn up to help national inventory reporting of estimations and anthropogenic greenhouse gas emissions and removals (IPCC, 2006). Stating that land use changes may cover all kinds of lands, the guidelines which is drawn up for ensuring consistency and completeness in estimation and reporting of greenhouse gas emissions and removals serve the purpose of improving current approaches. Published by IPCC in 2006, "IPCC Guidelines for National Greenhouse Gas Inventories" are published in 5 volumes. These are:

- General guidelines and reporting
- Energy
- Industrial processes and product use
- Agriculture, forestry and other land use
- Waste.

4th volume provides guidance for preparing annual greenhouse gas inventories for Agriculture, Forestry and Other Land Use (AFOLU) sector.

Our subject of study and the guidelines that we will take into consideration in practice is the 4th volume "Agriculture, Forestry and Other Land Use". For AFOLU sector, 'managed areas' concept has stood out for anthropogenic greenhouse gas emissions and removal in sinks. The managed area concept in the guidelines describes as the field on which human interventions and applications are present to fulfil production, ecologic or social functions (IPCC, 2006). For unmanaged areas, greenhouse gas emission / removal notifications are not necessary. However, the guidelines emphasize that measuring the area of unmanaged areas and monitoring it in time may be a useful practice for countries in order to maintain the consistency in area accounting when land use change occurs. Therefore, AFOLU sector involves matters such as;

- CO_2 emissions and removals as a result of carbon stock changes in biomass, dead organic matter and mineral soils for all managed areas,
- CO_2 and non-CO_2 emissions as a result of fires in all managed areas,
- N_2O emissions from all managed areas,

- CO_2 emissions in relation to liming and urea application on managed soils,
- CH_4 emissions caused by rice agriculture,
- CO_2 and N_2O emissions caused by cultivated organic soils,
- CO_2 and N_2O emissions caused by managed wetlands,
- CH_4 emission as a result of livestock (enteric fermentation),
- CH_4 and N_2O emissions caused by fertilizer management systems and
- Carbon stock change in relation to harvested wood products.

Following pools should be evaluated separately for each one of six land use categories which were specified before to create an inventory containing CO_2 and non-CO_2 greenhouse gas emissions and removals (Table 1).

Table 1. Pools used for land use categories and their descriptions

Pool		**Description**
Biomass	Above-ground biomass	All biomasses of both woody and herbaceous vegetation over the ground (including stems, branches, bark, seeds and leaves)
	Below-ground biomass	All biomasses of alive roots (fine roots below 2 mm diameter are mostly excluded from calculation, because mostly they cannot be distinguished experimentally from soil organic matter or litter).
Dead organic matter	Dead wood	It includes all dead woody biomass which is on the ground or soil and which does not contain litter. The diameter of dead wood, wood on the surface, dead roots and stems must be equal to or larger than 10 cm (or the diameter determined by the country).
	Litter	All non-living biomass which are larger than the soil organic matter limit (recommended 2 mm) and dead woody waste less than minimum diameter selected for dead wood which is being decomposed in or on mineral or organic soil (for example 10 cm) should be taken into consideration.
Soils	Soil organic matter[1]	In mineral soils, organic carbon on a certain depth level is selected by the country and it is implemented continuously during time series[2]. Living and dead fine roots and DOM (dead organic matter) in the soil is smaller than roots and minimum dimeter limit recommended for DOM (recommended 2 mm) and it is included in organic matters in the soil if it cannot be distinguished from them experimentally.

[1] Within the soil matrix, it contains organic material (living and non-living) which is defined operationally as a certain dimension fraction (for example, all matters which pass through a 2 mm sieve). If Tier 3 method is used for soil C stock estimations, soil may contain inorganic carbon. CO_2 emissions of liming and urea applications to soils are estimated using Tier 1 or Tier 2 method.

[2] For carbon stocks in organic soils, an open calculation cannot be made using Tier 1 or Tier 2 method which estimates annual carbon flow only from organic soils, but carbon stocks in organic soils can be estimated in a Tier 3 method.

In IPCC 2006 guidelines, Agriculture, Forestry and Other Land Uses category, which is evaluated as the 3rd category after 1. Energy and 2. Industrial Processes and Product Use among the categories included in 4th volume, is divided into three subcategories as 3A. Livestock, 3B. Area and 3C. Aggregate sources and non-CO_2 emission sources on Land. 3B. Area category is used to calculate the inventory caused by land use changes. As is known, the changes in land use and management affect the plant biomass and carbon in the soil. LULUCF sector investigate the impacts of conditions and reactions of the affected ecosystem in areas which do not contain a change in land use which leads to greenhouse gas emission (for example no change in use, for example in areas where forests remain as forest lands) and contain a land use change (for example grasslands or croplands converted to forest land). Calculation of land use and greenhouse gas emission / removal caused by land use is evaluated differently for each land category. These are given below with their abbreviations (Table 2).

Table 2. Land categories and subcategories used in inventory calculations

Subcategories of LULUCF 4 (CRF codes)	Subcategories / Abbreviations / CRF codes	Carbon pools
Forest lands (4.A)	Forest lands remaining forest land /FF/4.A.1	1. Biomass, 2. DOM (dead organic matter), 3. Soil
	Land converted to forest land /LF/4.A.2	
Croplands (4.B)	Croplands remaining cropland /CC/4.B.1	
	Land converted to cropland /LC/4.B.2	
Grasslands (4.C)	Grasslands remaining grassland /GG/4.C.1	
	Land converted to grassland /LG/4.C.2	
Wetlands (4.D)	Wetland remaining wetlands /WW/4.D.1	
	Land converted to wetlands /LW/4.D.2	
Settlements (4.E)	Settlement remaining settlements /SS/4.E.1	
	Land converted to settlements /LS/4.E.2	
Other land (4.F)	Other land remaining other land /OO/4.F.1	
	Land converted to other land /LO/4.F.2	
Harvested Wood Products (4.G)		

Methods used in AFOLU sector are supported with the calculation approach which is called three layered and tiers. In general, as the tier increases, the accuracy of the inventory is improved and uncertainty is decreased. However, the complexity and need for resources increases for calculations in higher tiers. In inventory calculations, calculation combinations containing separate tiers for each pool can be used. For example, Tier 2 for biomass and Tier 1 for soil carbon. The accuracy of the estimation varies depending on presence of current data other than the tier approach.

To select the suitable tier approach, following criteria are explained in IPCC 2006 guidelines. According to this:

Tier 1: It is designed to use the equations and default parameter values given in IPCC 2006 guidelines (for example emission and stock change factors) in the simplest way. Country specific activity data are required, but usually worldwide activity data estimation sources (deforestation rates, agricultural production statistics, global land cover maps, fertilizer use, livestock population data, etc.) can be used for Tier 1. However, such data may yield rough results in general.

Tier 2: Tier 2 may use the same methodological approach with Tier 1, but it implements emission and stock change factors which contain very important land use or livestock categories based on country or region specific data. Country defined emission factors are more suitable for climate regions, land use systems and livestock categories that the country are included in.

Tier 3: In Tier 3, higher level methods are used including models and inventory measurement systems based on activity data which are adapted to address national conditions, are repeated (monitored) in time and are high resolution and which are separated on sub-national level. These higher level methods provide more accuracy in estimations compared to lower layers. Such systems may contain age, class/production data, soil data and land use, management activity data and repeated field sampling at regular time intervals and/or based on CBS and various monitoring types may be integrated into the system. The lands on which land use change took place can be monitored at least statistically. In most cases, these systems are climate dependent and for that reason variability may be seen on annual basis.

For example, for selecting the suitable tier in forest lands, IPCC 2006 guidelines emphasize following approaches. According to this:

Tier-1: In areas where forest lands remain forest land or in biomass carbon pool, Tier-1 approach is not a key category. Country specific AD and EF (emission / removal factor) data are not required.

Tier-2: In areas where forest lands remain forest land or in biomass carbon pool, Tier-2 approach is a key category. Tier-2 is applied in situations where AD and EF country specific estimations are available.

Tier-3: In areas where forest lands remain forest land or in biomass carbon pool, Tier-3 approach is a key category. This approach requires dynamic models calibrated according to national conditions which allow direct calculation of biomass increase or detailed national forest inventory data which are supported with allometric equations. This application may vary from country to country due to the differences in inventory methods and forest conditions.

Depending on the changes in carbon stocks, estimation equations are developed in IPCC 2006 guidelines for each land use category for AFOLU sector emissions and removal of CO_2. Here, calculations are made separately for areas converted to a different land use as well as areas in which status did not change in land use category. Carbon stock changes are made with the following equation in general:

$$\Delta C_{AFOLU} = \Delta C_{FL} + \Delta C_{CL} + \Delta C_{GL} + \Delta C_{WL} + \Delta C_{SL} + \Delta C_{OL} \qquad (2)$$

Where,

ΔC = carbon stock change

Abbreviations of land uses are shown below:

AFOLU = Agriculture, forestry and other land uses
FL = Forest land
CL = Cropland
GL = Grassland
WL = Wetland
SL = Settlements
OL = Other lands

In other words, it is attempted to estimate carbon stock change for all layers or subdivisions of land stock (for example climate region, ecotype, soil type, management regime, etc.) for each land use category in AFOLU. Carbon stock changes in a layer are estimated by taking into consideration the carbon cycle processes among five carbon pools and by adding changes in all pools as in the following equation. In the guidelines, carbon stock changes in the soil can be distinguished according to the changes in carbon stocks in mineral soils and emissions from organic soils. Harvested wood products (HWP) are also included in the report as an additional pool.

$$\Delta C_{LUi} = \Delta C_{AB} + \Delta C_{BB} + \Delta C_{DW} + \Delta C_{LI} + \Delta C_{SO} + \Delta C_{HWP} \qquad (3)$$

Where,

ΔC_{LUi} = Carbon stock changes for a layer of land use category

Carbon pools are shown with the following subscripts:

AB = Above-ground biomass
BB = Below-ground biomass
DW = Dead wood
LI = Litter
SO = Soils
HWP = Harvested wood products

In the guidelines, estimating changes in carbon pools and fluxes are evaluated to be dependent on data and model availability and additional information collection and analysis resources and capacities (Figure 4). Table 1 shows which pool is related with which land use category for Tier-1 approach. However, depending on the country conditions and selected tier approach, stock changes may not be estimated for all pools shown in the above equation. For that reason, some simplifier approaches may be used for Tier-1 approach. For example, litter and dead wood pools can be evaluated together for Tier-1 or dead organic matter stocks are considered zero for non-forest land use categories under this approach.

According to IPCC (2006), carbon cycle involves changes in carbon stocks due to both continuous process (for example growing, decaying-degrading) and natural losses caused by fire, windstorms, insects, diseases, and other disturbances. While continuous processes may affect carbon stocks in all regions each year, disturbances cause emissions and ecosystem carbon is redistributed in certain areas (in other words, where the disturbance takes place) and within the year. Natural disturbances may have long term impacts such as wind-blown or decay of burnt trees.

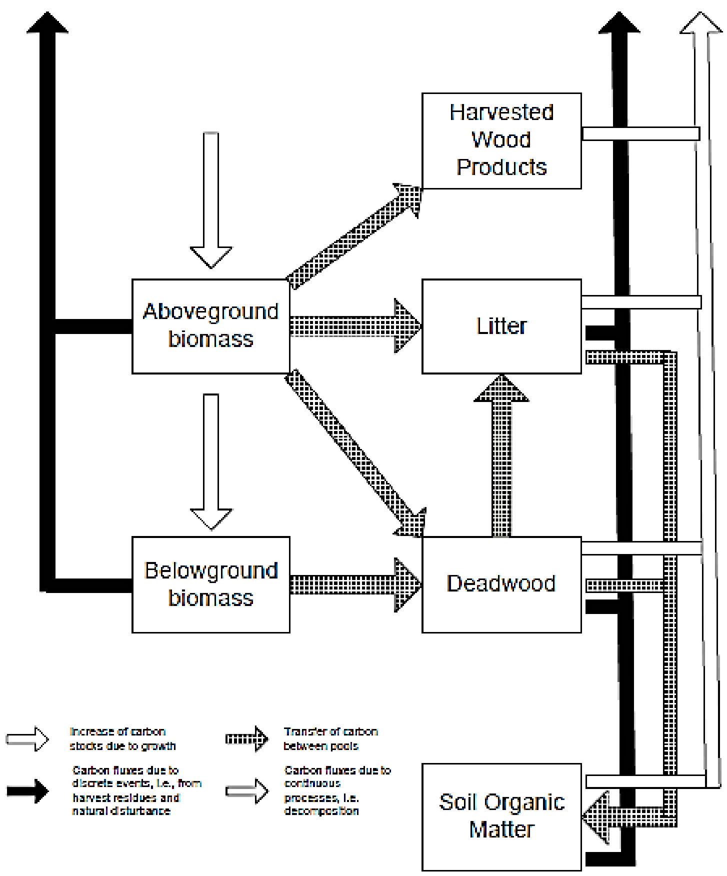

Figure 4. Generalized carbon cycle of terrestrial AFOLU ecosystems which shows carbon flow in and out of the system as well as five carbon pools within the system (IPCC, 2006).

Practically, Tier-1 assumes that all post-disturbance emissions (less removal of harvested wood products) as a part of impact incident, in other words as the year in which disturbances takes place. For example, instead of estimating the decay of dead organic matter left after an impact for a couple of years, all post-disturbance emissions are estimated within the year in which the incident takes place (IPCC, 2006).

1.1.1. Change in Above-ground and Below-ground Biomass Carbon Stocks

Annual carbon stock changes in any pool can be estimated using the process based approach in the following equation which determines Gain-Loss Method that can be applied to all carbon gains or losses. Gains may be related with growth (increase in biomass) and caused by another pool (for example, transfer of carbon from living biomass carbon pool to dead organic matter pool due to harvest or natural disturbances). In the guidelines, it is stated that carbon removal is transfer from atmosphere to pool and CO_2 emissions are transfer from pool to atmosphere. Losses are categorized as losses caused by natural disturbances on managed lands such as cutting down or harvest, collecting fuelwood and fire, insect epidemics and extreme weather conditions (for example, hurricanes, flood).

$$\Delta C = \Delta C_G - \Delta C_L \quad (4)$$

Where;

ΔC = Annual carbon stock change in pool, ton C yr^{-1}
ΔC_G = Annual carbon gain, ton C yr^{-1}
ΔC_L = Annual carbon loss, ton C yr^{-1}

Gains are always marked with a positive (+) sign. Losses may be evaluated as carbon transfers from one pool to the other (for example, carbon during harvest operation is a loss caused by above-ground biomass pool) or decay, harvest, burning, etc. are always marked with a negative (-) sign.

Approach of Gain-Loss method based on an alternative stock is shown in the following equation (a). In this method which is called as stock change, it is calculated by measuring carbon stocks in related pools on two points in time for evaluating carbon stocks. In some cases, primary data about biomass can be in the form of wood volume data obtained from forest studies. This situation is shown in equation (b) and it is calculated with factors required for converting wood volume to carbon mass.

$$\Delta C = (C_{t2}-C_{t1})/(t2-t1) \quad (5a)$$

and

$$C = \sum_{i,j} \left\{ A_{i,j} x\, V_{i,j} x BCEF_{S_{i,j}} x \left(1 + R_{i,j}\right) x CF_{ij} \right\} \quad (5b)$$

Where,

ΔC = Annual carbon stock change in pool, tonnes C yr^{-1}
C_{t1} = Carbon stock in the pool in t1 time, tonnes C
C_{t2} = Carbon stock in the pool in t2 time, tonnes C
C = Total carbon in biomass from t2 time to t1 time
A= area of land remaining in the same land-use category, ha
V = merchantable growing stock volume, m^3 ha^{-1}
i = i ecologic zone (i = 1 to n)
j = j climate region (j = 1 to m)

R = rate of below-ground biomass to above-ground biomass, ton d.m. below-ground biomass (tonnes d.m. above-ground biomass) $^{-1}$
CF = carbon fraction of dry matter, tonnes C (tonne d.m.)$^{-1}$
$BCEF_S$= coefficient of converting stem wood volume to above-ground mass and expanding.

If carbon stock changes are estimated per hectare, this value is multiplied by total area of each layer to obtain the total stock change estimation of the pool. In some cases, activity data may be in the form of country sums (for example, harvested wood); in that case stock change estimations for the pool in question can be estimated directly from activity data after suitable factors are applied to convert into carbon mass.

Non-CO_2 emissions are obtained from various sources such as soil, animal and fertilizer emissions and biomass, dead wood and litter burning. In opposition to estimating CO_2 emissions from biomass stock changes, estimation of non-CO_2 greenhouse gases generally contains an emission rate which spreads directly into the atmosphere from a source.

The ratio (following equation) generally can be determined as an emission factor for a specific gas (for example, CH_4, N_2O) and source category and as an area (for example, for soil or area burning), population (for example, for livestock) or mass (for example, biomass defining emission source of fertilizer) (IPCC, 2006).

$$\text{Emission} = AD \times EF \qquad (6)$$

Where,

Emission = non-CO_2 emissions, tones of non-CO_2 gases

AD = Activity data in relation to emission source (it can be area, number of animals or mass unit depending on source type)
EF = Emission factor for a specific gas and source category, tonnes per unit A

Most of non-CO_2 greenhouse emissions are either related with a certain land use (for example CH_4 emissions from rice) or typically estimated from total data on national level (for example, CH_4 emissions obtained from farm animals and N_2O emissions from managed soils).

In cases where an emission source is related with a single land use, this emission methodology is explained in the related section in IPCC 2006 guidelines for the land use category in question (for example, methane obtained from rice in Chapter 5 in Cropland). Based on compositional data in general, emissions are addressed in different chapters in the guidelines (for example, Chapter 10 for emissions in relation to livestock and Chapter 11 on N_2O emissions from managed soils and CO_2 emissions from liming and urea applications).

With the purpose of reporting, changes in carbon stock categories (includes transfers to atmosphere) can be converted to CO_2 emissions by multiplying C stock change with - 44/12. Here, 44/12 is evaluated as the rate of molecular weights in conversion from C to CO_2 (IPCC, 2006).

Following equation is used to estimate annual increase in biomass carbon stocks (ΔC_G) using Gain-Loss Method:

$$\Delta C_G = \sum_{i,j}(A_{i,j}\, x G_{TOTAL_{i,j}} x\, CF_{i.j}) \qquad (7)$$

Where,

ΔC_G = annual increase in biomass carbon stocks due to biomass growth in land remaining in the same land category by vegetation type and climatic zone, ton C yr^{-1}
A = area of land remaining in the same category, ha
G_{TOTAL} = mean annual biomass growth, tonnes dry matter ha^{-1} yr^{-1}
ijk = i climate type relation, j forest type, k management application, etc.
i = ecologic zone, (i=1 to n)
j = climate zone, ton (i=1 to m)
CF = dry matter carbon fraction, tonnes C (tonne d.m.)$^{-1}$

G_{TOTAL} is total biomass increase expanded from above-ground biomass increase containing above-ground biomass increase. G_{TOTAL} is calculated according to the following equation.

For Tier 1, $G_{TOTAL} = \sum\{G_W\ x\ (1+R)\}$ (Biomass increment data – dry matter is directly used) (8)

For Tier 2-3, $G_{TOTAL} = \sum\{I_W\ x\ BCEF_I x(1+R)\}$ (Net annual increment data, used to estimate GW by applying biomass conversion and expansion coefficient) (9).

Where,

G_{TOTAL} = average annual biomass growth above and below-ground, tonnes dry matter ha^{-1} yr^{-1}
G_W = average annual above-ground biomass growth for a specific woody vegetation type, tonnes dry matter ha^{-1} yr^{-1}
R = ratio of below-ground biomass to above-ground biomass for a specific vegetation type, in tonnes d.m. below-ground biomass (tonne above-ground d.m. biomass)$^{-1}$. R can be set to zero if assuming no changes of below-ground biomass allocation patterns (Tier 1)
I_V = average net annual increment for specific vegetation type, m^3 ha^{-1} yr^{-1}
$BCEF_S$= biomass conversion and expansion factor for conversion of net annual increment(including bark) to above-ground biomass growth for specific vegetation type, tonnes above-ground biomass growth (m^3 net annual increment)$^{-1}$

Following equation is used to estimate annual decrease in biomass carbon stocks (ΔC_L) caused by losses using Gain-Loss Method:

$$\Delta C_L = L_{W.} + L_F + L_D \qquad (10)$$

Where,

ΔC_L = annual decrease in carbon stocks due to biomass loss in land remaining in the same land category, tonnes C yr^{-1}
L_W = annual carbon loss due to wood removals, tonnes C yr^{-1}
L_F = annual biomass carbon loss due to fuelwood removals, tonnes C yr^{-1}
L_D = annual biomass carbon losses due to disturbances (forest fires, insect and fungi damages), tonnes C yr^{-1}.

L_W is calculated using the following equation:

$$L_{W.} = \{H x BCEF_R x(1+R) x CF\} \qquad (11)$$

Where,

L_W= annual carbon loss due to biomass removals, tonnes C yr^{-1}
H = annual wood removals, roundwood m^3 yr^{-1}
R = ratio of below-ground biomass to above-ground biomass, in tonnes d.m. below-ground biomass (tonne above-ground d.m. biomass)$^{-1}$
CF = carbon fraction of dry matter, tonnes C (ton d.m.)$^{-1}$

$BCEF_R$= biomass conversion and expansion factor for conversion of removals in merchantable biomass to total biomass removals (including bark), tonnes biomass removal (m^3 of removals)$^{-1}$

Not: $BCEF_R$ is found by dividing $BCEF_S$ by 0.9.

L_F is calculated using the following equation.

$$L_F = \left[\{FG_{trees} x BCEF_R x(1+R)\} + FG_{piece} x D\right] x CF \qquad (12)$$

Where,

L_F = annual carbon loss due to fuelwood removals, tonnes C yr^{-1}
FG_{trees} = annual volume of fuelwood removal of whole trees, m^3 yr^{-1}
FG_{part} = annual volume of fuelwood removal as tree parts, m^3 yr^{-1}
R = ratio of below-ground biomass to above-ground biomass, in tonnes d.m. below-ground biomass (tonne above-ground d.m. biomass)$^{-1}$ R can be set to zero if assuming no changes of below-ground biomass allocation patterns. (Tier 1)
CF = carbon fraction of dry matter, tonnes C (tonne dry matter)$^{-1}$
D = wood density, ton d.m. m^{-3}
$BCEF_R$= biomass conversion and expansion factor for conversion of removals in merchantable biomass to biomass removals (including bark), tonnes biomass removal (m^3 of removals)$^{-1}$

L_D is calculated using the following equation.

$$L_D = \{A_D x\ B_W x\ (1+R) x CF x f d\} \qquad (13)$$

Where,

L_D= annual other losses of carbon, tonnes C yr^{-1}
A_D= area affected by disturbances, ha yr^{-1}
B_W = average above-ground biomass of land areas affected by disturbances, tonnes dm ha^{-1}
R = ratio of below-ground biomass to above-ground biomass, in tonnes d.m. below-ground biomass (tonne above-ground d.m. biomass)$^{-1}$ R can be set to zero if no changes of below-ground biomass are assumed. (Tier 1)
CF = carbon fraction of dry matter, tonnes C (tonnes d.m)$^{-1}$
fd = fraction of biomass lost in disturbance (fd parameter defines the rate of biomass lost from biomass pool: for example, the biomass rate lost due to insect effect is taken into consideration as fd = 0.3).

1.1.2. Change in Carbon Stocks in Dead Organic Matter

According to IPCC 2006 guidelines, Tier 1 approach assumes that the change in carbon stocks in dead wood and litter pools did not take place in time in areas where land use category status did not change. However, countries may use higher tier methods to estimate the carbon dynamics of dead organic matter (DOM). Countries which use Tier 1 method to estimate DOM pools in areas where the status remains the same report the change in these carbon stocks from these pools or the changes in the carbon emissions as zero. Together with this rule, for example CO_2 emissions from burning of dead organic matter during forest fire and increases in dead organic matter carbon stocks are not reported in the years following the fire. However, non-CO_2 gas emissions from burning of DOM pools are reported. For estimation of carbon stock changes in DOM pools, Tier 2 approach calculates changes in dead wood and litter carbon pools. The equation used in this calculation is shown below:

$$\Delta C_{DOM} = \Delta C_{DW} + \Delta C_{LT} \qquad (14)$$

Where,

ΔC_{DOM} = annual change in carbon stocks in dead organic matter (includes dead wood and litter), tonnes C yr^{-1}

ΔC_{DW} = change in carbon stocks in dead wood, tonnes C yr^{-1}
ΔC_{LT} = change in carbon stocks in litter, tonnes C yr-1

In dead organic matter calculation, Gain-Loss Method and Stock change methods may also be used in estimating either stock input-output estimations or the difference in DOM pools at two points in time.

According to Gain-Loss method, annual change of carbon stocks in litter and dead wood is calculated using the following equation:

$$\Delta C_{DOM} = A \; x \; \{(DOM_{in} - DOM_{out}) \; x \; CF\} \qquad (15)$$

Where,
ΔC_{DOM} = annual change in carbon stocks in the dead wood/litter pool, tonnes C yr^{-1}
A = area of managed land, ha
DOM_{in} = average annual transfer of biomass into the dead wood/litter pool due to annual processes and disturbances, tonnes d.m ha^{-1} yr^{-1}
DOM_{out} = average annual decay and disturbance carbon loss out of dead wood or litter pool, tonnes d.m. ha^{-1} yr^{-1}
CF = carbon fraction of dry matter, tonnes C (tonne d.m.) $^{-1}$

Tier 2 and 3, in addition to estimation of transfer and decay rates, estimation of activity data such as harvest, natural impacts and the impacts of these impacts on DOM pool dynamics are also required.

According to stock change method, annual change of carbon stocks in litter and dead wood is calculated using the following equation:

$$\Delta C_{DOM} = \left[A \; x \frac{(DOM_{t2} - DOM_{t1})}{T}\right] x \; CF \qquad (16)$$

Where,
ΔC_{DOM} = annual change in carbon stocks in dead wood or litter, tonnes C yr^{-1}
A = area of managed land, ha
DOM_{t1}= dead wood/litter stock at time t1 for managed land, tonnes d.m. ha^{-1}
DOM_{t2}= dead wood/litter stock at time t2 for managed land, tonnes d.m. ha^{-1}
T = (t2 – t1) = time period between time of the second stock estimate and the first stock estimate, yr
CF = carbon fraction of dry matter (default = 0.37 for litter), tonnes C (tonne d.m.) $^{-1}$

Total carbon in biomass transferred to dead organic matter (DOM_{in}) is calculated using the following equation:

$$DOM_{in} = \{L_M + L_S + (L_D \; x \; f_{BLol})\} \qquad (17)$$

Where,
DOM_{in} = total carbon in biomass transferred to dead organic matter, tonnes C yr^{-1}
L_M = annual biomass carbon transfer to DOM due to mortality, tonnes C yr^{-1}
L_S = annual biomass carbon transfer to DOM as slash, tonnes C yr^{-1}
L_D = annual biomass carbon loss resulting from disturbances, tonnes C yr^{-1}
f_{Blol} = fraction of biomass left to decay on the ground (transferred to dead organic matter) from loss due to disturbance.

According to IPCC (2006) guidelines, mortality refers to a situation arising from competition in which stand development stages, age, diseases and other processes are not included as impacts. When higher calculation tiers are used, mortality should not be neglected. Especially on Tier 2 and Tier 3, annual biomass carbon transfer to mortality related DOM (L_M) is calculated using the following equation:

$$L_M = \sum(A \ x \ G_W \ x \ CF \ x \ m) \qquad (18)$$

Where,
L_M = Annual biomass carbon loss due to mortality, tonnes C yr^{-1}
A = area of forest land remaining forest land, ha
G_W = above-ground biomass growth, tonnes dm ha^{-1} yr^{-1}
CF = carbon fraction of dry matter, tonnes C (tonne dm)$^{-1}$
m = mortality rate expressed as a fraction of above-ground biomass growth, yr^{-1}

Mortality rates vary among stand development stages and reaches peak level in stem exclusion phase. In addition, these are also closely related to stocking level, forest type, management intensity and impact history.

Harvest residues are biomass transfer caused by total annual carbon loss due to wood production and evaluated as production and fuelwood residues. Annual biomass transfer to cut residue related DOM is calculated using the following equation:

$$L_S = [\{H \ x \ BCEF_R x \ (1 + R)\} - \{H \ x \ D\}] \ x \ CF \qquad (19)$$

Where,
L_S = annual carbon transfer from above-ground biomass to slash, including dead roots, tonnes C yr^{-1}
H = annual wood harvest (wood or fuelwood removal), m^3 yr^{-1}
$BCEF_R$ = Biomass conversion and expansion factors applicable to wood removals, which transforms merchantable volume of wood removal into above-ground biomass removals. If $BCEF_R$ values are not available and if BEF_R and basic wood density (D) values are separately estimated then the following conversion can be used.

$$BCEF_R = BEF_R \ x \ D \qquad (20)$$

BEF_R = biomass expansion factor, non-dimensional
D = the basic wood density tonnes dm m^{-3}

R = ratio of below-ground biomass to above-ground biomass, in tonnes d.m. below-ground biomass ((tonne above-ground d.m. biomass)$^{-1}$. R can be set to zero if root biomass increment is not included in equation 5a and 5b, R should be set to zero.
CF = carbon fraction of dry matter, tonnes C (tonne dm)$^{-1}$

Collection of fuelwood including production of living tree pieces does not produce any additional biomass input to dead organic matter pools. Inventories using higher tiers are able to calculate the amount of logging slash remaining after harvest by defining the above-ground biomass rate after the harvest.

1.1.3. Change in Carbon Stocks in Soils

According to IPCC (2006) guidelines, although there are organic and inorganic carbon forms are present in the soils, it can be said that land use and management typically have a larger impact on organic carbon stocks. Therefore, methods mentioned in IPCC (2006) guidelines mostly focus on soil organic carbon. Al least 12 to 20 percent of organic soils (for example peat and muck) depending on mass contain organic matters. Other soils are classified as mineral soils and these have relatively lower amounts of organic matters which typically take place in medium to well-draining conditions and are dominant in most ecosystems other than wetlands. Mineral soils are carbon pools affected by land use and management activities. In these soils, soil organic carbon stocks may change if the net balance between carbon input and carbon loss in the soil fundamentally by means of management or disturbance. Decomposition affected by climate and edaphic factors controls carbon outputs in soils to a large extent. The level of soil impacts caused by management activity can be added to these factors. For example, the changes may occur in soil organic carbon storage by land use change and changing the erosion rates. Carbon dynamic of organic carbons is closely related to hydrologic conditions which include current humidity in soils, depth of water table and reduction oxidation conditions and to plant type composition and litter status of these plant types (IPCC, 2006).

In IPCC (2006) guidelines, following equation is shown to estimate total change in soil carbon stocks:

$$\Delta C_{Soils} = \Delta C_{Mineral} - L_{Organic} + \Delta C_{Inorganic} \qquad (21)$$

Where,

ΔC_{Soils} = annual change in carbon stocks in soils, tonnes C yr^{-1}
$\Delta C_{Mineral}$ = annual change in organic carbon stocks in mineral soils, tonnes C yr^{-1}
$L_{Organic}$ = annual loss of carbon from drained organic soils, tonnes C yr^{-1}
$\Delta C_{Inorganic}$ = annual change in inorganic carbon stocks from soils, tonnes C yr^{-1} (assumed to be 0 unless using a Tier 3 approach).

According to IPCC (2006) guidelines, soil organic carbon stocks in mineral soils are calculated according a default 30 cm depth for Tier 1 and 2. If data is available, larger depth levels can be selected and thus Tier 2 can be used. Litter carbon stocks should not be included in calculation, because they are included in calculations separately. Stock changes in organic soils are based on emission factors which represent annual organic C loss along the profile due to draining. Annual carbon stock change rates in mineral soils are estimated as the difference between stocks at two points depending on the time of stock change factors. This estimation equation is shown below:

$$\Delta C_{mineral} = \frac{(SOC_0 - SOC_{(0-T)})}{D} \qquad (13)$$

$$SOC = \sum_{C,S,i}\left(SOC_{REF_{c,s,i}} x\ F_{LU_{c,s,i}}\ x\ F_{MG_{c,s,i}} x\ F_{I_{c,s,i}} x\ A_{c,s,i}\right) \qquad (14)$$

Where,

$\Delta C_{Mineral}$ = annual change in carbon stocks in mineral soils, tonnes C yr^{-1}
SOC_0 = soil organic carbon stock in the last year of an inventory time period, tonnes C ha^{-1}
$SOC_{(0-T)}$ = soil organic carbon stock at the beginning of the inventory time period, tonnes C ha^{-1}
T = number of years over a single inventory time period, yr
D = Time dependence of stock change factors which is the default time period for transition between equilibrium SOC values, yr
c = represents the climate zones, s the soil types, and i the set of management systems that are present in a country.
SOC_{REF}= the reference carbon stock, tonnes C ha^{-1}
F_{LU} = stock change factor for land-use systems or sub-system for a particular land-use, dimensionless
F_{MG} = stock change factor for management regime, dimensionless
F_I = stock change factor for input of organic matter, dimensionless
A = land area of the stratum being estimated, ha. All land in the stratum should have common biophysical conditions (i.e., climate and soil type) and management history over the inventory time period to be treated together for analytical purposes.

In organic soils, draining status stimulates the oxidation of the organic matter created in a largely anoxic environment. The acreage of drained and managed organic soils under every climate type is multiplied by the related emission factor to obtain an estimation of annual CO_2 emissions (IPCC, 2006). This equation is shown below:

$$L_{organic} = \sum_c (A \ x \ EF)_c \qquad (15)$$

Where,

$L_{Organic}$ = annual carbon loss from drained organic soils, tonnes C yr^{-1}
A = land area of drained organic soils in climate type c, ha
EF = emission factor for climate type c, tonnes C ha^{-1} yr^{-1}

All detailed explanations about calculations are available in IPCC (2006) guidelines. Other than the calculations above considering CO_2 gas, the guidelines also include calculations for non-CO_2 gases. In addition, the guidelines include an additional section for inventories to be obtained using Tier 3.

2. THE EXISTING ACTIVITY DATA RESOURCES

In UNFCCC official internet site, activity data are defined in this way: They are data relating with the size of human activities ending up with emissions or extractions occurring in a certain time period. Carbon stock change is obtained by multiplying carbon stock change occurring in a unite area and the area size. For gases other than CO_2, existence of special emission factors for the gas being considered is required. Emission quantity is obtained by multiplying emission factor with activity data. In the calculations activity data specific to the country are needed. But although rough results are also provided with activity data prediction sources at global scale being specified in IPCC (2006) guide (for example nonforesting ratios, agricultural production statistics, global land cover maps, usage of fertilizers, data relating with grassland animal populations) , they can be used for Tier 1. At Tier 2 activity data being more differentiated with more detailed time cycle and spatial resolution corresponding to coeffients being defined for regarding country specific regions and special land use or livestock categories. At Tier 3 activity data being more detailed when compared with Tier 2 and having high resolution as including detailed works at regional scale within the country and being obtained as a result of such studies are being used. As it is gone from Tier 1 to Tier 3 the need for detailed data increases. Therefore Tier 3 contains upper level methods and modelling and it may contain models that can make more precise predictions. As connections between parameters regarding activity data that will be used at Tier 3 are more solid, with a CBS database system impacts of land usage can be monitored for a long period.

Area sizes being required for CO_2 emission and removal calculations from land usage categories can be realized with activity data. Influence of each relevant activity on carbon stocks is determined as per unit area. This impact is multiplied with the area where each event takes place. Another particular which should not be forgotten her is that IPCC provides guidance by also considering the managed areas and areas that are not managed and which have underwent changes due to anthropogenic impacts. For example for agricultural areas as activity data enteric fermentation, for fertilizer management implementations farm animal populations per animal categories in the farms, mineral fertilizer (nitrogen) spreading on agricultural soil, agricultural products, percentage of burned agricultural areas and similar data can be evaluated (Bellasen and Stephan, 2015).

In grassland areas carbon stock changes are influenced disturbances such as human activities, harvesting of wooden biomass, degradation of grassland areas, grazing, fires, wrongly grassland management etc. Soil organic carbon and root biomass play dominant roles at grassland areas as under soil biomass. Conant and Paustian (2004) state that activity data relating with grassland management are gathered less frequently and with a more rough scale when compared with data relating with forest or agricultural inventories. Same researchers state that due to limited information regarding grassland areas, carbon dynamics limit the evaluation potential for vertical changes and changes in management plan.

Wet areas consist of soils being covered or saturated with water all throughout or during part of the year as not being within other categories or forests. It is stated in the guide that differentiation should be made between wetlands being managed or not being managed for greenhouse gas inventory on these lands. It is known that on these lands especially greenhouse gases such as CO_2, CH_4 and N_2O create emissions.

Regarding urban areas, it is stated that trees being included in urban tree formations and rural settlement areas are included in the guide. Regarding areas being transformed to urban areas guide provides methodology for predicting CO_2 emissions.

Other land include all areas not being managed and not being included in usage category (bare soil, rock, ice, other lands).

Certain information that will be used as activity data can be obtained from various institutions. For example mineral soil type can be found by using schemes based on USDA classification taxonomy and WRB (World Reference Base) classification. Ecological zones can be obtained from internet address of http://www.fao.org and obtained from schemes in Figure 5.1 and Figure 6.1 being placed in IPCC (2006) guide and from Table 5.4.

Some of the existing resources that can be evaluated as activity data are given below.

2.1. INTERNATIONAL ACTIVITY DATA RESOURCES

2.1.1. IPCC climate type map

For Tier 1 first of all country should be evaluated with climate, ecosystem, soil, and management implementation categories. For this purpose from the guide IPCC major climate zones map (Figure 5) and climatic regions classification scheme can be used. On this scheme, by using parameters such as elevation, average annual temperature, average annual precipitation, and potential evapotranspiration ratios, climate zone of a place can be determined.

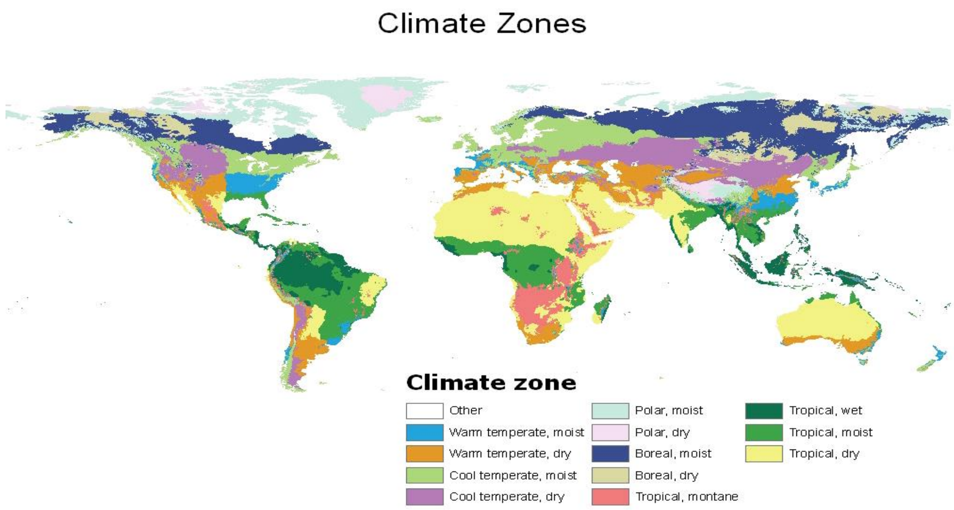

Figure 5. Major climate zones (IPCC, 2006)

According to this map it is seen that Turkey includes warm temperate-dry, cool temperate-moist and cool temperate-dry type of climate zones.

2.1.2. CORINE land map

For AKAKDO sector changes in land usage bear vital importance. For determining activity data calculating human influenced emission/removal for a certain period, area sizes of different land usage situations come to the forefront. Because emission/removal values relating with forest, agricultural, grassland, wetlands and urban areas show variations. Besides it is obvious that the more updated the land usage situation is, the lower the mistakes relating with emission/removal calculations would be. CORINE Land Cover (CLC) studies bear a significant place. CORINE (Coordination of Information on the Environment – Environmental information order), was developed by European Union Committee (CEC) for gathering all lands in EU member countries under a common classification. This remote sensing method which is developed in 1985 and which is gained to literature in 1990, has been udated in years 2000, 2006 and 2012 and it can create land cover inventory in 44 classes. According to EEA (2007), smallest mapping unit of CLC is 25 ha and it is seen that information is gathered at three different hierarchical levels. It is seen that at 3rd level information is gathered at 44 classes with a scale of 1/100000 (Table 3). Technological changes has enabled for resolution in satellite images to be reduced to cm levels. But for CLC a mapping unit of 25 ha is still accepted as a high value for mapping. Koca et al. (2008) have stated that CORINE application which generally used Landsat data had difficulty in differentiating classes of 2.2.3. Olive gardens and 2.4.4. cropland being mixed with forest and that working with satellites such as QuickBird and Ikonos having high capacity for differentiating would enable a more correct assessment.

Table 3. CORINE Land Cover (CLC) nomenclature

Level 1	Level 2	Level 3
1. Artificial surfaces	1.1. Urban fabric	1.1.1. Continuous urban fabric 1.1.2. Discontinuous urban fabric
	1.2. Industrial, commercial and transport units	1.2.1 Industrial or commercial units 1.2.2 Road and rail networks and associated land 1.2.3 Port areas 1.2.4 Airports
	1.3 Mine, dump and construction sites	1.3.1 Mineral extraction sites 1.3.2 Dump sites 1.3.3 Construction sites
	1.4 Artificial, non-agricultural vegetated areas	1.4.1 Green urban areas 1.4.2 Sport and leisure facilities
2. Agricultural areas	2.1 Arable land	2.1.1 Non-irrigated arable land 2.1.2 Permanently irrigated land 2.1.3 Rice fields
	2.2 Permanent crops	2.2.1 Vineyards 2.2.2 Fruit trees and berry plantations 2.2.3 Olive gardens
	2.3 Pastures	2.3.1 Pastures
	2.4 Heterogeneous agricultural areas	2.4.1 Annual crops associated with permanent crops 2.4.2 Complex cultivation patterns 2.4.3 Land principally occupied by agriculture, with significant areas of natural vegetation 2.4.4 Agroforestry lands
3. Forest and semi-natural areas	3.1 Forests	3.1.1 Broad leafed forests 3.1.2 Needle leaved forests 3.1.3 Mixed forests
	3.2 Scrub and/or herbaceous vegetation associations	3.2.1 Natural grasslands 3.2.2 Moors and heathland 3.2.3 Sclerophyllous vegetation 3.2.4 Transitional woodland-shrub
	3.3 Open spaces with little or no vegetation	3.3.1 Beaches, dunes, sands 3.3.2 Bare rocks 3.3.3 Sparsely vegetated areas 3.3.4 Burnt areas 3.3.5 Glaciers and perpetual snow
4. Wetlands	4.1 Inland wetlands	4.1.1 Inland marshes 4.1.2 Peat lands
	4.2 Maritime wetlands	4.2.1 Salt marshes 4.2.2 Salines 4.2.3 Intertidal flats
5. Water bodies	5.1 Inland waters	5.1.1 Water courses 5.1.2 Water bodies
	5.2 Sea waters	5.2.1 Coastal lagoons 5.2.2 Estuaries 5.2.3 Sea and oceans

Some national studies being conducted from various satellite images for determining land covers in CLC or outside CLC are presented below.

Doygun et al, (2012), have investigated changes in land usages occurring in 8 classes being urban, agricultural, forest, scrubs, herbaceous, salterns, salt marshes, water masses and others within district of Cigli. According to the research it is seen that urban and industrial areas expended to folds within 25 years time. Besides due to afforestation works being done for drying marshy areas, area of forests has increased 7 times (Forest $areas_{1984}$= 35.64 ha, Forest $areas_{2009}$ = 234.81 ha). According to analysis of year 2009, due to structuring, agricultural (Agricultural $area_{1984}$= 1426.68 ha, Agricultural $area_{2009}$ = 590.76 ha) and afforestation activities, areas of salty marshes have reduced by %50 in year 1984.

According to Atesoglu, (2016) on two separate test areas being situated in Western Black sea and Middle Anatolian regions verification evaluation was done by means of CORINE-2006 land cover data and high resolution Google Earth data. When 5000 points being randomly selected from Google-Earth are controlled with CORINE land cover data, It has been determined that for the test area being situated in Western Black Sea Region, verification ratio with CORINE-2006 data was %51.80 and that verification ratio for test area being situated in Middle Anatolian-Aegean region was %55.32. Therefore according to the outcome of research it was found out that CORINE-2006 data was not updated and that verification values of data were low.

In the study they conducted on a study area near the city of Samsun, Dengiz and Turan, (2014) have investigated land usage effectiveness by using archive data for year 1984 in the provincial inventory of Samsun, topographical maps and ASTER satellite images for years 2005. For the classification process, four main land covers and land usage class have been formed in ENVI 5.0v program and land survey has been conducted for controlling the classes being formed. Land usage types being specified by using land usage types for year 1984 and land usage types being determined by using satellite images for years 2005 and 2011 have been compared with land usage capability classes. When compared with year 1984, it is seen that croplands decreased nearly 2.5 folds in 2005 and that agriculture areas decreased by 4 folds in 2011.

In the study they conducted Doygun et al (2014) tried to determine the changes occurring on Kahramanmaras – Ahir Mountain plant cover by spot satellite image with 20 m resolution belonging to year 1986 and Rapid satellite image with “red edge” band as being more effective in vegetation mapping and having 6,5 m resolution for year 2013. An increase of %2.5 is determined in coniferous forest groups and a decrease of %8 is determined in broad leaved forests. In cultivated lands a decrease of %12 is seen, in areas with continuous products an increase of %6 is seen and in urban areas an increase of %4.5 is seen.

Kara and Karatepe (2012) have tried to determine the changes in land usages in the district of Beykoz by using Landsat satellite images for years 1986 and 2011 and by using thematic. According to the outcome of research, it has been calculated that in 1986 areas with broadleaf forests were 1596 hectares more when compared with 2011 and that areas of coniferous forest areas were 6180 hectares in 1986 and that these areas were 6005 hectares in 2011. It was seen that grassland areas were 1527 hectares in 1986 and that they have increased to 2714 hectares in 2011. Areas of agriculture that were 3604 hectares in 1986 were decreased by 1103 hectares in 2011.

Sayi and Genc (2013) have prepared land usage and plant cover maps (AKBO) including forest, grassland, agricultural, water, settlement, bare land classes for the city of Canakkale by using Landsat TM/ETM satellite images. In the research it was found out that especially as a result of forest fires, area was same as the reflection values for grassland and agricultural class.

Yildirimer et al (2015), have tried to determine the areas that can be influenced from big dam projects in Coruh river basin by using stand data map and CORINE land cover (CLC-2006) maps. According to the outcome of research it was determined that an area of 8137 will remain under water, and that mostly the forest areas will be influenced, (%62 according to stand data maps; %52 according to CORINE land covers), and that settlement areas would be least influenced (%0.77 according to stand data maps, %1.77 according to CORINE land cover).

Yavasli et al (2013), have determined that changes occurring in forest areas within the borders of city of Mugla by using change Landstat images for years 2000-2010 and Disturbance Index (DI) algorithm. It is seen that in 10 years time forest area of 18.410 ha was damaged but that area of 18.239 ha. was regained as forest areas.

2.1.3. FAO / FAOSTAT

FAOSTAT database is a statistical database where data of 245 countries are being published by FAO (Food and Agriculture Organization of the United Nations). Database is free of charge and it can be accessed without registering. Database and internet site have three language options being English, French, and Spanish. There is also a recording option enabling for users to download bigger databases. While this registry is charged, there are certain debates regarding the registry's being. FAOSTAT is a database being composed of various sub-sections such as agricultural production, trade, consumption of agricultural products, agricultural prices, resources, employees, forestry and fishery. Data are being provided to users as online or as Excel, CSV and XML outputs. All the indicators in the database present time series of more than 1 million, being recorded till now, while the oldest one belongs to year 1961.

2.1.4. FAO / UNESCO World Soil Map

During seventh congress of International Union of Soil (IUSS) being realized in year 1960 in Wisconsin, Madison, emphasized the necessity of publishing soil maps of continents and big regions. FAO and UNESCO started a project that would continue for 20 years in year 1961 with the aim to prepare a World Soil Map having a scale of 1:5000000. In the project report being prepared in English, French, Spanish, and Russian, map and soil unites containing information sources, topographic basis, texture, sloping classes and phases are presented with explanations. On the internet site being prepared by (http://www.fao.org/soils-portal/soil-survey/soil-maps-and-databases/faounesco-soil-map-of-the-world/en/) maps can also be seen separately as including continents such as North America, Mexico and Middle America, South America, Europe, Africa, South Asia, North and Middle Asia, Southeast Asia, Australia and continent parts. Turkish soil map being produced from FAO / UNESCO European map is given below (Figure 6).

Land usage and land cover being within harmonized earth soil database (version 1.2) is separated into 7 sub-classes as being specified below:

- rain-fed cultivated land;
- irrigated cultivated land;
- forest land;
- grassland and other plant areas (areas other than agricultural and forest areas)
- barren/very sparsely vegetated land;
- water;
- Urban land and land required for housing and infrastructure.

In order to form these 7 land classes, 6 pieces of geographical datasets have been used. These are: 1) GLC2000 land cover database for 30 arc-sn, 2) Classification of an IFPRI general land cover providing 17 land cover classes in 30 arc-sn, 3) Global forest resources evaluation of FAO with 30 arc-sn resolution,2000 (FAO, 2001), 4) Numeric global map of areas that can be irrigated (FAO / University of Frankfurt) version 4.0 (GTIA), 5) IUCN-WCMC protected area inventory for 30 arc-sn 6) Spatial population density inventory being developed for 2000 by FAO-SDRN as being based on spatial data of LANDSCAN 2003 and UN 2000 population figures' calibration (30 arc-sn).

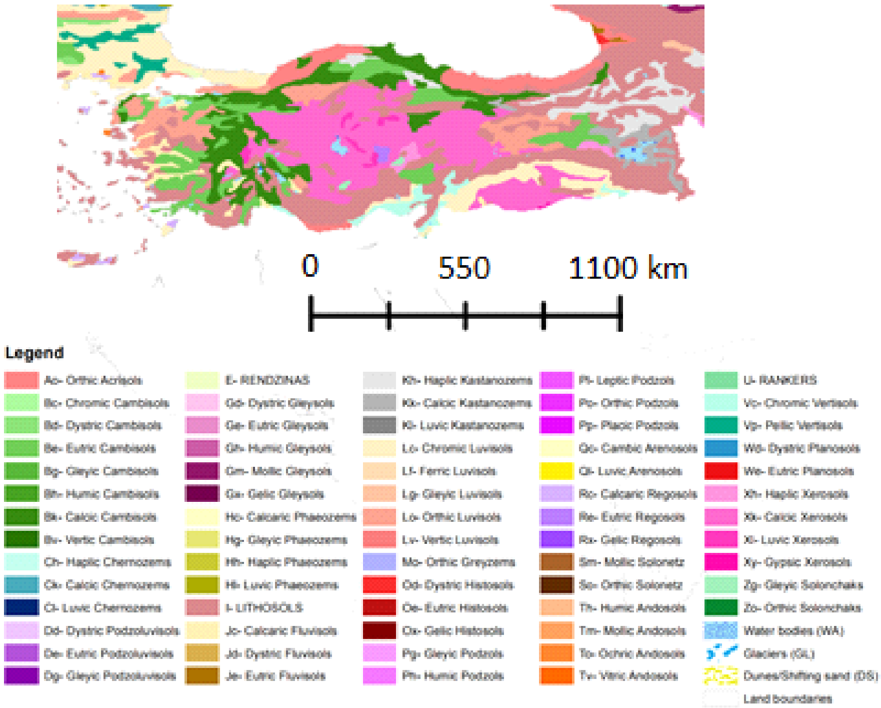

Figure 6. Soils being present in Turkey according to FAO/UNESCO European soil map

Within harmonized earth soil database (version 1.2) organic carbon percentage of upper soil (0-30 cm) (% weight) and organic carbon percentage (% weight) of lower soil (30-100 cm) are evaluated by forming tables as per dominant soil unite and other 4 sub-soil unites (Figure 7).

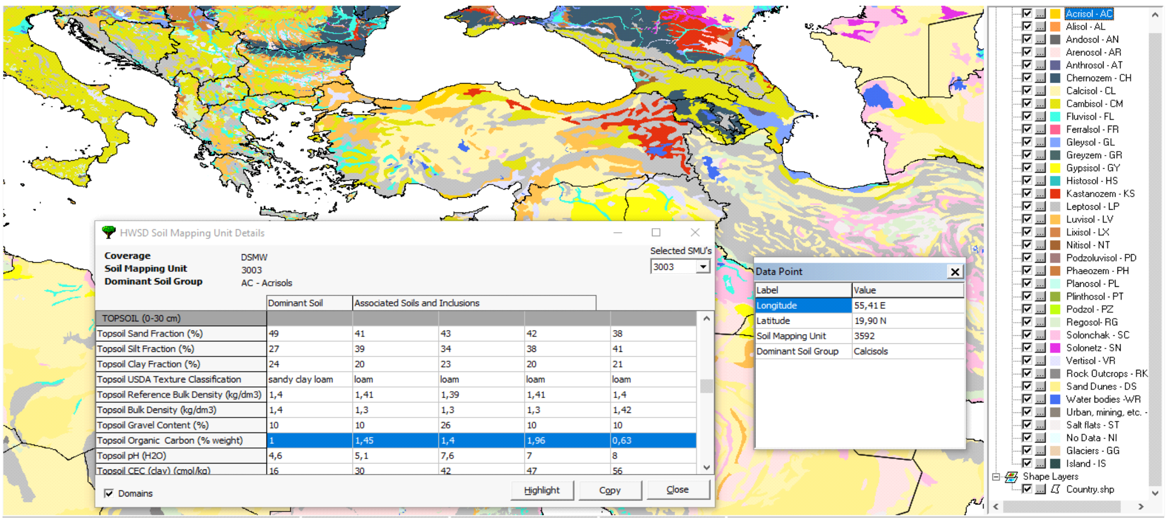

Figure 7. Details of HWSD soil mapping unite

2.1.5. FAO Global Soil Organic Carbon Map (GSOCmap)

GSOCmap, provides very useful information to its users for them to monitor soil conditions, to determine disrupted areas, to specify restoration targets, to discover SOC removal potentials, to support greenhouse gas emissions within scope of UNFCCC, to take decisions being based on evidences for mitigating and harmonizing the changing climate (Resource: http://www.fao.org/global-soil-partnership/pillars-action/4-information-and-data/global-soil-organic-carbon-gsoc-map/en/).

2.1.6. Earth Soil Emission Potential Inventory

Earth Soil Emission Potential Inventory (WISE), has been used to establish a series of data sets being composed of soil features being produced for 106 soil unites being evaluated on earth soil. These data sets were then used for establishing GIS raster image files for below mentioned variables: total useable water capacity (mm water per 1 m soil depth); soil organic carbon density (kg C / m^2 per depth interval of 0-30 cm); soil organic carbon density (kg C / m^2 for depth interval of 0-100 cm); soil carbonate carbon density (kg C / m^2 for depth interval of 0-100 cm); soil pH (depth interval of 0-30 cm); and soil pH (depth interval of 30-100 cm) (resource: https://daac.ornl.gov/cgi-bin/dsviewer.pl?ds_id=546)

2.2. NATIONAL ACTIVITY DATA SOURCES

2.2.1. ENVANIS

In Turkey there are two pieces of forest inventory being prepared in years of 1972 and 2004. It is seen that for 1972 inventory, years between 1963-1972 are evaluated and that for 2004 inventory, years between 1973-2004 are evaluated. Field inventories are prepared in periods of 10 years. ENVANIS (Inventory Statistical System for Forests) database being created by General Directorate of Forestry being part of Ministry of Forestry and Water Affairs, and being used since 2004, is one of the national activity databases. This database being arranged in the form of a table is a table being arranged as per stands and tree types in the sections forming the borders of forest management plans as including the outcomes of this plan and it contains important data such as annual increment and volume increase (growing stock) (Figure 8). ENVANIS has been created by mapping the forest cover on 1/25000 basis with the aim to determine forest assets and growth tendency of these forests. Inventory data being gathered from the land by means of inventory records are entered in the database and by realizing mapping, bases are created for forest management plans. Information in the inventory and database are being used by FAO.

PLAN CODE NO			Features of management type						Area				TOTAL FOREST AREA Ha		Growing stock				Annual Increment			
									High Forests		Coppices				High		Coppices		High		Coppices	
REGION	Forest enterprises	PLANING UNIT	Purpose (Function, Status)		Form of Forest	Management Type	tree species	mixed	Productive Ha	Degraded Ha	Productive Ha	Degraded Ha		(a) Age Class high forests Ha	Productive Ha	Degraded Ha	Productive Ha	Degraded Ha	Productive Ha	Degraded Ha	Productive Ha	Degraded Ha
	B	C			(	H	I	J	Q	R	S	T	U	AB	AG	AH	AI	AJ	AK	AL	AM	AN
1	101	10101	A	1	A	K	63	F	0	0	0	0	0,0	0	0	0	0	0	0	0	0	0
1	101	10101	M	11	A	K	30	D	11,2	0	0	0	11,2	0	2367	0	0	0	39	0	0	0
1	101	10101	M	6	A	K	1	C	33	0	0	0	33,0	0	3620	0	0	0	247	0	0	0
1	101	10101	M	10	A	K	8	B	830	3310,2	0	0	4140,2	632,8	2533	8330	0	0	167	760	0	0
1	101	10101	T	6	A	K	8	C	2044	137,1	0	0	2181,1	1255,4	40950	274	0	0	2498	14	0	0
1	101	10101	M	3	A	K	1	A	643,4	194,4	0	0	837,8	174,6	4965	1166	0	0	433	224	0	0
1	101	10102	O	1	A	K	1	B	5039,5	238,2	0	0	5277,7	1592,2	97768	926	0	0	8087	69	0	0
1	101	10102	A	1	A	K	51	F	0	0	0	0	0,0	0	0	0	0	0	0	0	0	0
1	101	10102	T	6	A	K	8	A	1291,4	42,6	0	0	1334,0	636,8	16208	218	0	0	867	13	0	0
1	101	10102	F	9	A	K	53	F	0	6741,4	0	0	6741,4	0	0	18447	0	0	0	923	0	0
1	101	10102	M	5	A	K	11	A	26,9	50,4	0	0	77,3	0	1484	137	0	0	45	8	0	0
1	101	10102	M	10	A	K	1	A	19,3	0	0	0	19,3	0	963	0	0	0	54	0	0	0
1	101	10102	M	11	A	K	1	A	8,1	0	0	0	8,1	0	310	0	0	0	26	0	0	0
1	101	10103	O	1	A	K	1	B	1217,4	211,3	0	0	1428,7	322,4	39524	2113	0	0	2596	63	0	0
1	101	10103	O	1	A	K	1	A	6299,8	963,8	0	0	7263,6	505,2	423652	9588	0	0	18407	288	0	0
1	101	10103	A	1	A	K	51	F	0	0	0	0	0,0	0	0	0	0	0	0	0	0	0
1	101	10103	T	5	A	K	8	A	278,9	6,5	0	0	285,4	124	4920	26	0	0	271	1	0	0
1	101	10103	M	10	A	K	1	A	1691,3	1474,1	0	0	3165,4	138,3	59647	12935	0	0	3224	397	0	0
1	101	10103	M	3	A	K	1	A	1528,4	760,8	0	0	2289,2	6,4	67073	7466	0	0	3896	224	0	0
1	101	10103	M	3	A	K	1	A	1611,5	484,6	0	0	2096,1	69,9	144351	4090	0	0	6225	120	0	0
1	101	10103	F	6	A	K	1	A	105,7	31,6	0	0	137,3	0	6875	282	0	0	316	8	0	0
1	101	10103	M	3	A	K	1	A	18,1	10	0	0	28,1	0	1426	20	0	0	56	1	0	0

Figure 8. Image of ENVANIS database system

During the implementation process of forest management plans there is need to specify existing variables relating with climate changes for the database from where data and information relating with many important parameters are being regularly managed. At the same time it is required for parameters being within national forest inventory system and developing calculation and evaluation opportunities in national carbon inventory to be determined. For example in ENVANIS system stands are being classified as per three criteria such as canopy cover, stand development and stand types. However in the system there are no basic data being required as relating with carbon pools and flux that is occurring.

Within context of system for monitoring, evaluating and reporting health and vitality of forest ecosystems it is required for the contribution of database to national carbon inventory to be investigated with respect to data and information by means of forest ecosystem monitoring program where data and information regarding systematic continuous sample areas on the land that are not dense and dense continuous sample areas as being representative.

Apart from ENVANIS, ORBIS system containing general information about forests (offline), Fire management system including forest map (stand map, forest villages, honey forests), forest fire infrastructure, Noah's ark National Biological Varieties Database and ARIS (Land cover database) including land cover database and similar information systems producing outputs that can be evaluated as activity data can be used.

2.2.2. Studies of Ministry of Food, Agriculture and Animal Breeding

"Countrywise Geographical Soil Efficiency and Organic Carbon (TOK) Information Management System" Project (UTF/TUR/057/TUR) having a budget of nearly one million was carried out by soil, fertilizer and water resources central research institute directorate with the support of FAO budget as covering years of 2012-2015. Within the scope of project, besides establishing and mapping certain physical (EC, pH, texture, lime) and chemical (N, P, K, Ca, Mg, Mn, Zc, Fe in total) features of Turkish agricultural soils, map of organic carbon distribution of Turkish soils (%)(Figure 7) and map of carbon budget of Turkish soil (t/ha) have been obtained. Project was carried out in 81 cities and soil samples were obtained from a depth of 0-30 cm by considering geology, land usage, topography. Besides countrywise soil geographical data bank and soil information system internet site, carbon stock distribution map of Turkish soils is also created (Figure 9). By combining this map belonging to our country with maps being created in other countries within the body of FAO, world soil carbon map being named as GSOCmap v1.1. (http://54.229.242.119/apps/GSOCmap.html) was obtained.

Certain projects the results of which can be used as activity data by TAGEM (General Directorate of Agricultural Researches and Policies) are given below as a table (Table 4).

Table 4.Projects being produced within the body of TAGEM the results of which can be used as activity data

Division	Project name	Years	Researcher	Supporter	Situation
Climatic change and agricultural ecology division	Impact of nitrogen fertilizer applications as being divided to Nitrosoxide greenhouse gas emissions	2017-2018	Merve AYSEL ALTUNDAG	TAGEM	Research continues
Soil and plant feeding division	Impact of soil processing techniques on carbon removal of soils and their sustainability	2011-2016	Dr. Derya SUREK, Dr. Hesna OZCAN Yakup KOSKER Tugba YETER Prof. Dr. Ayten NAMLI Assoc.Prof.Dr.Ufuk TURKER Ali KOC Ertugrul KILINC	TAGEM	Research continues
Soil and plant feeding division	Integrated project: Organic wastes and waste management Sub-project: Impacts of mixing of plant stems with soil during wheat-poppy cultivation period, on efficiency and certain soil features	2016-2020	Fahri KAYAALP, M.Resat SOBA, Dr. Hesna OZCAN, Dr. Derya SUREK, Ugur BAY, Ozgur SUNA	TAGEM	Research continues
Division of agricultural irrigation and land rehabilitation	By trying certain energy plants on different marginal trial areas, determining adaptability, bio-mass production and bio-solid potentials	2013-2016	Assoc.Prof.Dr. Ferit KOCACINAR (Sutcu Imam University.) Dr. Aynur OZBAHCE	TUBITAK	Research continues.

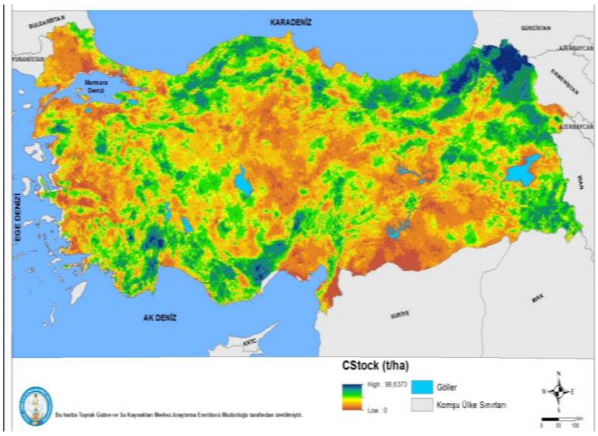

Figure 9. Carbon stock distribution map for Turkish soils

Another important project being conducted by Republic of Turkey Ministry of Food, Agriculture and Livestock is project with title of "National Rangeland Use and Management" with no 106G017 being supported by TUBITAK. In the project total grassland areas of 48 cities are calculated as 16.327.000 hectares and this quantity is found to be bigger than total grassland area of our country which is 14.6 million hectares (Table 6). In the project conclusion report it is predicted that the increase in grassland areas was due to the fact that other non-agricultural areas which are not defined as grassland areas but which will be used as grassland areas were included in the figures. According to Table 5, it is seen that within project context the city having highest grassland areas was Erzurum with area of 1.545.869 ha. Within project scope the city having lowest grassland areas was Bilecik with area of 10.660 ha. In 48 pilot cities being selected within project scope measurements were done at 3444 grassland points. As numeric basis of the project, CORINE land map, soil maps being produced by General Directorate of Rural Services, Landsat and spot satellite images have been used. Grassland areas on CORINE land map are evaluated as areas within 3.2.1. Natural grasslands. It is found out that among 3444 points where land survey is done, 544 contained very few soil organic substances (<%1), 1058 of them had few soil organic substances (%1-%2), 710 had intermediate level of soil organic substances (%2-%3), 372 of them had good level of soil organic substances (%3-%4) and 744 of them had high level of (>%4) soil organic substances.

Table 5. Total grassland assets of cities within scope of "National grassland usage and management project" being supported by TUBITAK

No	Cities	Grassland areas (ha)	No	Cities	Grassland areas (ha)
1	Adana	84.946	25	Iğdır	241.138
2	Adıyaman	260.594	26	Karaman	331.871
3	Afyon	296.572	27	Kars	606.974
4	Ağrı	685.384	28	Kayseri	668.705
5	Aksaray	241.583	29	Kırıkkale	158.103
6	Amasya	40.615	30	Kırşehir	165.963
7	Ankara	638.079	31	Kilis	25.880
8	Ardahan	339.550	32	K.Maraş	329.142
9	Artvin	100.756	33	Konya	1.037.807
10	Bayburt	185.776	34	Malatya	502.954
11	Bilecik	10.660	35	Mersin	232.825
12	Bingöl	407.165	36	Muş	462.258
13	Bitlis	209.258	37	Nevşehir	105.814
14	Çankırı	303.762	38	Niğde	283.483
15	Çorum	329.876	39	Ordu	75.667
16	Burdur	162.397	40	Osmaniye	10.707
17	Elazığ	405.403	41	Rize	71.610
18	Erzincan	797.339	42	Samsun	37.280
19	Erzurum	1.545.869	43	Sivas	1.139.675
20	Eskişehir	395.990	44	S.Urfa	660.253
21	G.Antep	136.817	45	Tokat	156.466

22	Giresun	140.216	46	Trabzon	92.009
23	Gümüşhane	232.121	47	Van	699.566
24	Hatay	43.905	48	Yozgat	234.534
TOTAL 16.325.317 ha					

By digitizing areas that are determined from satellite images within scope of STATIP (Project for Detection and Improvement of Problematic Agricultural Land) and by obtaining certain outputs from the project, they can be used as activity data. Main purpose of project is to define land and soil resources as per soil protection and land usage law with no 5403, to classify them, to prepare land usage plans, to evaluate communal, economic and environmental dimensions by means of participant methods during protection and development stage, and to establish a database for avoiding wrong usages not aiming for the purposes. Thus, in order to create fundamental basis numerical STATIP maps are produced in 81 cities. While these maps are produced, numerical maps being created within scope of soil database and Corine Land Cover, spot images for year 2006, and high resolution satellite images were used. With the help of high resolution satellite images being obtained from the collaboration with ITU-UHUZAM in 2009, it is seen that revision works relating with numerical maps with 1 hectare sensitivity are continuing. STATIP integration of agricultural parcels as being obtained within TARBIL project scope in 2013 shall be provided.

Another project the outputs of which can be used as activity data is **TARBIL** project (Agricultural monitoring and information system project). TARBIL project was commenced in year 2008 as "Integrated Agricultural Monitoring and Information System" project (TARIT) with the direction of State Planning Organization (DPT) and financial support with code of 2000A020010 as a pilot project of 3 years. Project was started with the collaboration of Republic of Turkey Ministry of Food, Agriculture And Livestock General Directorate of Agricultural Research And Policies (TAGEM) and ITU Research and Application Center for Satellite Communications and Remote Sensing (ITU-UHUZAM). Apart from 25 pieces of stations being selected in the city of Sanliurfa being the first pilot application area, additional 25 pieces of stations were established in the cities of Diyarbakir, Mardin and Gaziantep and in 2012 with the addition of 50 pieces of stations, it was reached to 100 stations in total. Number of ground stations have increased through the years and from these ground stations, measurements and recording in 34 different data types can be done. Two fundamental data are used for establishing database of agricultural parcels in the project: SPOT 5 satellite images with 2.5 m resolution and cadaste parcels being obtained in shp format from General Directorate of Land Registry Cadastre (TKGM) KVK system.

LPIS (Land Parcel Identification System) project is being carried out by General Directorate of Agricultural Reform Department head of geographical information systems and it is evaluated as an important activity data source since project outputs are based on electronic map basis and on air or satellite orthophoto images. Project is composed of three main sections. First section includes creation of orthophoto images, second section is composed of external quality control section and third section is composed of digitizing stages. Project is commenced by taking sensitive 3 dimensional air photos of whole Turkey with scale of 1/5 thousand. Within project scope 32 million 500 thousand agricultural parcels of Turkey are determined.

2.2.3. Data of Turkish statistical institution (TUIK)

All data including working results of public institutions in Turkey are gathered at TUIK being another public institution and they are provided to users on internet site of institution and with periodical bulletins. Especially with database system of institution, data are obtained for Turkey in general and as per provincial scales. In statistical tables sections in database, changes in agricultural and forest areas between years of 1988 and 2016 are shown (Table 6).

Table 6. Changes in agricultural and forest areas between years of 1988-2016 as per TUIK data

Agricultural land and forest area, 1988-2016 (Thousand Hectare)

Year	Total utilized agricultural land	Total arable land and land under permanent crops	Total arable land	Area of cereals and other crop products		Area of vegetable gardens	Area of ornamental plants [6]	Total land under permanent crops	Land under permanent crops			Land under permanent meadows and pastures[1]	Forest area[2]
				Sown area	Fallow land				Area of other fruits, beverage and spices crops	Area of vineyard	Area of olive trees		
1988	**41 940**	**27 763**	**24 786**	18 995	5 179	612	-	**2 977**	1 531	590	856	**14 177**	**20 199**
1989	**42 074**	**27 897**	**24 880**	19 036	5 234	610	-	**3 017**	1 563	597	857	**14 177**	**20 199**
1990	**42 033**	**27 856**	**24 827**	18 868	5 324	635	-	**3 029**	1 583	580	866	**14 177**	**20 199**
1991	**40 032**	**27 654**	**24 631**	18 776	5 203	652	-	**3 023**	1 560	586	877	**12 378**	**20 199**
1992	**39 953**	**27 575**	**24 563**	18 811	5 089	663	-	**3 012**	1 565	576	871	**12 378**	**20 199**
1993	**39 913**	**27 535**	**24 481**	18 940	4 887	654	-	**3 054**	1 615	567	872	**12 378**	**20 199**
1994	**40 049**	**27 671**	**24 605**	18 641	5 255	709	-	**3 066**	1 618	567	881	**12 378**	**20 199**
1995[3][4]	**39 212**	**26 834**	**24 314**	18 252	5 124	938	-	**2 520**	1 399	565	556	**12 378**	**20 199**
1996	**39 364**	**26 986**	**24 457**	18 469	5 094	894	-	**2 529**	1 401	560	568	**12 378**	**20 199**
1997	**39 241**	**26 863**	**24 239**	18 431	4 917	891	-	**2 624**	1 422	545	658	**12 378**	**20 199**
1998	**39 344**	**26 966**	**24 362**	18 561	4 902	899	-	**2 604**	1 463	541	600	**12 378**	**20 199**
1999	**39 179**	**26 801**	**24 213**	18 260	5 039	914	-	**2 588**	1 458	535	595	**12 378**	**20 763**
2000	**38 757**	**26 379**	**23 768**	18 038	4 826	904	-	**2 611**	1 476	535	600	**12 378**	**20 763**
2001	**40 967**	**26 350**	**23 740**	17 917	4 914	909	-	**2 610**	1 485	525	600	**14 617**	**20 763**
2002	**41 196**	**26 579**	**23 905**	17 935	5 040	930	-	**2 674**	1 524	530	620	**14 617**	**20 763**

2003	**40 644**	**26 027**	**23 310**	17 408	4 991	911	-	**2 717**	1 562	530	625	**14 617**	**20 763**
2004	**41 210**	**26 593**	**23 813**	17 962	4 956	895	-	**2 780**	1 616	520	644	**14 617**	**20 763**
2005	**41 223**	**26 606**	**23 775**	18 005	4 876	894	-	**2 831**	1 653	516	662	**14 617**	**21 189**
2006	**40 493**	**25 876**	**22 981**	17 440	4 691	850	-	**2 895**	1 670	514	712	**14 617**	**21 189**
2007	**39 504**	**24 887**	**21 979**	16 945	4 219	815	-	**2 909**	1 671	485	753	**14 617**	**21 189**
2008	**39 122**	**24 505**	**21 555**	16 460	4 259	836	-	**2 950**	1 693	483	774	**14 617**	**21 189**
2009	**38 912**	**24 295**	**21 351**	16 217	4 323	811	-	**2 943**	1 686	479	778	**14 617**	**21 390**
2010	**39 011**	**24 394**	**21 384**	16 333	4 249	802	-	**3 011**	1 749	478	784	**14 617**	**21 537**
2011 (5)	**38 231**	**23 614**	**20 523**	15 692	4 017	810	4	**3 091**	1 820	473	798	**14 617**	**21 537**
2012	**38 399**	**23 782**	**20 581**	15 463	4 286	827	5	**3 201**	1 925	462	814	**14 617**	**21 678**
2013	**38 423**	**23 806**	**20 574**	15 613	4 148	808	5	**3 232**	1 937	469	826	**14 617**	**21 678**
2014	**38 558**	**23 941**	**20 699**	15 782	4 108	804	5	**3 243**	1 950	467	826	**14 617**	**21 678**
2015	**38 551**	**23 934**	**20 650**	15 723	4 114	808	5	**3 284**	1 985	462	837	**14 617**	**22 343**
2016 (*)	**38 328**	**23 711**	**20 382**	15 575	3 998	804	5	**3 329**	2 048	435	846	**14 617**	**22 343**

Kaynak: Gıda, Tarım ve Hayvancılık Bakanlığı

Not. Rakamlar yuvarlamadan dolayı toplamı vermeyebilir.

(1) Bilgiler 1980, 1991 ve 2001 Genel Tarım Sayımı sonuçlarıdır.

(2) % 11 ve daha fazla kapalılıktaki normal orman alanları ile % 10 ve daha az kapalılıktaki bozuk orman alanlarını içerir. Bilgiler Orman ve Su İşleri Bakanlığı'ndan alınmıştır.

(3) 1995 yılından itibaren sadece meyve ve zeytin kapalı alanları verilmiş olup, dağınık ağaçların kapladığı alan dahil edilmemiştir.

(4) 1995 yılından itibaren Avrupa Birliğinin faaliyetlere göre Ürünlerin İstatistiki Sınıflamasına (CPA 2002) göre gruplandırılmıştır.

(5) 2011 yılından itibaren birden fazla ekilişler dahil edilmemiştir.

(6) Veriler 2011 yılından itibaren derlenmeye başlanmıştır.

*** Bilgi geçicidir.**

Source: Ministry of Food, Agriculture and Livestock

Note. Figures may not be equal to total due to rounding off.

(1) Data are results of 1980, 1991 and 2001 General Agricultural Censuses.

(2) Normal forest area having 11 % or more than 11 % forest tree density and spoiled forest area having 10 % or less than 10 % forest tree density are included. Data are compiled Ministry of Forestry and Water Affairs.

(3) Since 1995, only the closed area of fruit and olive trees have been given and the area of scattered trees have not been included.

(4) Data are grouped according to Statistical Classification of Products By Activity in European Economic Community (CPA 2002) since 1995.

(5) Data are not included secondery area since 2011.

(6) Data have been compiled since 2011.

* Data is provisional.

When statistical tables within TUIK are investigated, it can be seen that agricultural areas are handled in more detail when compared with forest areas. Changes in spatial distribution of cultivated areas, fallow lands, ornament plants, fruit and vegetable gardens as per years are obtained from tables. Besides by producing tables similar to table 7 from periodical bulletins in which statistical publishings of institution are placed, data are provided for creating activity data. However when they are evaluated with respect to forestry, it is seen that on the tables only general forest area quantities are shown. This situation makes it more advantageous to obtain statistical data relating with forest areas from ENVANIS system.

Table 7. Some agricultural data being obtained from TUIK periodical bulletins.

Products	Cultivation areas (1000 ha)									Production (1000 ton)								
	2006	2008	2010	2011	2012	2013	2014	2015	2016	2006	2008	2010	2011	2012	2013	2014	2015	2016
Wheat	8490	8090	8103	8096	7529	7773	7919	7867	7672	20010	17782	19660	21800	20100	22050	19000	22600	20600
Barley	3650	2950	3040	2869	2749	2721	2787	2784	2740	9551	5923	7240	7600	7100	7900	6300	8000	6700
Rye	131	126	141	128	143	138	115	112	115	271	247	366	366	370	365	300	330	300
Oat	100	91	88	86	89	93	94	103	99	209	196	204	218	210	235	210	250	225
Paddy	99	100	99	99	120	111	111	116	116	696	753	860	900	880	900	830	920	920
Safflower	0,4	5	14	13	16	29	44	43	40	0,4	7	26	18	20	45	62	70	58
Sunflower	585	580	641	656	605	610	657	685	720	1118	992	1320	1335	1370	1523	1638	1681	1671
Corn	536	595	594	589	623	660	659	688	680	3811	4274	4310	4200	4600	5900	5950	6400	6400
coleseed	5	28	31	27	30	31	32	35	35	13	84	106	91	110	102	110	120	125
Dried beans	129	98	103	95	93	85	91	94	90	196	155	213	201	200	195	215	235	235
Cotton unseed	591	495	481	542	488	451	468	434	416	2550	1820	2150	2580	2320	2250	2350	2050	2100
Lentil	424	319	234	215	237	281	250	224	252	623	131	447	405	438	417	345	360	365
Chickpea	524	505	456	446	416	424	389	359	360	552	518	531	487	518	506	450	460	455
Potatoes	158	149	139	145	174	126	130	154	145	4366	4197	4513	4613	4795	3948	4166	4760	4750
Onion(K)	66	66	63	66	73	62	60	58	60	1765	2007	1900	2141	1736	1905	1790	1879	2121
Soya	12	9	23	26	32	43	34	37	38	47	34	87	102	122	180	150	161	165
Sugar beet	326	322	329	297	281	291	289	274	322	14452	15488	17942	16126	15000	16489	16743	16023	19465
Tobacco	146	147	81	77	108	136	106	920	922	98	93	55	45	73	90	75	68	70
Tea	77	76	76	76	76	76	76	76	76	1121	1100	1306	1231	1250	1180	1266	1328	1350

Source : TUIK 2016

2.2.4. Studies being conducted by General Directorate of Combating Desertification and Erosion

With soil organic carbon project being signed between General Directorate of Combating Desertification and Erosion control being part of The Ministry of Forestry and Water Affairs and TUBITAK BILGEM software technologies research institute (YTE) on the date of 05.04.2017, it is planned to determine existing carbon stock of our country relating with soil organic carbon (TOK), to monitor the changes in soil organic carbon stock, and to conduct studies for increasing carbon stock. Within the context of methodology being developed for carbon monitoring system, it is determined that from fixed points to be established with intervals of 16 km, monitoring can be done for periods of 5 or 10 years. It is planned to establish a monitoring net of 3009 points by adding 2289 points to 720 points which were previously established for Turkey with intervals of 16 km within scope of CP Forest. Project has not been completed yet.

UASIS (National Land Cover/Usage Classification and Monitoring System) feasibility project is a project being carried by many partners including TUBITAK BILGEM, General Directorate of struggling with Desertification and erosion, and TAGEM and it was planned with the aim to specify national land cover classifications and to monitor the changes in specified classes by means of a continuous and sustainable system. It is planned to obtain results that can enable for studies to be made at a scale that can answer to the needs of institutions by being used with optimum efficiency with respect to national satellites such as RASAT, Gokturk-2 and Gokturk-1, enabling for sensitive works to be done with the purpose of determining and managing national land cover/usage classifications with a scale of 1/25.000 and at 4th level. Furthermore it will be enabled for homogeneous land cover classifications to be established as per biophysical features. It is predicted that output of this project can be used as important activity data source in the future.

2.2.5. Data for peatlands (From General Directorate of Nature Protection and National Parks)

Peatlands occur with differentiation of plant materials and accumulation of products. Peatlands are evaluated within important wetlands and they are seen as areas having important carbon stock. Peatlands are fields that are under administrative control of General Directorate of Nature Protection and National Parks. Data that can be evaluated as activity data relating with these fields in our country are shown below (Table 8).

Table 8. Activity data relating with peatlands in our country

NO	DISTRICT AND LOCATION	LICENSED AREA (Hectare)	AREAS WHERE PEATLAND EXTRACTION PERMIT IS GIVEN (Hectare)	DEPTH FOR EXTRACTING PEATLAND (Meters)
1	SAKARYA KONACIK VILLAGE, KULAK LOCATION-KARASU	150	2.00	1.5
2	SAKARYA TASKISIGI VILLAGE -ADAPAZARI	491,22	0.76	1.0
3	SAKARYA Arifaga village-kaynarca	261,9	1.91	1.5
4	SAKARYA NEVIYE SARIGoL LOCATION-ARIFIYE	169,69	1.99	1.5
5	Bolu-Duzce	10 ha	1.00	1.15
6	Bolu-Duzce	10 ha	1.00	1.15
7	KUTAHYA	No data	1,99	4.00
8	KUTAHYA	No data	1.97	4.00
9	KUTAHYA	No data	1.98	4.00
10	KUTAHYA	No data	1.15	4.00
11	KUTAHYA	No data	1.24	4.00
12	Hatay Iskenderun Sariseki	No data	2.00	2.00
13	Hatay Iskenderun Sariseki	No data	0.50	2.00
14	Hatay Iskenderun Sariseki	No data	2.00	2.00
15	DENIZLI Cameli Kizilyaka Golyeri location	No data	0.45	3.00
16	DENIZLI Acipayam district. Kumafsari quarter. Uverhoyugu location	No data	1.96	3.00
17	DENIZLI Cameli Kizilyaka Golyeri location	No data	0.37	3.00
18	DENIZLI Civril Beydilli village Isıkli lake location	No data	4.00	3.00
19	DENIZLI Civril Gokgol quarter Gokgol location	No data	1.94	3.00
20	DENIZLI Civril Ishakli quarter Gokgol location	No data	20.50	3.00
21	Burdur Bogazici village	No data	2.95	5.00
22	Burdur Elmacik village/Taslisavak location	No data	2.94	5.00
23	Burdur Bogazici village	No data	1.98	5.00
24	Burdur/Gölhisar Uylupınar village	No data	1.95	1.00
25	Burdur/Golhisar Uylupinar village	No data	1.61	1.00
26	Burdur/Golhisar Uylupinar village	No data	1.99	1.00
27	Burdur/Celtikli Beskavak village/ Karaevli lake location	No data	2.00	5.00
28	Burdur/Golhisar Uylupinar village	No data	1.97	1.00
29	Burdur/Golhisar Ibecik village	No data	0.31	2.00
30	Burdur/Golhisar Uylupinar village	No data	1.66	1.00
31	Burdur/Golhisar Uylupinar village	No data	1.99	1.00
32	Burdur/Golhisar Uylupinar village	No data	1.99	1.00
33	Burdur/Celtikci Beskavak village/Karaevli lake location	No data	2.00	5.00
34	Burdur/Celtikci Beskavak village/Karaevli lake location	No data	2.00	5.00
35	Burdur Bogazici village	No data	2.00	5.00
36	Burdur/Golhisar Uylupinar village	No data	0.65	1.00
37	Burdur Bogazici village	No data	1.99	5.00
38	Burdur/Golhisar Uylupinar village	No data	1.99	1.00
39	Burdur/Celtikci Beskavak village/Karaevli lake location	No data	1.99	5.00
40	Antalya/Elmali Kisla village Karagol location	No data	2.00	1.20

41	Antalya/ElmalıKisla village Karagol location	No data	2.00	1.20
42	Antalya/Elmali Kisla village Karagol	No data	2.00	1.20
43	Antalya/Elmai Kisla village Karagol	No data		
44	Antalya/Elmali Kisla village Karagol	No data	1.75	1.20
45	Antalya/Elmali Kisla village Karagol	No data	2.00	1.20
46	Antalya/Elmali Kisla village Karagol	No data	No data	1.20
47	Antalya/Elmali Kisla village Karagol	No data		
48	Antalya/Elmali Kisla village Karagol	No data	2.00	1.20
49	Antalya/Elmali Kisla village Karagol	No data	1.9	1.20
50	Antalya/Elmali Kisla village Karagol	No data	2.00	1.20
51	AFYONKARAHISAR Dinar district. Bulucalani village. Arapisik location	No data	2.95	1.00
52	AFYONKARAHISAR Dinar district. Bulucalani village. Arapisik location	No data	1.98	1.00
53	AFYONKARAHISAR Emirdag district. Buyuktugluk village. Buyukpayamli Cukuru location	No data	24.95	2.00
54	Adiyaman Golbasi lakes natural park	No data	2.00	1.00
55	Adiyaman Golbasi lakes natural park	No data	3.00	1.00
56	Adiyaman Golbasi lakes natural park	No data	1.00	1.00
57	Adiyaman Golbasi lakes natural park	No data	3.00	1.00
58	Adiyaman Golbasi lakes natural park	No data	3.00	1.00
59	Adiyaman Golbasi lakes natural park	No data	4.00	1.00
60	Adiyaman Golbasi lakes natural park	No data	2.00	1.00
61	Adiyaman Golbasi lakes natural park	No data	4.00	1.00
62	Adiyaman Golbasi lakes natural park	No data	5.00	1.00
63	KAHRAMANMARAS Afsin Gokcayir ruins	No data	1.99	5.00
64	KAHRAMANMARAs Turkoglu Gavur lake	No data	2.00	1.00
65	KAHRAMANMARAS Turkoglu Gavur lake	No data	2.00	0.25
66	KAHRAMANMARAS Turkoglu Gavur lake	No data	2.00	0.15-0.20
67	Erzurum Karacoban	No data	3.00	2.00
68	Agri Patnos	No data	2.00	2.00

2.2.6. Afforestration and grassland rehabilitation data

In our country afforestration data are obtained from inventory information being prepared within body of OGM (General Directorate of Forestry) Afforestration Department. Grassland rehabilitation data are obtained from tables being prepared by General Directorate of Plant Production (BUGEM).

Afforestration implementation results for years 2013-2017 being presented in activity report of General Directorate of Forestry for year 2017 are shown below (Table 9):

Table 9. Data for OGM afforestration spatial sizes (ha)

	2013	**2014**	**2015**	**2016**	**2017**
Survey-Project (ha)	375.930	230.553	226.974	409.712	493.666
Afforestration installation (ha)	46.656	40.325	38.986	48.230	46.934
Afforestration improvement (ha)	123.674	118.181	118.522	146.558	162.921
Private afforestration works (ha)	1.975	3.984	3.012	3.245	1.361

Within scope of projects in investment program for year 2017, on an area of 493.666 hectare survey-project studies were conducted, on an area of 46.934 hectare afforestration improvement was done and on an area of

162.921 hectare, afforestrate on improvement works are realized. As per activity report for year 2017, by means of private afforestration works being realized with revenue generating types such as walnuts, almonds, pine nuts, locust, and chestnuts, afforestration works are done on an area of 1361 ha.

Spatial sizes of grassland rehabilitation areas being within OGM authorization limits for years 2013-2017 as being presented in Activity Report of General Directorate of Forestry for 2017 are shown below (Table 10):

Table 10. Spatial sizes of grassland rehabilitation areas being presented in activity report of General Directorate of Forestry for year 2017.

	2013	**2014**	**2015**	**2016**	**2017**
Grassland rehabilitation (ha)	9.920	16.383	23.843	12.778	15.167

Distribution of these data as per Regional Directorates of Forestry can be reached from OGM activity reports being published each year.

2.2.7. Data relating with dam construction areas

Since dams accumulate and differentiate organic materials such as soil, vegetation, vegetation differentiation products and sediments, they increase metan and carbondioxide concentrations in water and air. Besides it is seen that dam areas are generally established on areas being covered with vegetation and especially at forest areas. This particular can be considered as carbon storage can not be realized on these areas due to establishment of dams on forest areas being seen as continental sink areas.

Information relating with dams are obtained by State Hydrolic Works. For activity data it is especially important to obtain data relating with dam surface area size. It is known that dam surface size has a dynamic structure due to climatic factors such as amount of precipitation and evaporation.

2.2.8. Data relating with poplar areas

Data relating with poplar areas are obtained from Poplar and Fast-Growing Forest Trees Research Institute. But it is stated that in Poplar and Fast-Growing Forest Trees Research Institute, there are no spatial data being based on CBS measurements. But the relevant institute is a member of International Poplar Commission. Therefore, Turkish poplar plantation areas being determined by using Country progress report of national commission as being periodically (once in 4 years) prepared by International Poplar Commission and by using local methods are given in table 11:

Table 11. Poplar plantation areas in our country

Period	**Poplar plantation areas**
1992-1995	150000 ha
1996-1999	145000 ha
2000-2004	130000 ha
2004-2008	125000 ha
2008-2012	125000 ha
2012-2015	145000 ha

2.2.9. National academic studies being conducted with over the soil and below the soil bio-masses

When biomass of a live tree is considered; it is required to determine bio-mass situations of stemwood, branches and shoots, coniferous and broadleafs and roots. Bio-masses can be defined as wet or oven-dry weight. In recent years single tree volume tables were used for calculating forest yields and for determining stem-wood of a tree and only main stem-wood volume of tree was coming to the forefront while other elements were not considered as bio-mass calculation factors in thesağacın sadece calculations. This kind of a calculation requires for general efficiency of a forest area or a stand to be evaluated by only considering stem-wood. Even the stem-wood volume was evaluated mainly as having without bark. But in recent years as various benefits and services being provided by forests are recognized this missing efficiency calculation has caused for viewpoints to change. Hence not only the stem-woods of forest trees are being considered but above the groud (bark, branches, shoots, coniferous and broadleafs) and belowground live bio-masses (roots) are also being considered. In today’s conditions whereas there is the principle to obtain various benefits from forests, completely knowing about the capacity of a tree or a stand can be effective in determining the extent of using the potential and its sustainability.

Researchers who emphasize that a tree is a variable depending on its diameter, length and size, (Müller and Zahn, 1958; Meyer, 1962) state that these features are valid for all trees having similar diameters, lengths and characteristics and they emphasize existence of factors being influential on volume tables. Nowadays it is seen that in establishing tree volume tables two different methods are directly and indirectly evaluated. In direct methods first by calculating body size figure coefficients (reference coefficients) for various diameters and lengths tree volumes can be found (Kalipsiz, 1984). In tree volume tables being directly calculated, instead of figure coefficients diameters and lengths of many trees are measured and results are obtained by using equations consisting of arithmetical and logarithmical curves being formed by spreading on two dimensional spatial plain. Single entry volume tables are tables being evaluated only as per stem-wood diameter of tree. It gives volume of a single tree with a failure ratio of % 10-15 (maximum %40) (Bayburtlu, 2007). As single entry volume tables models such as Kopezky-Behrhardt volume model are used. This model is given below.

$$V= b_o + b_i d^2$$

Double entry volume tables are tables which give stem-wood volume as per stem-wood diameter and length of tree. Besides tree volume tables with many entries can be used where variables such as top features, figure coefficient are evaluated together (Yavuz, 1995). There are also different equations being used in various researches for obtaining double entry volume tables (Saraçoğlu, 1991; Ercanli et al, 2008; Bozkus and Carus, 2014; Polat et al 2014). Since single entry volume tables are developed as per diameters, finding tree volumes as per double entry volume tables is more practical. Since length of each tree having same diameter will not always be equal, there is room for making mistakes with single entry volume tables and whem compared with equations used for preparing double entry tables, determination coefficients of equations being developed for these tables (R^2) can be lower.

Generally for finding bio-mass it is required to evaluate each element of tree separately. Branches and shoots are evaluated as live or not and their weights are measured. Since it is difficult to calculate weights of leafs separately first of all weights of branches having leafs are determined and then by measuring branches being free of leafs weights of leafs on each branch and shoot can be determined. If there are fruit or seeds on branches this process is repeated and it is continued with measurement and determination of differences. Stem-wood being separated to sections (For example 2.05 m. or 1/3rd and 2/3rd of tree) and being cleaned from branches and shoots is cut from marked places and top wood in conic shape and other two wood parts being in cut conic shape are separately weighed and added for finding the result. Apart from this measurement where fresh weights are evaluated on the land, in order to conduct dry weight calculations samples can be taken from various parts (such as segments from stem-woods being divided to sections, live branch and leaf examples). If amount of moisture on unit surfaces of various parts of tree are known, by knowing oven-dry weights it may not be required to make measurements of dry weights being difficult to conduct on the land. Because wet weight is equal to sum of oven-dry weight and moisture amount. Therefore, by eliminating moisture weight from wet herbal material, oven-dry weight value can be obtained. Here it is seen that moisture amount varies as per climatic conditions and characteristics of raising environment, tree types, atmosphere at the time of cutting, soil moisture situation and similar conditions. Moisture condition on herbal material can vary depending on tree components. It should be known that moisture amount on stem-wood and moisture amount on leaves can be different. By taking longitudinal and cross sections it can be seen that stem-wood contains different moisture amounts. Significant differences are found in moisture amounts of spring and summer wood or main wood or sapwood as can be observed from cross sections of stem-wood (Loetsch and Zöhrer 1973). For this reason considering dry weight of tree in calculations of total bio-masses can come to the forefront with respect to bio-mass differences occurring due to moisture differences originating from raising environment, climate and plant features. Thus, dry weight is preferred more in bio-mass calculations due to the reason that it minimizes probability of mistakes occurrences when compared with wet weight.

As it is difficult and time consuming to calculate bio-mass of each tree being divided into segments by finding its volumetric value, it is required to find reliable prediction methods for finding bio-masses. Besides as the shape of tree is similar to cylinder, cone or paraboloid but since it is not completely harmonious with them, it is difficult to find volumetric values by making geometrical calculation. But for calculating tree volumes, certain tools enabling calculation with minimum failures can be developed. Volume tables are tables giving stem-wood volume or commercial values as per easily measurable variables such as stem diameter of a planted tree, body diameter and length or stem diameter-length and figure coefficient (Kalipsiz, 1999). Volume tables are one of these tools that can enable such predictions. Kapucu et al, (2002) stated that in the selection of sample trees to be used in establishing volume equations, in order to represent various diameters and lengths of existing trees, attention should be paid for them to be planted and dry as being free of diseases, with solid top section, having single stem as being healthy. Due to application of different cultural techniques and different raising environments and other characteristic features, even if there is a stand being composed of same tree types, it can be caused for stands having different volumetric values to be present. Determining impacts of this type of situations on the stands can require long term measurements and observations and it can also necessitate high labor work. It was observed that with the help of volume tables these negative aspects were eliminated and that tree and stand volumes were predicted in a shorter time with minimum failure rate. It should not be forgotten that when volume tables are established factors such as easy measurement of tree and easier digitizing (diameter, length etc) are considered.

Just like volume tables, dry and wet weight tables in which evaluations are made with tree diameters or regression equations of tree diameters and lengths are also created. According to Saracoglu (2002) in the calculation of tree and stand bio-masses, different methods such as mid tree method, area method and regression modeling are used. But as it is difficult and time consuming to find the volume of sample tree on the land and bureau by means of division method, it is required for easier methods to be found for dealing with volumes of stands. Besides characteristic features such as different cultural techniques being applied and different raising environments, give rise to existence of stands with different volumes even if there is a stand being composed of same tree type. Besides the fact that it requires measurements and observations for long periods to determine the impacts of this type of influences on stands, it also necessitates heavy labor work. But volume of a tree can also be defined as a function of factors (diameter, length etc) relating with easy measurement of tree and easier digitizing.

Frequency of stands can influence bio-mass situations as they increase competition conditions and as there is increase in the trees (Kalipsiz, 1963; Saracoglu, 1988). Therefore frequency of stands can influence annual volume increase. But volume increase does not change as being parallel to frequency of stands (Kalipsiz, 1982). As per the decrease in frequency, number of trees that can benefit from conditions of raising environment can increase. But in this situation as number of trees in unite area gets reduced, total volume increase can decrease. In this situation it is important for optimum frequency degree to be achieved. Thus, best increases are observed in stands of the same age and in stands with frequency of certain limits. But while this certain limit frequenct varies as per stands and relevant types, it is required for them to be determined with many researches. When all these particulars are evaluated, it is thought that increase in stands at a certain age, as raising freely reach to the highest level. In America this theory has come to the forefront in the development of concept named as Best Management Practice and by making trials on stands providing maximum increase with a proper quality in a continuous way, certain silvicultural intervention techniques were revealed. Quantity of frequency of stands changing as a result of silvicultural interventions, can be used as an important parameter for determining the influence of silvicultural interventions in increasing direction. Tekin (2008), has prepared a crop table for pure, same aged, natural Anatolian black pine stands on 143 trial areas in the city of Isparta

[*Pinus nigra* Arnold subsp. pallasiana (Lamb.) Holmboe] as depending on relevant frequencies. In this research variables such as stand volume and volume elements, bonitet, age, frequency, length have been considered. Stand frequency degree has been determined by Curtis et al (1981) by dividing stand stem-wood surface (m2/ha), to square root of stand stem mid tree.

In the research he conducted, Tekin (2008), has revealed that for stands having same bonitet and frequency degrees as the age of stand increased although number of trees in the stand had a tendency to decrease an increase was seen in parameters such as stem-wood surface, volume, mid diameter and mid length. It is seen that increase in stand age also increased stand volume and that increase in bio-mass values of old stands was more than those of young stands. Another important finding is that while bonitet index increase and stand volume increase are higher for same aged stands with same frequency, as bonitet index increases bio-mass also increased. In the research it is also found that annual increasing value reached to the maximum value before the age of 30 and that it began to reduce after this age.

Saracoglu (1988), has created dry weight tables as per single and double entry volume tables of mountain alder types (*Alnus barbata*) on trial areas at various regions of Eastern Black Sea region. In the research ratio of dry weight of stemwood to wet volume is found as 504kg/m3 (Annex Table 1).

Durkaya (1998) has determined biomass quantity per hectare and for each tree in stands of oaks on 32 different trial areas within borders of Zonguldak Regional Directorate of Forestry (*Q. Robur* and *petrea*) by obtaining wet and oven-dry weight tables. Diameters and lengths of trees on trial areas have been measured (Annex Table 2).

Atmaca (2008), has established wet and oven-dry weight tables for calculating biomasses per hectare and for each tree in stands of yellow pines on 33 different trial points within borders of Erzurum Regional Directorate. Diameters and lengths of trees on trial areas have been measured (Annex Table 3).

Uludag (2006) has created single and double entry stem volume tables for plane trees *(Platanus orientalis l.)* on 30 trial points within borders of Kastamonu Forest Regional Directorate of Forestry and Catalzeytin Forest District Directorates. For this purpose below models were tried (Annex Table 4).

Bayburtlu (2007) has created single and double entry tree volume tables for 46 trees among quaking aspen stands at East Anatolian and Eastern Black Sea regions and he has created bonitet index table revealing efficiency strength of raising environment (Annex Table 5).

Unsal (2007) has formed wet and oven-dry weight tables for predicting biomass quantities per hectare and per each tree in red pine stands within borders of Adana Regional Directorate and Karaisali Forest District Directorates (Annex Table 6).

In his study, Cakil (2008) has predicted biomass quantities per hectare and per each tree in black pine stand at 44 different trial areas within borders of Zonguldak Forest Regional Directorate by using wet and oven-dry tables (Annex Table 7).

Tekin (2008), has prepared crop table for stands of natural Anatolian black pine on 143 different trial areas in the region of Isparta [*Pinus nigra* Arnold subsp. *pallasiana* (Lamb.) Holmboe] as depending on frequencies (Annex Table 8).

Akray (2009), has investigated carbon content of leafs, branches, litters and soils of red pines (*Pinus brutia* Ten.), cermes oak (*Quercus coccifera* L.) and locust (*Ceratonia siliqua* L.) trees and he has revealed that plant fractions could influence total carbon quantity in the soil.

Ulkudur (2010), has prepared wet and oven-dry weight tables by using mid tree method with the aim to predict biomass quantities per hectare and per each tree in cedar stands on 36 different sample areas within borders of Antalya Regional Directorate (Annex Tables 9 and 10).

In his research Eraslan (2009), has applied methods such as random branch sampling and importance sampling for predicting over the soil biomasses for sample trees being composed of black pine trees. In the research it is emphasized that this method predicted over the soil bio-mass in a more correct way when compared with single and double entry volume tables.

Yagci (2010), has investigated the impact of cultivation distances 24-25 years from now, on the biomass and carbon quantities both above the soil and under the soil regarding artificial youth fields of oriental beech (*Fagus orientalis* Lipsky) at Hopa (Artvin)-Cankurtaran location. In the research for fewly growing oriental beech stands total biomass was found 22,95 ha/ton, and for frequently raised oriental beech stands it was calculated as 20,98 ton/ha. Besides statistically important differences are found in few and densely raised stands with respect to root biomasses and over the soil biomass values as per diameter levels. Researcher has reached to the conclusion that usage of 2500 pieces of saplings per hectare for oriental beech plantation fields would yield optimum outcomes with respect to biomasses and stemwood quality.

Ulker (2010) has predicted single tree biomass quantities regarding yellow pine stands at 32 different trial areas within borders of Amasya Regional Directorate by creating wet and dry biomass tables (Annex Table 11).

Aydin (2010), has determined dry weights as per equations he has developed according to tree components by making trials on 46 sample trees with the aim to specify biomasses of yellow pine stands within borders of Artvin Regional Directorate of Forestry and Borcka Forest District Directorates (Annex Table 12).

In his study Kezik (2011) has revealed best rarefaction and pruning ratios with respect to biomasses that can be implemented during rehabilitation stage of oak coppices within borders of Mardin Mazidagi Forest Sub-district Directorates.

Karaburk (2011), has made trials on 34 pieces of samples trees and obtained single and double entry dry weight equations for preparing wet and oven-dry weight tables for Nordmann fir stands in the city of Bartin (Annex Tables 13-14).

In his study Macaroglu (2011) has calculated whole tree oven-dry weights by using single and double entry biomass equations (models) being obtained by previous researchers for mixed stands being composed of types such as *Abies bornmulleriana*, *Fagus orientalis*, *Pinus silvestris, Quercus sp.* Within borders of Bartin Forest District Directorates. In the research as stand development ages were investigated it was seen that most development took place in “d”. Besides it was found out that regarding stands, mixed stands stored more biomasses when compared with pure stands and that leafed types stored more biomasses when compared with coniferous ones. It was determined that maximum storage took place at KnGd3 stand. Therefore, besides their advantages of increasing biovariability, as mixed stands cause high biomass increase to take place, it is seen that they are more advantageous with respect to pure stands (Annex Table 15).

Dogan (2010), has developed various equations as per tree components relating with wet weights for predicting biomasses of Nordmann firs in relation to their diameters and with the aim to specify relation of leaf surface area and sapwood for Nordmann firs within borders of Asar Forest Sub-district Directorates as part of Duzce District Directorates (Annex Table 16).

Dogan (2010), has developed wet weight equations as representing different tree components for predicting biomasses of beech trees(Fagus orientalis Lipsky.) as per diameters and to specify relation of leaf surface area and sapwood within Asar Forest Sub-district Directorates of Duzce District Directorates (*Fagus orientalis* Lipsky.) (Annex Table 17).

In a study being conducted by Orhan (2013) above the soil biomass tables are prepared for black sea stands in Zonguldak Regional Directorate, for yellow pine stands in Erzurum Regional Directorate, and for red pine stands in Karaisali (Adana) Forest Sub-district Directorates and as being different from previous studies differentiation of branch woods regarding their being commercial or not has been done in this study. (Annex Tables 18, 19 and 20).

In his study Aktas (2013) has applied normal crop table relating with red pines (*Pinus brutia* ten), being prepared by Alemdag (1962) for intervined red pine stands within borders of Aglasun Forest Sub-district Directorates as part of Burdur District Directorates and he has tested convenience with respect to volume, annual volumetric increase and mid diameter predictions. It was found out that red pine normal crop table being formed by Alemdag (1962) could be reliably used for red pine stands in Burdur.

In his research Isik (2013), has investigated biomass and carbon storage quantities of Kapikaya Forest Sub-district Directorates as per three different methods biomass conversion factor, biomass conversion factor per tree types, and allometrinic equations. Carbon storage quantity of forest area being evaluated was calculated as 397033.5 ton according to biomass conversion factor, it was calculated as 397245.3 ton according to biomass conversion factor method depending on tree types and it was calculated as 545656.1 ton according to allometric equation method. One of the most important findings of the research was that since allometric equations are developed as per equations based on diameters it provided more correct and actual results when compared with other two methods.

Yilmaz (2014),has developed regression equations modeling changes in volumetric increases of same aged, pure and natural red pines (*Pinus brutia* Ten.) and black pines (*Pinus nigra* Arnold) being in Aglasun and Camoluk Forest Sub-district Directorates within borders of Isparta Regional Directorate and Burdur District Directorates as per bonitet index, stand age and stand frequency degrees. According to the results, stand volume increase gets reduced with stand age while bonitet index and frequency degree increase.

Yilmaz (2015), has created biomass tables by using equations being formed as per wet weights as per regression analysis technique being applied on 159 pieces of trial trees being determined among red pine stands in the region of Antalya (*Pinus brutia* Ten.) (Annex Table 21).

Su (2014), has prepared single and double entry volume table and bonitet index table for artificial stands (*Pinus brutia* Ten.) within borders of Antalya Regional Directorate of forestry and Korkuteli Forest Sub-district Directorates (Annex Table 22).

Seki (2015), has developed dynamic bonitet index models for black pine stands (*Pinus nigra* J.F.Arnold) on 132 pieces of trial areas within borders of Taskopru Forest District Directorates.

In a study being conducted by Say, (2016) over the soil and under the soil biomass quantities of natural and planted young yellow pine stands Cerkes Forest Sub-district Directorates within borders of Cerkes (Cankiri) Forest District Directorates were obtained by preparing wet and oven-dry weight tables (Annex Tables 23, 24, 25 and 26).

In the thesis research he conducted Ozkaya (2016), has determined total biomass, over the soil biomass, under soil biomass, stem and leaf biomass values of forest rose with purple flowers (Rhododendron ponticum) on forest areas serving the purpose of a plant cover. On the research area within city of Artvin in Eastern Blacksea region leaf biomass of forest rose with purple flowers makes up %27.08 of its over the soil biomass and it makes up %72.92 of its stem biomass. It is found out that %17.78 of total biomass is composed of leaves and that %47.88 of it is composed of stem biomass (Annex Table 27).

Maral (2016), investigated the influence of different land usages in Kastamonu region (forest, agricultural and grassland areas) on carbon and nitrogen storage ratios. In the research it is determined that highest carbon ratio (0-20 cm soil) is found in soils under forest area and that lowest carbon levels are found in agricultural areas.

Erkeles (2017) has found out that on acidic soils where there are trial areas on which liming and thinning are performed in beech stands there was decrease in fine and capillary root biomass quantities within first two years and that after eight years, increases took place in fine and capillary biomass quantities causing for root competition to increase again.

Kahriman et al (2017) have developed equations for preparing single, bonitet based tree volume tables for single and double entries regarding 486 samples trees among pure and natural red pine (*Pinus brutia* Ten.) stands in Antalya and Mersin regions (Annex Table 28).

Biomass equations being obtained from studies short summaries of which are given above can be found in additional tables (Annex Tables 1-28).

Sarginci, (2014) have found out that carbon content of soil, dead cover, living cover, and trees with respect to mixed stands of oriental beech (*Fagus orientalis* Lipsky) and Anatolian chestnut (*Castanea sativa* Mill.) in Akcakoca region were 92.1, 4.2, 25 ve 169 Mg ha^{-1} respectively. In this research as diameters of stem height of oriental beech and Anatolian chestnuts increased, a linear increase was seen in over the soil and under the soil biomasses and carbon quantities.

Makineci et al (2015) have analyzed carbon concentrations of leaf, root, branch, bark and similar tree components in Kirklareli Demirkoy, Vize and Catalca on pure oak stands being separated to 3 different stem diameter levels (0-8, 8-20, 20-36). Results of analysis are given in table 12. It is found out that when under soil tree components are not considered, over the soil tree biomass, soil pedon and total ecosystem carbon increased as it is went from small diameter level to big diameter level. Again as it is went from small diameter level to big diameter level although root carbon ratio within total tree carbon increased, it was found out that there was a decrease in carbon quantity within leaf and barks. Branch carbon also increased as it was went from small diameter levels to big diameter levels and at each of the three diameter levels over the soil carbon was represented with the ratios of %14, 16 and 18 (small, intermediate and big diameter levels) respectively. It is found out that carbon share of ground covers in ecosystem was %0.5 for small diameter levels and that it was %0.02 for big diameter levels. As it is went from small to big diameter scales carbon quantity in total ecosystem increased (97.1, 177.2 and 192.0 Mg ha^{-1}). Researcher has also evaluated a development age of 69 years for small and big diameter levels he has found out that carbon content in total ecosystem was 1.4 Mg ha^{-1} per year and that it was 1.1 Mg ha^{-1} in tree biomass. Carbon calculation equations being developed by researcher as per stem diameters are given below.

Table 12. Carbon calculation equations being developed as per stem diameter

Features	**Equations**	**R^2**	**P**
Leaf	$y=0.658.9x^{0.4834}$	0.43	0.000
Branch	$y=409.46x^{1.0936}$	0.79	0.000
Bark	$y=347.44x^{1.0628}$	0.77	0.000
Root	$y=835.99x^{1.3277}$	0.84	0.000
Tree biomass	$y=2277.6x^{1.1333}$	0.83	0.000
Ground covers	$y=397.94x^{-0.125}$	0.04	0.023
Organic soil (dead cover+fermantation+humus)	$y=1316x^{0.2769}$	0.51	0.000
Soil pedon	$y=76280x^{0.0885}$	0.05	0.013
Total ecosystem	$y=74786x^{0.2807}$	0.47	0.000

Evrendilek et al (2006), have determined above the soil and under the soil biomass values for trees having stem height that is more than 8 cm, as being formed from mixed stands of *Abies cilicica, P. nigra, and C. libani* types and *Pinus brutia, Pinus nigra, Cedrus libani, Juniperus excelsa* pure stands in Mediterranean region at Katran hollow region.

Researcher has calculated stand volume (including bark) according to below equation.

$$V = a \times SBA \times H$$

$$SBA = (m^2ha^{-1}) = \pi \times (dbh/200)^2(m^2stem^{-1}) \times \text{tree stocking (stem ha}^{-1})$$

Here;

V = volume (m^3 ha^{-1}),

SBA = average stand stem surface (m^2 ha^{-1}),

α= stand figure coefficient (0.44006 for coniferous ones),

H = average stand height (m)

dbh =Diameter (cm)at stem height of 1.30 m

200 = factor for converting from diameter (cm) to semidiameter (m).

According to Schlesinger (1997) carbon content of biomass is assumed to be %45 -%50 of oven-dry weight. Therefore in order to calculate carbon content in biomass, biomass value has been multiplied with coefficient of 0.475. Besides to calculate CO_2 equivalent of carbon stock in stands carbon quantity is multiplied with coefficient of 3.67.

Total carbon storage in all types being the research topic, is calculated as 97.8±79 Mg C ha^{-1}. 83.0 ± 67MgCha^{-1} portion of this value represents over the soil biomass and portion of 14.8 ± 12 Mg C ha^{-1} represents above the soil biomass. Average net ecosystem production (NEP) is calculated 98.4 ± 54.1 Gg CO_2 $year^{-1}$ (Gg = 10^9 g) for research area of 134.2 km^2 (Evrendilek et al 2006).

In the research differentiation speed of coniferous leaves having significant impacts on dead covers of the types has also been calculated. Accordingly differentiation speed (*k*)was listed as below from highest to lowest.

$$k_{Cedrus} > k_{Pnigra} > k_{mixedstand} > k_{Pbrutia} > k_{Juniperus}$$

For calculating over the soil biomass of coniferous types stem volume is multiplied by conversion factor of 0.5 Mg and for obtaining billet and root biomass values stem volume is multiplied with conversion factor of 0.09 Mg (FAO, 2000).

Sivkikaya et al (2013), have calculated total carbon quantity (ton) and growing stock values (m3) for *Cedrus libani* A. Rich., *Pinus brutia* Ten, *Pinus nigra* Arn., *Fagus orientalis* Lipsky, *Abies cilicica* Carr., *Quercus* sp., and *Pinus pinea* L. types dominating in Hartlap (Kahramanmaras) region by referring to inventory reports for the years of 1991 and 2002 with land cover changes and over the soil, under the soil and total biomass values (ton). During the period of 11 years changes were also made in management plans. For example coppice stands were transformed into high forests. Another change relating with research was that there has been a change towards older age classes. Accordingly while area size in broadleaf forests was higher in 1991 (3683.6 ha) when compared with year 2002 (1984.3) , an increase was observed in carbon quantity in 2002 (56711.5 ton) when compared with year 1991 (53037.5 ton). Similar situation is also observed in mixed stands. In coniferous forests the opposite situation is observed. When compared with year 1991 (4555.1 ha) in year 2002 (4465.0 ha) a small change has occurred in the area of coniferous forests. In these forests total carbon quantity was calculated as 153904.8 ton in 1991, and it was calculated as 138218.7 ton in 2002. Researcher thinks that the reason for this situation is due to the conversion of coppice forests into high forests . Researcher has also stated that increase, biomass and carbon storage were higher in high forests with respect to coppice forests. For example while there is an increase of 15 m^3 (growing stock) per hectare in coppice stands, this figure is found to be 19 m^3 in oak high forests. The reason for the situation in degraded forests is explained with low intake capacity they have got. But due to increase in areas of degraded forests, it is seen that total carbon accumulation in coniferous forests decreased in 2002 when compared with 1991.

In the study they conducted Gunlu et al (2014) aimed to predict over the soil biomass value by using individual band reflectance and 10 vegetation indices being obtained from Landsat TM satellite images . In the model being created by using TM1 and TM2, it was found that R^2= 0.465. In the other above the soil biomass model by gathering certain TM (2, 3 and 4) bands, it was established between Enhanced Vegetation Index (EVI) and Normalized Difference 57 (ND57) and for this model, R^2 was found as 0.606. According to the outcome of research, for the prediction of biomass and LAI, it is considered that vegetation indices are good indicators.

Over the soil and under the soil biomass studies being conducted at grassland areas in our country are summarized below:

In the study they conducted in the city of Isparta, Davraz Mountain Kozagaci Plain Kocapinar grassland in 2011 and 2012, Babalik and Fakir (2017), while over the soil biomass quantity was 208.24 kg/da on grassland, it was

256.49 kg/da on protected areas and under the soil biomass was determined as 347.88 kg/da and 454.41 kg/da respectively.

According to data of General Directorate of renewable energy for 2015, biomass potential of Turkey is 20.307.069,02 TEP/year (1 TEP=11.629 kWh).

In the study they conducted in the city of Bartin, in district of Kozcagiz in 2012, Lermi and Palta (2014) have found out that stem ratio of toothed bur clover (*Medicago polymorpha*) was %50.44, that its leaf ratio was %31.85, and that its flower ratio was %17.74. Besides dry substance efficiency was found to be 0.90 g/plant.

In the study they conducted in the city of Bartin, in the village of Akmanlar between years of 2012-2014, Lermi and Palta (2016), have found out that highest biological efficiency and straw efficiency of bee plant (*Phacelia tanacetifolia* Benthmam) within autumn cultivation period were 3977 kg/da and 3828 kg/da respectively.

Tuna et al (2015), found out that biomass (excluding root) of 48 pieces of natural Brachypodium distachyon being collected from different geographical regions in our country 4.5 g plant^{-1}.

In a study conducted in Konya in years of 2008 and 2009 by Seflek, (2010) it was found that biomass efficiencies of varios millet types (Blackwell and Kanlow) were 4839 (Blackwell) – 8814 kg/da (Kanlow), dry substance ratios were found as %31.26 (Alamo) - %35.65 (Kanlow), and dry substance efficiencies were found as 1682 (Blackwell) – 3142 kg/da (Kanlow).

Geren et al (2011), have found out that dry substance efficiency of Bornova (Izmir) Miscanthus – giganteus plant was 1966 kg/da as per the study they conducted in 2008-2009.

In their research Sabanduzen and Akcura (2017) have found out that average efficiencies of 49 oat genotypes varied between 335 kg da^{-1} and 860 kg da^{-1} during the cultivation periods of 2014-2015 and 2015-2016 in Canakkale.

Ozturk et al (2012), have determined over the soil and under the soil biomass values at 86 different grassland areas in Aegean region. Highest values of over the soil biomasses were observed in the spring season in the cities of Aydin (139.18 g), Balıkesir (122.68 g) and Canakkale (103.78 g). Highest values of under the soil biomasses were obtained in the spring season in the cities of Aydin (80 g) and Canakkale (80 g) and in the winter season in the city of Balikesir (80 g).

In our country the studies being conducted as relating with the calculations of over the soil and under the soil biomasses in our country are quite few. Especially there aren't any studies that are conducted as relating with biomass energy. A sample being created from these studies is summarized below:

In the study conducted by Demir et al. between years of 2005-2015 in the city of Mersin (2015) agricultural biomass energy equivalent potential has been determined and it was found out that total agricultural biomass energy of 45.228 MW could be obtained as being obtained from cereals with an amount of 21.717 MW, from fruits with an amount of 14.445 MW, from vegetables with an amount of 4.212 MW, from legumes with an amount of 3.246 MW, and from fatty seeds with an amount of 1.608 MW.

While there aren't any national studies showing that silvicultural intervention could change energy balance of forest cover and that it could influence carbon dynamics, there are relevant studies that are conducted internationally (Clarke et al., 2015; Bai et al, 2017; Cheng et al., 2017).

2.2.10. Academic Studies Conducted on Soil Carbon

Tiryaki (2011) searched the effects on surface biomass and growth in beech tree of lime treatment for oriental beech stands which were rejuvenated with artificial way in 1984 on acidic soils at Artvin Hopa- Cankurtaran Locality. During the research, as a result of the lime treatment of 100 kg for each unit which was carried out in 2009 and 2010, it was calculated that 10% increase occurred in terms of existence of tree and total surface biomass gone up 5.9% owing to effect of rising soil pH in the areas where lime treatment was applied at the end of 2010 compared to control areas. Taşgın (2011) revealed in which manner nitrogen addition at certain amounts along with fixed lime addition to acidic soil was efficient from the aspect of growth and increase in the same research areas. According to the research results, it was observed that research area in which lime treatment + 4 kg nitrogen application were conducted made around 1.8fold more volume increase as compared with the beech species in control areas. Acidic soils hinders intake capability of some plant nutrients (Ca, Mg, P) which are important for plants and in some cases, causes increase at level to show toxic effect in soils of the elements like Fe, Mn, Al, etc. (Feger et. al., 1991; Ponette et. al., 1996). Therefore, addition of lime into soil with the aim of raising fertility capacity of soils have positive effects for plant growth or increase. Microbial biomass, C, N and P contents of litter and top soils were determined by Bolat (2011) through chloroform fumigation extraction method for mixed stands of Oriental beech (*Fagus orientalis* Lispsy), Uludag abies (*Abies nordmanniana* subsp. Bornmülleriana Mattf.) and abies- beech within the Bartın provincial borders. Besides, microbial activity was identified by making measurement of basal respiration. Average microbial C, N and P contents were found higher for abies stand than other stands. In addition, it was ascertained that microbial C, N and P contents of soils were relatively higher in summer and autumn seasons than spring and winter seasons. It is thought that microorganism activation of soil is affected especially from the changes in temperature conditions, as a result, microbial C, N and P contents of soil also alter.

Küçüer (2007) tried to find impacts of deforestation in Karasu costs of Black Sea region by detecting soil carbon percent values in 45 pcs sampling points. It was established in the research that deforestation which has taken place over the last 20 years did not result in any significant change in the carbon amount kept in soil statistically.

Ma (2006) and Zhang et. al. (2015) have determined that the relationships between volume increase and carbon content of soil may be obtained from literature studies. In regard to the cases which could not be obtained from literature, the researchers indicate that calculation may be made with the following negative exponential equations for mild grasses (IÇ), alpine grasses + mountain grasses (AÇ+DÇ) and abandoned fields (TET). (Table 13).

Table 13. Relationship of volume weight and soil carbon

Type of land use	Relationship of volume weight – SC
IÇ	Volume weight = $1.6085 \times e^{(-0.01244 \times TOK)}$
AÇ+DÇ	Volume weight = $0.3 + 1.28 \times e^{(-0.0172 \times TOK)}$
TET	Volume weight = $1.3770 \times e^{(-0.0048 \times TOK}$

Evrendilek et. al., (2004) has specified that average loss of soil organic carbon (SOC) caused by conventional tillage in first 20-30 years may become between 20%-50% compared to first carbon content for agriculture and forest. Even though a fast exponential decrease is seen in the first 20 years, they have stated that SOC level reaches to balance gradually in next 30 years.

Evrendilek et. al (2004) have identified soil carbon content as per the following formula.

$$SOC = 0.58^{a} \text{ x Soil Organic Matter (SOM)}$$

here

[a] = Bemmelen index = coefficient to convert organic substance concentration into organic carbon content

$$SOC\ (kg\ ha^{-1}) = (\%SOC/100) \text{ x soil mass } (kg\ ha^{-1})$$

Soil mass (kg ha^{-1}) = depth (m) x mass depth (Bulk density) (Mg m^{-3}) x 10000 m^2 ha^{-1} x 1000 kg Mg^{-1}

Evrendilek et al (2004) have determined according to result of their research that the highest carbon amount in 0-10 cm depth for the soils under three types of land use such as forest, agriculture and grassland belong to grassland area (31818 kg ha^{-1}). They were found 29926 kg ha^{-1} and 17666 kg ha^{-1} respectively for forest and agriculture. In the soil samples at 10-20 cm. depth, it is seen that the highest soil carbon amount is reached in forest (26554 kg ha^{-1}). Soil carbon amount were found 25499 kg ha^{-1} and 14970 kg ha^{-1} respectively for grassland and agriculture.

Peatlands were considered as the lands subjected to land change as a result of extensive anthropogenic effects. The peatlands which generate CO_2 and CH_4 emission and play key role in climate change can occur based on the reasons like peatland mining, agricultural irrigation, overgrazing and deforestation, etc. Evrendilek et. al (2015) have emphasized in their research that carbon dioxide (CO_2) emissions coming from drained peatlands change depending on drainage intensity and size of peatlands, peat thickness, land use and type of land cover (LULC) which are converted into peatlands. The researcher has calculated the carbon content in peatlands according to the following equation.

SOC (t C ha^{-1}) = depth of peatland (m) x volume weight (t m^{-3}) x SOC (C %) x 10000 m^2 ha^{-1}

The researcher has indicated that net annual carbon emission from drained Yeniçağa peatlands and drainage based wetlands change between minimum 12.5 t C ha^{-1} $year^{-1}$ and maximum 32.5 t C ha^{-1} $year^{-1}$. When these values obtained from Yeniçağa peatlands were extrapolated to 240 km2 size being total peatland found in Turkey during the research, it was predicted that 0.30-0.78 Mt CO2 emission would actualize from the peatlands in Turkey in 2009. In addition, he also expressed that this quantity corresponded to 0.01-0.02 % od 3230 Mt which was total CO2 emission value based on land use change in 2009.

In the research conducted in Harran plain, Sakın et. al (2010) calculated that 56.41 Tg Carbon existed in the soil with 0-100 cm thickness, 67.80 Tg carbon at 0-120 cm thickness and 87.91 Tg Carbon at 0-160 cm thickness. 77.81% of soil organic carbon was found in alluvial, brown and limeless brown forest soils. According to research results, it is seen that soil organic carbon amount is low in the area where extensive agricultural techniques are utilized, high in grassland and forest area. In addition, it was pointed out in the research that organic carbon intensity in soils is affected from agriculture, temperature and rainfall particularly.

In the research conducted in Galyan-Atasu (Trabzon) dam basin, Kara and Baykara (2014) statistically proved that organic carbon concentrations were not influenced from soil aggregate stability in the soils under use of agriculture and forest land. The researchers calculated microbial biomass carbon content of soil (C_{mic}) according to the method mentioned in the publication of Brookes et. al (1985) and Vance et. al (1987). In this method, by means of chloroform-fumigation-extraction techniques, samples were prepared after mineral soil samples having humidity value under land conditions in 0.5 M K_2SO_4 (1.4 w / v) were made oven dry. Organic carbon content of K_2SO_4 extract may be calculated with back titration with ferrous ammonium sulphate following oxidation with 0.4 N $K_2Cr_2O_7$ at 150ºC for 30 minutes. C_{mic} is calculated with C=2.64 EC equation from the difference between extractable organic carbon values between soil samples with and without fumigation. Here, FC is the difference between extractable organic carbon values among the soil samples with and without fumigation. Jenkinson and Ladd, (1981) used measurement technique which was made by use of NaOH with flow injection analysis for electrical conductivity of a 20 gr sample according to fumigation-incubation technique of soil microbial biomass carbon. With use of CO2 which is taken out of fumigation samples of soil microbial biomass carbon, carbon amount is calculated. (Franzluebbers et. al, 1999). As a result of multiplication of this value with 0.45 (kc) attest factor, amount of microbial biomass carbon may be calculated.

Tüfekçioğlu et. al (2010) searched soil respiration rates, using soda-lime method along with other soil properties (humidity, temperature, etc.) once for each two month in a period of 2 years for the areas where corsica pine of 25 years (Pinus nigra Arn.) were available following fire broken out in July 2003, Kastamonu. Thin and small rooted biomass amounts were identified once for 2 months by use of sequential coring method. According to results of the research, it is seen that as soil temperature and soil humidity increases, respiration rates of soil also go up. Biomass value of fine root was found lower in burnt area compared to control area. Biomass value of average fine root was calculated 4940 kg/ha for burnt area, 54500 kg/ha for control area. It was presented that this difference was statistically significant too. ($p<0.01$)

In the research conducted in forest area, sand dunes and thermophile forest of flood plain at İğneada region located in Thrace region, Tecimen and Kavgacı (2010) calculated organic carbon percentages as % 5.619, % 4.191 and % 0.478 respectively for the soil samples taken from 0-5 cm depth. Carbon values were found % 3.793, % 1.872 and % 0.393 respectively for the soils at 5-15 cm depth. The reason for finding the organic carbon value lower in sand dunes as compared with other ecosystem types is indicated as very low amount of litter. It was expressed that monoculture stand type of thermophile forests may cause obtaining carbon content in litter lower than relevant stands in flood plains.

Monthly soil respiration research was conducted between January 2005- November 2005 in acacia plantation and grass area next to it (control area) at Murgul (Artvin) region by Guner et. al. (2010). It was indicated that both areas affected from acid rains. Average soil respiration was found 0.74 C m g-2 in acacia plantation area, 1.03 g C m-2 day-1 in grass area The researchers used soda-lime method in order to identify CO2 exit from soil.

Sakin et. al (2016) investigated soil respiration with soda-lime method during the research conducted at the picnic site in Şanlıurfa. In consequence of the research, CO2 exit from soil was 2.51 (min) - 6.84 (max) g m^{-2} day^{-1}, average carbon exit was calculated 4.05. m g-2 day-1. The researcher also searched if these parameters have any effect on CO2 exit, realizing measurement of temperature and humidity values in container at which soda-lime method was used except for relative humidity and temperature measurements. Accordingly, it could be seen that CO2 exit was inversely proportional to relative humidity (-0.882, $p<0.01$) and temperature in container (-0.897, $p<0.01$) and had high correlation. It was found that relative humidity in container (0.867, $p<0.01$) had positive high correlation with CO2 exit.

Soda-lime method used by Sakin et. al (2016) was explained as follows.

In Soda-lime method, it was ensured that CO2 chemically connected to soda-lime which had alkali property. Soda Lime, a granular chemical consisting of the mixture of CaOH + NaOH (calcium and sodium hydroxides). This situation makes possible to fix CO2 with a number of chemical reactions. CO2 fixation may be calculated with the aid of the following equation. (Edwards, 1982).

$$E_{CO2}=(A_{sl}-B_{sl})*SDF / A*Z$$

E_{CO2} shows CO_2 emission (g day^{-1} m^{-2}), A_{sl}, CO2 amount absorbed with soda-lime, B_{sl}, initial soda-lime amount, SDF, water correction factor (1.69), Zi incubation period (time, day).

Bolat, I. (2014), in its research titled "The effect of thinning on microbial biomass C, N and basal respiration in black pine forest soils in Mudurnu, Turkey" made researches on soil organic carbon (%) and microbial biomass carbon (µg g^{-1}) during stand spacing studies belonging to pinus nigra (*Pinus nigra* Arn. Subsp. Pallasiana) within the Mudurnu district borders affiliated to Bolu province. Spacing was actualized in April 2009 and decreased the canopy density of stand at 70% rate (a spacing of 55% was made). According to results of the research, organic carbon percentage was found 4.07 ± 1.13 in soil mass at 0-5 cm height, 4.06 ± 1.69 at control area. Microbial biomass carbon amount in spacing and control area was calculated 791.35 (±527.77) µg g^{-1} and 624.78 (±333.25) µg g^{-1} respectively. According to the research, it was determined that although spacing increased biomass carbon amount, this increase was statistically insignificant. Besides, in the research, total organic matter concentrations in soils were calculated in accordance with Walkley-Black Potassium dichromate sulphuric acid oxidation procedure which was used frequently in our country in general. Details of the procedure were explained in detail in the research of Nelson and Sommers (1982).

According to Bolat, I. (2014), soil respiration is divided into two, basal respiration and substrate induced respiration. Basal respiration is the one that no organic substrate is included. Substrate induced Respiration is soil respiration measure in the presence of an added substrate like amino acids, etc. (Lin et. al, 1999). Basal respiration is measured with use of sodium hydroxide (NaOH) trap method. Therefore, microbial respiration may be predicted with substrate induced respiration (SIR). (Dilly and Munch, 1996).

Maximum initial respiration reaction of 1 kg dry litter (with 2.5 g H_20 gg dry litter);

Küçüker et. al (2015) calculated carbon storage values of the soil horizons at certain thicknesses for 360 pcs soil samples from April 2009 to November 2009 in agriculture and forest of Karasu. This calculation was made with the following formula.

$$C_{S,P,i} = (C_{Pb}Z_i\ (1\text{-}RM))/100$$

Here;

$C_{SP,i}$ = carbon stock of i horizon (kg/m^2)
C= carbon content of i horizon (%)
Pb = mass density of i horizon (kg/m^3)
Z_i = thickness of i horizon (m)
RM = stone fraction

By adding carbon stock in each horizon, total carbon stock value of that point was obtained. This equation is seen below.

$$C_S = \sum_{\text{İ}=1}^{n} C_{SP,\text{İ}}$$

Here,

Cs is the carbon stock described at 1 m depth for any certain location. (kg/m^2).

In the research, it was ascertained that carbon stock at 0-5 cm depth was statistically significant in agriculture and forest (agriculture= 1.74 kg/m2 and forest= 2.09 kg/m2, p= 0.014). No statistically significant difference was detected for soil carbon stock at 1 m depth. (agriculture= 12.12 kg/m2 and forest = 12.36 kg/m2).

Korkanç (2014) investigated soil organic carbon at 0-10 cm and 10-20 cm soil depth over bare land and pinus nigra of 15 years (Pinus nigra Arn. Subsp. Nigra- Black Pine), cedrus libani (Cedrus libani A. Rich- Lebanon cedar) which were evaluated as aforestation area found in Niğde akaya dam basin which shows semi-arid climate feature. Soil organic carbon (%) was found 1.19±1.74% in pinus nigra afforestation, % 1.49±1.82 in cedrus libani, % 0.64±1.69 in bare area for the soils at 0-10 cm depth. Considering 10-20 cm soil depth, soil organic carbon (%) was calculated 0.99±1.82% for pinus nigra afforestation, 0.82±2.54 % for sedrus libani and 0.44±1.52% for bare area. In the research, statistical significant of correlation with dispersion rate of soil organic carbon (%) was detected.

Bayramin et. al (2009) searched soil erodibility (USLE-K) and soil organic carbon (SOC) in *Pinus nigra* plantation of 40 years which were converted from grassland and the grasslands in İndağı (Çankırı) region. To that end, total 302 pcs soil samples were taken from 0-10 and 10-20 cm soil depth. Considering 0-10 cm soil depth, according to results of the research, it was seen that 2.4±0.1% soil organic carbon accumulated in grassland, 2.8±0.1 in plantation area. As to 0-20 cm depth, 1.8 ± 0.05 % soil organic carbon was calculated for grasslands, 1.6 ± 0.05 for plantation areas. It was revealed that soil organic carbon decreased in statistically significant way with depth ($p<0.05$). When organic carbon sequestration of soil in grasslands and plantation areas was considered, no statistically significant difference was seen. Therefore, it was presented in the research that soil organic carbon was not affected from lad use. When the researcher examined spatial distributions of soil organic carbon via Kriging method, effect of land use was found insignificant for 0-20 cm depth soil, it was revealed that land use at 0-10 cm depth could be efficient on spatial distributions of soil organic carbon.

Göl, (2017) calculated organic carbon amounts of soil at 0-20 cm depth along with various soil properties, evaluating North and South aspects at 180 pcs sampling points in total for three different land uses, forest, grassland and agricultural in Uludere (Çankırı) watershed. When North and South aspects were considered separately, the highest organic carbon percentage was seen % 1.58 ± 0.6 / % 1.09 ± 0.6 in forest. Soil organic carbon percentage was calculated % 0.69 ± 0.3 / % 0.41 ± 0.3 in grasslands and this value was % 0.23± 0.2 / 0.16 ± 0.2 in agriculture. Hence, the lowest organic carbon percentage of soil was seen in agriculture. Ross et. al (2016) indicates that agricultural activity accelerates decomposition process of soil organic matter, so cause decrease in organic carbon amounts of soil. Besides, carbon amount in South aspects are found lower than North aspects.

Sarıyıldız et. al (2017) investigated organic carbon amounts together with various physical soil properties at upper (0-10 cm) and lower (10-20 cm) soil depth for mineral soil samples of aged (aged 85) and young abies (aged 45) stands and the agricultural and grassland next to it in Kastamonu region. Soil organic carbon at soil level of 0-10 cm depth was found aged abies (% 2.56±0.70), young abies (% 2.20±0.85), grassland (% 1.76±0.43), and agriculture (% 1.25±0.25) respectively from the highest value towards the lowest one. At 10-20 cm soil level, it was found young abies (% 1.61±0.27), aged abies (% 1.55±0.73), grassland (% 1.43±0.22), and agriculture (% 0.95±0.51) from the highest value towards the lowest one.

Hacısalihoğlu et. al (2017) investigated effects of land use changes in Ünye (Ordu) region on soil properties, soil removal and soil carbon. Soil carbon amount was calculated 150.4 t/ha for grassland, 174.3 t/ha for forest.

Tüfekçioğlu and Küçük (2004) tried to determine effects on soil respiration of sampling time and plant species of young picea orientalis at which rhododendron (*Rhododendron ponticum* L.) was found at lower layer and aged picea orientalis (*Picea orientalis* (L.)Link.) stands at which rhododendron was found/not found and the grasslands next to them in Artvin-Genya mountain. Soil respiration determined in two different soil depths (0-15 cm and 15-35 cm) and through soda-lime methods from May 2003 till October was found 1.68±0.27 g C m^{-2} day^{-1} for grassland, 0.89±0.16 g C m^{-2} day^{-1} for aged stand (without rhododendron), 1.13±0.21 for young stand and 0.59±0.13 g C m^{-2} day^{-1} for aged stand (with rhododendron) in average. According to results of the research, statistically significant difference were detected between aged stand value and grassland value of soil respiration which was determined to have affected from soil temperature and soil humidity.

Besides, it was ascertained that soil respiration changed with fine root mass (<2 mm) ($R = 0.91$, $P < 0.001$), sand ratio of topsoil, ($R = 0.71$, $P < 0.05$), dust ratio of topsoil ($R = -0.69$, $P < 0.05$) and pH of subsurface soil (15-35 cm) ($R = 0.60$, $P < 0.05$).

Sarıyıldız et. al (2005) compared decomposition rates of litter samples in permeable nylon bags during 42 months for pure beech and picea stands and beech- picea mixed stands. It was seen that picea needles decomposed faster than beech needles due to different lignin amounts contained by leave and needles. In addition, the highest decomposition rates were seen in mixed stand followed by pure beech stand and the lowest difference was associated with picea stand. Based on this result, it was suggested that low pH values of soils in pure beech stand significantly decreased decomposition rate, but this negative situation was eliminated in mixed stands. In the research, organic carbon values were found as per wet chemical oxidation method determined by Judithá Charles and Simmons (1986). Average carbon was detected 47.1% for pure beech stand, 46.4% for pure spruce stand, 47.8 % for beech species in mixed sand and 46.2% for spruce species.

Sarıyıldız (2003) tried to ascertain effect on decomposition rates of chemical compositions of litters (total carbon, nitrogen, lignin, cellulose and hemicellulose) of picea (*Piecea prientlias*), yellow pine (*Pinus sylvestris*) and chestnut (*Castanea sativa*) species which grow in Artvin region. In the course of analyses conducted in 6th, 12th, 18th and 24th months, decomposition rates were calculated for the litter samples left in land in permeable nylon bags. At the end of first six months, decomposition rate was found 8.87% for picea, 16.4% for yellow pine and 25.9% for chestnut. Decomposition rates at the end of 24th month was found 35.9% for picea, 51.1% for yellow pine and 64.5% for chestnut. As a result of the research, it was found that lignin amount (r^2 = 0.97) was the most important chemical compound which affects mass losses of litter samples. Leco HF10 gravimetric carbon analyser (Leco Corporation, St. Joseph, USA) was used for organic carbon. During the research, average carbon amount was determined 46.4% for picea species, 46.2% for yellow pine and 51.3% for chestnut.

In the studies of Kara and Bolat (2008), microbial biomass carbon amount of soils at 0-5 cm depth in forest, grassland and agriculture under the same growing environment conditions in Bartın region was determined with chloroform fumigation extraction method. According to research results, average microbial biomass carbon contents were calculated 1028.29 µg g^{-1} for forest area, 898.47 µg g^{-1} for grassland land and 485.10 µg g^{-1} for cropland. In the research, organic carbon content of soil (%) calculated as per Walkley-Black wet oxidation method was found 4.14±0.22 in forest, 2.69±0.60 in grassland and 1.19±0.27 in agriculture.

Çelik et. al (2017) found soil organic carbon between % 0.07 and % 1.95 interval from soil samples at 0-20 cm depth in the area covered with pistachio in Birecik and Halfeti regions. Soil carbon was calculated with the following equations in the research.

$$BD=19.167-SOM / 11.7$$

$$SOCd=BDi*SOCi*Di$$

$$SOCs=SOCd*A$$

Here,

BD = volume weight (g cm^{-3}), SOM = soil organic matter (%), SOCd = density of soil organic carbon concentrations (kg m^{-2}), SOC = soil organic carbon (%), Di = depth (cm), SOCs = soil organic carbon storage (Tg), A = area (m^2)

Sakin et. al (2010) calculated organic and inorganic carbon, carbon storage separately in the soils at 0-100 m depth among large soil groups in Adana region. Total 567.19 Tg carbon sequestration in 168.37 Tg organic carbon, 398.83 Tg inorganic carbon were calculated at 0-100 m depth accordingly. 77.81% of organic carbon was seen in alluvial, brown, calcareous free brown forest soils. 59.77% of inorganic carbon was seen in alluvial, colluvial and brown forest soil. Organic and inorganic carbon storage was seen 13.78/-kg C m^{-2} in calcerous free forest soil, 6.01/35.43 C m^{-2} in regosol soils. Carbon storage was found 12.17/60.01 C m^{-2} in colluvial soils, 11.29/54.56 C m^{-2} in grey-brown soils, 9.84/48.32 C m^{-2} in alluvial soils, 8.34/26.27 C m^{-2} ,m Brown forest soils.

3.DATA SOURCES FOR EMISSION FACTOR

According to the Regulation on Control of Industry Based Air Pollution, emission factor is average emission amount at unit value (volume, time, area, etc.) of a certain pollutant arisen from any activity or equipment. Therefore, emission factors are the coefficients that indicate amounts of pollutant which are emitted to atmosphere on the basis of unit activities for any activity. Emission factors may show change from one country to another one, also vary in time depending on status, density and change of activities in country. With regard to emission factor in LULUCF sector particularly, coefficients have been formed over average emission amount in unit area. Considering tier approaches of IPCC, assumed values found in emission factor database were considered for emission factors of Tier 1. Assumed values specific to our country may be accessed from the table in IPCC 2006 guide or IPCC emission factor database. If no country name is given directly in the guide and the emission factor database, assumed emission factor values may be accessed with climate and ecologic region filtrations specific to country. When Tier 2 and 3 are considered, emission factor values are the ones more specific to country and the regions in country compared to assumed values which are used based on Tier 1 approach. This may be obtained with the scientific studies which are conducted according to IPCC calculation methods in country. If emission factors specific to country, region or the activity in country are used according to IPCC (2006) and new methods are utilized (except for assumed IPCC methods), it is emphasized that scientific base of these emission factors and methods should be completely described and documented.

3.1. DATA SOURCES FOR NATIONAL EMISSION FACTOR

There have been no emission factor specific to our country yet, but emission factor values may be reached on this subject in project result reports and academic studies conducted in spite of being limited. As a result of all these studies, results of the emission factor studies which are conducted by also considering LULUCF sector within the borders of our country are indicated in National Inventory Reports.

3.1.1. National Inventory Report (NIR, 2017)

According to results of research specific to Turkey, obtained emission factor values may be evaluated with Tier 2 approach. Therefore, the most important and current report in which country specific values to be used for Tier 2 as well as emission factor values obtained with Tier 1 approach by use of default values utilized in Tier 1 are gathered is National Inventory Report 2017 printed by Turkish Statistical Institute (TÜİK). One of the most remarkable researches related to emission factor for LULUCF sector in the inventory report is the results of TÜBİTAK Project with code no. 112Y096. This Project titled “development of ecosystem services software to support sustainable land planning studies- improvement of climate change” contains the detailed information relevant to digitization of ecosystem services including carbon sequestration in cities and urban regions.

It was realized in hot dry HAC soils which are dominant climate and soil type in Turkey and on 59 sample in forest, agriculture and grassland for carbon stock calculation in ponds of the Project. (Table 14). Since sample number related to carbon stock in agriculture lands of this study is low, the studies in Table 15 has taken their places in inventory report. Tolunay and Çömez (2008) found that the EF values associated with dead organic matter were 7.51 ± 6.61 ton / ha (n = 601) and 3.09 ± 1.58 ton / ha (n = 368) for conifers and bradleaf species, respectively. In the national inventory report, soil organic carbon EF values are 76.37 ± 51.03 ton / ha (n = 820) and 80.40 ± 58.95 ton / ha (n = 191) for conifers and broadleaf species, respectively (Tolunay and Çömez, 2008).

Table 14. Carbon stocks calculated for various land uses

	Soil (t C/ha)		Litter (t C/ha)		surface biomass (t C/ha)		Subsurface biomass [1] (t C/ha)	
	Ave.	St.dev.	Ave.	St.dev.	Ave.	St.dev.	Ave.	St.dev.
Grassland	100.56	36.69	0.06	0.07	0.49	0.36	1.37	NA
Agriculture (annual)	50.49	NA	0.27	0.36	0.75	0.27	0.00	NA
Coniferous	127.38	127.38	4.43	3.27	130.60	77.32	26.12	15.46
Broad leaved	97.29	29.98	2.86	1.65	157.75	125.98	37.86	30.23
Mixed forest	122.70	37.15	4.02	1.77	135.16	71.10	28.23	15.03
Leaved-recre.	97.77	21.53	1.49	0.70	157.59	125.72	37.86	30.23

[1] Subsurface biomass was calculated with default IPCC (2006) values.

Table 15. Organic carbon stock of soil (the project of Ministry of Food, Agriculture and Livestock)

,	Climate region	Aver. (t C/ha)	St. dev. (t	Sample size
Perennial		33.6	7.7	10
Annual		27.1	16.4	1 787
	Hot-dry	27.5	16.2	1 555
	Cold-dry	23.9	17.8	232
Grasslands		29.3	12.9	11

In the Project no. 112YO96, settlements were analysed by classifying them into 4 classes. According to impermeable area percentages limit values of Project, settlements were formed in terms of % 20, % 40, % 60 and % 80 impermeable area percentages. Emission factor values specific to country which are obtained from these 4 different settlement classes are shown below. (Table 16).

Table 16. Total carbon stock calculated for density classes of various settlements

Settlement class (SC)	settlement density (impermeable area %)	Aver. (t C /ha)	St.dev. (t C /ha)	sample number (#)
1	>10	85.27	74.19	1 145
2	>40	51.87	41.85	697
3	>60	32.04	25.32	438
4	>80	17.26	13.73	258

According to Table 16, it is seen that the highest emission factor value (85.27 t C/ha) is at 1th settlement class having impermeable area amount more than 10%, the lowest emission factor value (17.26 t C/ha) is at 4th settlement class having impermeable surface smaller than 80%.

3.2. DATA SOURCES FOR INTERNATIONAL EMISSION FACTOR

3.2.1. IPCC Emission Factor Database

Emission factor values of three different gases, carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O) are scrutinized based on 7 different sources in IPCC emission factor database system.

These sources:

1. Energy
2. Industrial processes
3. use of solvent and other products
4. Agriculture
5. land use change and forestry
6. waste
7. other

Emission factor values arisen by the source stated under the title “Land use change and forestry” which are specified in article 5 here are also indicated below separately in subtitles.

5A: Changes occurred in forestry and other woody biomass stocks

5B: Forest and grass transformation

5C: Abandoning Managed Areas

5D: CO_2 Emission and removal in soil

5E: Other

5-FL: Forest land

5-CL: Agriculture

5-GL: Grassland

5-WL: wetland

5-SL: settlement

5-OL: other land

Emission factors caused by these factors are shown in the following tables for reference years 1996 and 2006 and the large climate zones seen in our country. Large climate zones seen in our country are listed below.

1. Warm temperate, dry
2. Warm temperate, moist
3. Cool temperate, dry
4. Cool temperate, moist

Emission amounts as per IPCC data of three main greenhouse gases (CO2, CH4 and N2O) are tabulated according to climate and source category. (Annex Tables 29, 30 and 31).

4.KEY CATEGORIES

Key category analysis in greenhouse gas inventory of our country is carried out by TUİK. Calculation is made based on both amount and orientation in Tier 1. Both calculations are given below. (Table 17 and 18)

Table 17. Key category analysis for amount (NIR Turkey, 2017)

	Sector	Fuel	Gas	2015 Emission	ABS (Emission)	Waste (%)	Cumulative
1.A.1.	Energy industries	Solid fuels	CO_2	81 459.15	81 459.15	14.95	14.95
1.A.3. b.	Road Transport		CO_2	67 889.31	67 889.31	12.46	27.41
1.A.1.	Energy industries	Gas fuels	CO_2	46 891.27	46 891.27	8.61	36.02
4.A.1.	forest land remaining forest land		CO_2	-35 188.41	35 188.41	6.46	42.48
2.A.1.	Cement production (Mineral products)		CO_2	32 618.66	32 618.66	5.99	48.46
1.A.4.	Other sectors	Gas fuels	CO_2	27 679.90	27 679.90	5.08	53.54
3.A.	Enteric fermentation		CH_4	26 888.01	26 888.01	4.94	58.48
1.A.4.	Other sectors	solid fuels	CO_2	23 845.39	23 845.39	4.38	62.85
4.A.2.	Lands converted to forest lands		CO_2	-21 486.81	21 486.81	3.94	66.80
1.A.2.	Manufacturing industry and construction	solid fuels	CO_2	20 185.62	20 185.62	3.70	70.50
1.A.2.	Manufacturing industry and construction	Gas fuels	CO_2	19 618.52	19 618.52	3.60	74.10
3.D.a.	Total man. direct N2O emissions		N_2O	17 427.90	17 427.90	3.20	77.30
1.A.2.	Manufacturing industry and construction	liquid fuels	CO_2	16 000.94	16 000.94	2.94	80.24
5.A.	Solid waste disposal		CH_4	12 455.27	12 455.27	2.29	82.53
2.C.1.	İron and steel production		CO_2	11 452.26	11 452.26	2.10	84.63
1.A.4.	Other sectors	liquid fuels	CO_2	11 159.19	11 159.19	2.05	86.68
4.G.	Harvested wood products		CO_2	-10 227.40	10 227.40	1.88	88.55
1.A.1.	Energy industries	liquid fuels	CO_2	7 210.29	7 210.29	1.32	89.88
3.D.b.	Total man. direct N2O emissions		N_2O	5 449.64	5 449.64	1.00	90.88
2.F.6.	Other applications		HFC	4 678.31	4 678.31	0.86	91.74
1.A.3. a.	Domestic aviation		CO_2	4 161.93	4 161.93	0.76	92.50
3.B.	Fertilizer management		CH_4	3 159.66	3 159.66	0.58	93.08
3.B.	Fertilizer management		N_2O	3 144.12	3 144.12	0.58	93.66
2.A.2.	Lime production (Mineral products)		CO_2	2 628.30	2 628.30	0.48	94.14
4.C.2.	Areas converted to cropland		CO_2	2 593.58	2 593.58	0.48	94.61
5.D.	Waste water treatment and discharge		CH_4	2 371.23	2 371.23	0.44	95.05

As can be seen from Table 18, the sector having the highest emission value in 2015 was energy industries (1.A.1)

Table 18. Key category analysis for orientation (NIR Turkey, 2017)

	Sector	Fuel	Gas	2015	1990	Trend	Waste	Cum.
1.A.1.	Energy industries	Gas fuels	CO_2	46 891.27	5 024.67	0.15	11.11	11.11
4.A.1.	Forest land remaining forest land		CO_2	-35 188.41	-23 910.51	0.13	9.81	20.92
1.A.1.	Energy industries	solid fuels	CO_2	81 459.15	25 957.84	0.13	9.53	30.45
1.A.4.	Other sectors	Gas fuels	CO_2	27 679.90	93.85	0.11	8.19	38.64
1.A.3. b.	Road transportation		CO_2	67 889.31	24 142.97	0.09	6.52	45.16
4.A.2.	Lands converted to forest lands		CO_2	-21 486.81	-4 412.36	0.08	6.27	51.44
1.A.2.	Manufacturing industry and construction	Gas fuels	CO_2	19 618.52	1 557.09	0.07	4.96	56.40
1.A.4.	Other sectors	Liquid fuels	CO_2	11 159.19	14 436.34	0.07	4.87	61.26
3.A.	Enteric fermentation		CH_4	26 888.01	22 314.09	0.06	4.65	65.92
1.A.2.	Manufacturing industry and construction	Solid fuels	CO_2	20 185.62	17 435.82	0.05	3.88	69.80
2.A.1.	Cement production (Mineral production)		CO_2	32 618.66	10 444.54	0.05	3.79	73.59
4.G.	Harvested wood products		CO_2	-10 227.40	-4 368.20	0.04	2.92	76.51
1.A.2.	Manufacturing industry and construction	Liquid fuels	CO_2	16 000.94	13 232.02	0.04	2.74	79.25
3.D.a.	Total man. direct N2O emissions		N_2O	17 427.90	13 162.98	0.03	2.28	81.53
1.A.1.	Energy industries	Liquid fuels	CO_2	7 210.29	6 878.52	0.02	1.76	83.29
2.F.6.	Other applications		HFC	4 678.31		0.02	1.39	84.68
1.A.4.	Other sectors	Solid fuels	CO_2	23 845.39	14 713.62	0.02	1.25	85.93
1.A.4.	Other sectors	Biomass	CH_4	801.49	2 263.35	0.01	1.05	86.97
1.B.1	Solid fuels		CH_4	1 236.30	2 458.50	0.01	1.03	88.00
4.D.2.	Lands converted to wetlands		CO_2		1 741.74	0.01	0.99	88.99
5.D.	Wastewater treatment and discharge		CH_4	2 371.23	2 789.04	0.01	0.88	89.86
3.D.b.	Total man. direct N2O emissions		N_2O	5 449.64	4 365.13	0.01	0.85	90.72
4.C.2.	Lands converted to forest lands		CO_2	2 593.58	66.49	0.01	0.73	91.45
1.A.3. a.	Domestic aviation		CO_2	4 161.93	913.74	0.01	0.72	92.17
2.G.1.	Electrical equipment		SF6	1 984.85		0.01	0.59	92.77
4.B.2.	Lands converted to cropland		CO_2	6.12	929.02	0.01	0.53	93.29
2.A.2.	Lime production (Mineral products)		CO_2	2 628.30	2 290.53	0.01	0.52	93.81
1.B.2.	Natural gas		CH_4	1 998.51	143.70	0.01	0.51	94.32

b									
1.A.2.	Manufacturing industry and construction	Other fossil fuels	CO_2	1 605.75		0.01	0.48	94.80
3.B.	Fertilizer management		CH_4	3 159.66	2 352.09	0.01	0.39	95.19

In terms of amount

4.A.1. Forest Land Remaining Forest Land
4.A.2. Land Converted to Forest Land
4.G. Harvested Wood Products
4.C.2. Land Converted to Grassland

In addition to the ones above, in terms of trend;

4.D.2. Land Converted to Wetlands
4.B.2. Land Converted to Cropland

were determined as key category. These determined categories should be calculated as per Level 2.

5. REGULATIONS UNDER EU FOR LULUCF SECTOR

In order to understand the regulations on LULUCF of EU, it is required to know general mitigation strategy of EU well. EU mitigation strategy is mentioned below from general towards LULUCF.

EU put climate and energy package into force in 2009. Accordingly, for 2020,

- 20% decrease in greenhouse gas emission,
- Increasing to 20% of renewable energy share,
- 20% increase in energy efficiency are envisaged.

Mitigation target 2020 of EU is 20% compared to 1990. Primary 2 mechanisms play role to ensure that. These are ETS and ESD. It is predicted that 2020 emissions will be decreased 21% as compared to 1990 thanks to ETS, 10% compared to 2005 because of ESD. With joint effect of both, it is envisaged that 20% target will be caught in 2020. These two mechanisms are detailed below.

Emission Trading System (ETS) – is a “cap and trade” mechanism that provides efficient decrease of emissions from the aspect of benefit-cost. The largest carbon market of the World is primary mitigation system of EU too. Limit (allowed emission amount) decreases in time, so decrease is provided in total emissions. Within the scope of the system, companies may purchase emission permission from each other, also buy credit at certain rates from non-EU projects conducted across the World. To the companies who has failed to buy sufficient emission permission (credit) at the end of the year, serious fines are applied. The companies that have emission permission more than emission may sell these to other companies or keep these for their future usage. In 2013-2020 period, ETS has entered in its third phase. In this phase, more sectors are found in addition to other 3 phases, a certain fund is transferred to innovative energy sectors. Thanks to the system, 21% decrease will be provided in 2020 compared to 2005, 43% decrease in 2030 as compared to 2005. The gases and sectors involved in the system (around 45% of total emission);

Sectors that CO_2 emission is made;

I. Heat and energy production sector,

II. Sectors that extensive energy usage realizes (refineries, iron and steel industry, aluminium, metal, cement, lime, glass, ceramic, pulp, acid and organic chemical product sectors),
III. Commercial aviation

Sector that N_2O emission is made;

I. Nitric, adipic and glyoxylic acid production and glyoxal sectors

Sector that PFC (perfluorocarbon) emission is made;

I. Aluminium production sector

Effort Sharing Decision (ESD) – a component of EU Energy and Climate Package, a regulation that separate mitigation rate is determined for each country on annual greenhouse gas emissions of member countries in 2013-2020 period and also cover some sectors not included in ETS. Sectors in addition to ETS are transport, buildings, agriculture and waste. Emission permissions of member countries have been identified separately by taking per capita income as basis. While mitigations of rich countries reach 20%, it raises up to 20% increase in poor countries.

European Council adopted Climate and Energy Framework 2030 in October 2014. According to this framework, binding mitigation decision is taken at 40% ratio for 2030 across economy on the basis of base year 1990. In order to provide this mitigation, 43 % and 30 % mitigation should be realized respectively in ETS (European Trade System) and non-ETS sectors in 2030 compared to 2005 .

Regulations on LULUCF sector in force of European Union are;

Decision No 529/2013/EU of the European Parliament and of the Council of 21 May 2013 on accounting rules on greenhouse gas emissions and removals resulting from activities relating to land use, land-use change and forestry and on information concerning actions relating to those activities.

This decision regulates accounting system of LULUCF sector of EU member countries. LULUCF sector does not enter within the scope of 20% mitigation which is targeted for 2020 compared to 1990 with the resolution no. 406/2009/EC of EU. In other words, EU does not add LULUCF mitigations to 2020 target within the scope of EU UNFCCC. However, the same decisions envisage development of the rules and principles on integration into climate policies and monitoring of LULUCF sector. Here, objective of the decision no. 529/2013/EU is to reveal some principles related to inclusion of LULUCF into EU climate policies and to actualize regulations. It eliminates some uncertainties in definitions and calculations without emerging the necessity of any accounting or reporting for member countries and ensures coordination. LULUCF definitions present in this document have also importance in terms of LULUCF sector of Turkey and should be compatible.

Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC Text with EEA relevance

This regulation is new decision which is brought instead of the decision no. 280/2004/EC of EU, defines reporting and monitoring system under Kyoto Protocol. Since our country does not make KP reporting, this regulation is not directly interested in our reporting system.

COMMISSION STAFF WORKING DOCUMENT IMPACT ASSESSMENT Accompanying the document Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry into the 2030 climate and energy *framework and amending Regulation No 525/2013 of the European Parliament and the Council on a mechanism for monitoring and reporting greenhouse gas emissions and other information relevant to climate change.*

This regulation is a decision in addition to the decision no. 525/2013, deals with inclusion of LULUCF sector into Climate and Energy Framework 2030 and arrangement of monitoring-reporting mechanism.

6. CURRENT SITUATION, REQUIREMENTS AND GAPS IN LULUCF INVENTORY

For LULUCF sector, firstly current situation in calculations should be analysed. Current situation is determined by forming emission factor sources used with responsible institutions in which activity data sources are developed.

6.1.CURRENT SITUATION

The metodal approach and emission factors used in AKAKDO sector calculations are shown in the table below.

Table 19. Metodal approach and emission factors used in AKAKDO calculations

Greenhouse Gas Resources and Sink Categories	CO_2		CH_4		N_2O	
	Method Application	EF	Method Application	EF	Method Application	EF
4. AKAKDO	T2	CS, D	T2	D	T1,T2	D
A. Forest land	T2	CS	T2	D	T2	D
B. Cropland	T1,T2	D	NE	NE	T1	D
C. Grassland	D,T1,T2	CS, D	NE	NE	NE	NE
D. Wetland	NE	NE	NE	NE	NE	NE
E. Settlement	CS	D	NE	NE	NE	NE
F. Other land	NO	NO	NO	NO	NO	NO
G. Harvested Wood Product	T2	D	-	-	-	-
H. Other	NO	NO	NO	NO	NO	NO

Where; T1 = Tier 1, T2 = Tier 2, CS= Country spesific, D =Default, NO = Not occured, NE = Not estimated

Activity data used in LULUCF Sector calculations are (Table 20);

Table 20. Our substrates of current activity data and the institutions responsible for substrates

Our Database for Current Activity	Related Institution
CORINE 1990, 2000, 2006, 2012	OSİB, GTHB
ENVANIS	OGM
Climate and Soil maps	TAGEM
Dam areas and dates (former usage way is missing)	DSİ
TUIK land area, fertilizer and cereal production figures	TİK
The one taking peatland permission and depth data	DKMPGM
Data on poplar wood (spatial substrate missing)	OGM
OGM Wood production figures	OGM
OGM Fire Statistics	OGM

OGM Illegal benefiting data	OGM
BUGEM and OGM grassland rehabilitation data	BUGEM, GDF

Emission Factor data used in LULUCF sector calculations are (Table 21);

Table 21. Emission Factor data and sources used in calculations

Emission factor	Coefficient	Category	Value	Uncertainty	Source
	BCEF	FL-FL	0.541-0.709 ton/m3	uncertain	Tolunay,2013
	R	FL-FL	0.20-0.46	High	IPCC, 2006
	Young stand Iv	FL-FL	1.24-1.95 m3/ha	Uncertain	Expert opinion
	CF	FL-FL	0.48-0.51	High	IPCC 2006
	fd	FL-FL, L-FL	0.44	Uncertain	OGM
M_B		FL-FL, L-FL		Uncertain	OGM
DOM		FL-FL	3.09-7.51 ton C/ha	Medium	Tolunay and Çömez, 2008
SOC		FL-FL, L-FL	76.37 - 80.40 ton C/ha	Medium	Tolunay and Çömez, 2008
Surface biomass carbon		L-GL	0.49 ton C/ha	Medium	Serengil et. al, 2014
Subsoil biomass carbon		L-GL	1.37 ton C/ha	Medium	Serengil et. al, 2014
Surface biomass carbon		CL-CL, L-CL	0.75 ton C/ha	Medium	Serengil et. al, 2014
Subsoil biomass carbon		CL-CL, L-CL	0 ton C/ha	High	IPCC, 2006
Total carbon stock		L-SL	85.27 ton C/ha 51.87 ton C/ha 32.04 ton C/ha 17.26 ton C/ha	Low	Serengil et. al, 2014
SOC annual		L-CL- CL-CL	23.9-27.5 ton C/ha	Low	TRGM
SOC perennial		L-CL, CL-CL	33.6 ton C/ha	Low	TRGM
SOC		L-GL	29.3 ton C/ha	Low	TRGM
Perennial agriculture Iv		CL-CL	1 ton C/ha year	High	Italia inventory
Poplar Iv		CL-CL	28 m3/ha year	Medium	National source
Poplar WD		CL-CL	0.40 ton/m3	Medium	National source

6.2.REQUIREMENTS AND GAPS

Requirements and gaps in terms of Activity Data and Emission Factor /EF) in LULUCF Inventory may be sorted as follows;

I. One of the most important data required for calculation in LULUCF sector is Activity Data. As can be seen from Table 22, some cells of land use matrix is described with NO symbol and some with NE symbol. NE symbol means this change has taken place but could not be reported due to insufficiencies.

Table 22. Land use matrix by LULUCF sector

TO USE / FROM USE	Woodland (managed)	woodlands (unmanaged)	Croplands	Grassland (managed)	Grassland (unmanaged)	Wetlands (managed)	wetlands (unmanaged)	Settlements	Other land	Total unmanaged areas	**Total previous land**
	(kha)										
Woodlands (managed)	20437.59	NO	NO	234.21	NO	NO	NO	NO	NO	NO	20671.81
Woodlands (unmanaged)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Croplands	NO	NO	28080.39	1.34	NO	NO	NE	0.28	NE	NE	28082.01
Grassland (managed)	1905.34	NO	2.00	14617.00	NE	NO	NE	1.83	NE	NE	16526.17
Grassland (unmanaged)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Wetlands (managed)	NO	NO	NO	NE	NE	1251.63	NE	NE	NE	NE	1251.63
Wetlands (unmanaged)	NO	NO	NO	NE	NE	NE	NE	NE	NE	NE	NO,NE
Settlements	NO	NO	NE	NE	NE	NE	NE	864.68	NE	NE	864.68
Other land	NO	NO	NE	NE	NE	NE	NE	NE	10959.90	NE	10959.90
Total unmanaged areas	NO	NO	NO	NE	NO	NE	NE	NE	NE	NE	NO,NE
Total area	22342.94	NO	28082.39	14852.55	NO,NE	1251.63	NO,NE	866.79	10959.90	NO,NE	78356.20
Net change	1671.13	NO	0.38	-1673.62	NO,NE	0.00	NO,NE	2.11	0.00	NO,NE	0.00

In the first stage, it is required that Turkey forms land use matrix and generates a consistent time series for each land use and change.

Spatial data related to organic soils exist but description on organic matter in aforesaid substrate is incompatible with IPPC organic matter description. As a result, activity data concerning organic soils is reported NE for many categories. Category of forest lands are given as example in Table 23.

Table 23. Activity Data in the category of forest lands and the changes in carbon stocks

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	ACTIVITY DATA			CHANGES IN CARBON STOCK AND NET CO_2 EMISSIONS/REMOVALS FROM SOILS							Net CO_2 emissions/ removals
				Carbon stock change in living biomass			Net carbon stock change in dead wood	Net carbon stock change in litter	Net carbon stock change in soils		
Land-use category	Total area (kha)	Area of mineral soil (kha)	**Area of organic soil (kha)**	Gains	Losses	Net change			Mineral soils	Organic soils	
				(kt C)							(kt)
A. Total forest land	22342.94	22342.94	**NO,NE**								-56675.21
1. Forest land remaining forest land	20437.59	20437.59	**NE**	18195.69	-8598.85	9596.84	NE	NE	NE	NE	-35188.41

IPCC's organic soil description is as follows;

Organic soils are described according to the following criteria. All soil not conforming to these criteria are classified as mineral. (based on FAO 1998, IPCC, 2006)

1- *The soils of 20 cm, the organic horizon thickness of which is at least 10 cm or contain minimum 12% organic matter.*
2- *The soils which remain under water for maximum a few days and contain organic carbon as much as at least 20% of its weight (around 35% organic matter)*

3- Out of the soils which remain under water from time to time:

a. The one that has got very low clay content, contain organic carbon as much as at least 12% of its weight (around 20% organic matter) or

b. The one whose clay content is 60% or contain organic carbon as much as at least 18% of its weight (around 30% organic matter) or

c. Medium level and proportional organic carbon corresponding to medium level clay content.

Attention should be paid to key categories and reporting level and data quality should be increased, uncertainties should be decreased. According to calculation in declarantion 2017, key categories and calculation levels are as follows. (Table 24)

Table 24. Categories and calculation levels

Category and sub-category	Tier
By Amount;	
4.A.1. Forest Lands	Level 1, 2
4.A.2. Lands converted to forest land	Level 1, 2
4.G. Wood products	Level 1, 2
4.C.2. Lands converted to grassland	Level 1, 2
By Trend	
4.D.2. Lands converted to wetland	Level 1, 2
4.B.2. Lands converted to cropland.	Level 1, 2

Forest Lands: This category is the largest carbon sink in LULUCF inventory.

- Activity data (gains and losses) are provided from ENVANIS and related departments,
- National (BCEF, Fd coefficient) coefficients and IPCC valid data (root-shoot ratio, carbon fraction, Gef emission factor, CF burning factor) are used in calculations.
- It is estimated that biomass increases in unit area of forest lands on the basis of various reasons. As a result, it is anticipated that carbon stock change both in soil and litter. Determination and calculation of this change require a modelling study and means Level 3 calculation.
- Making a model application for forest lands in a way to cover former article will be necessary sooner or later. Being a dynamic and actuel model which will consider transitions between carbon stocks would be proper.
- Start of national forest inventory studies in Turkey is a pretty good development for LULUCF sector. Data expected from National Forest Inventory in terms of LULUCF Inventory are as follows;
    - I. Organic carbon stock value of soil. It is expressed in IPCC 2006 guide that large part of organic carbon is found on upper 30 cm depth and influenced from land use. There exist organic carbon in lower depth and horizons definitely and it is apparent that it will not be affected from changes as that topsoil. Therefore, it would be appropriate to make organic carbon calculation on top soil and if possible at a second depth stage. Humidity, volume weight, skeleton content and carbon percentage values are needed for that.
    - II. If it is planned to pass Level 3 in forest lands category, it would be appropriate to make a model application for litter and dead wood. To that end, litter and dead wood calculation should be made in the same period of the year (in 4 different seasons if possible) on fixed sample areas. For that purpose, litter weight per unit area, humidity percentage and carbon percentage values will be needed in sample areas. Dead wood

sampling should be performed with calculation of dead woods in all area not by transect method. Decomposition levels of dead woods should be identified with wedge test.

III. Measuring forest canopy with leaf area index should be beneficial. Because, in this manner, a statistical equation may be developed between dead organic material and leaf area.

IV. Other requisite data are diameter, length, age, species and increments like in a typical management sampling study.

Lands converted to forest: It shows some difference from the category of forest lands. Firstly, no land use information exists for the lands converted to forest. As a result, some assumptions may be made.

- Activity data (gains and losses) are provided from the departments relate to ENVANIS,
- General national coefficients are used for dead organic material values in the areas converted to forest. Only litter value is calculated within the scope of dead organic material. DOM calculation in inventory should be singled out in litter and dead wood and calculation should be made with the coefficients appropriate for climate or ecozone. Dead wood should also be calculated and given separate. Because, separate calculation of litter and dead wood are compulsory for Tier 2 calculation. Similarly, calculation of soil organic carbon value should be made with the coefficients suitable for climate or ecozone.

Wood Products: This category also reserves an important place in greenhouse gas inventory, because annually a few millions ton of carbon is kept without releasing to atmosphere in Turkey. Primary reason for that is continuous transition from fuelwood to industry wood in use of wood raw material. In release of wood products to atmosphere, first degree decomposition function which is recommended by IPCC 2006 is used. In case a study is carried out about half-life of the wood products needed for use of this function, it would be beneficial. But it is not thought as an urgent need. Again, for accumulation of wood products in solid waste storage areas,

- Activity data (production, timber and wood panel production figures) are national figures,
- National and IPCC coefficients are used to convert volumetric production figures into carbon stock,
- IPCC coefficients are utilized for half-life values in calculations.
- Since half-life is 2 years, no calculation is made for paper. Calculation is useful for interaction with other usage and in terms of mass balance.

Lands converted to grassland: 2 sub-categories are found in this category, these are

I. Forest lands converted to grassland
II. Agriculture lands converted to grassland

Calculation problems related to each two subcategories are;

- Land amount which is activity data for conversion from forest land to grassland appears quite high. Confirmation of this activity data would be beneficial. In conversion from forest to grassland, it should be assumed that surface biomass is cut and subjects to production in the same year. No this subject is explained in NIR report.
- Calculation is made in complete contrast to grassland converted to forest. The values used as emission factor are the values specific to country which are calculated for grassland and forest lands. Especially for grassland, surface and subsoil biomass figures should be urgently updated with a literature search.

Lands converted to wetland: The emissions arisen from agriculture and grassland with construction of dam are calculated in this category. Activity data is received from general directorate of State Hydrolic Works, those who are used for grassland and agriculture lands as emission factor are used here too. When carbon stock values used for annual and perennial agriculture and grassland are updated, calculations of this category will also be updated and improved. Therefore, national carbon stock values which are separated as per climate and soil types if possible are needed urgently for agriculture and grassland.

Lands converted to agriculture land: In this category, only conversion from grassland is calculated.

- Activity data is CORINE land cover substrate, consistency problem is seen for time series. Even though CORINE substrate is not mainly developed for AKAKDO calculations, it is merely spatial substrate dating back to 1990. Inexistence of land confirmation and the low resolution are serious problems. CORINE substrates 1990, 2000, 2006 and 2012 are present but their generation by different institutions and teams create consistency problem. Its development in future years within the scope of UASIS and similar projects is one of the privileged areas.
- The matters mentioned above should also be considered in the meaning of emission factor. Namely, with compilation of new scientific studies, emission factors should be developed.

7.REFERENCES

Akray, Ç., 2009. Doğu Akdeniz Bölgesinde Yetişen Üç Farklı Bitkinin Yaprak, Dal Ve Ölüörtüsündeki Tanen Miktarının Toprak Karbon İçeriğine Etkisi, Çukurova Üniversitesi Fen Bilimleri Enstitüsü, Adana.

Aktaş, M., 2013. Burdur yöresindeki doğal kızılçam (pinus brutia ten.) meşcerelerinde kızılçam normal hasılat tablosunun meşcere hacim ve hacim artım tahminlerinin karşılaştırılması(Doctoral dissertation, Süleyman Demirel Üniversitesi Fen Bilimleri Enstitüsü).

Asan Ü, Destan S, Özkan U.Y., 2002. İstanbul korularının karbon depolama, oksijen üretimi ve toz tutma kapasitesinin kestirilmesi. Orman Amenajamanında Kavramsal Açılımlar ve Yeni Hedefler Sempozyumu, Bildiriler Kitabı, istanbul, Turkey, pp. 194-202.

Ateşoğlu, A., 2016. Havza çalışmalarında kullanılan CORINE 2006 arazi sınıflandırma verilerinin doğruluğunun araştırılması. Journal of the Faculty of Forestry Istanbul University 2016, 66(1). 173-183.

Atmaca, S., 2008. Erzurum Orman Bölge Müdürlüğü Sarıçam Biyokütle Tablolarının Düzenlenmesi. *Yüksek Lisans Tezi, ZKÜ Fen Bilimleri Enstitüsü, Orman Mühendisliği Anabilim Dalı, Zonguldak*.

Aydın, Ç., 2010. Artvin Orman Bölge Müdürlüğü Borçka Orman işletme Müdürlüğü Sarıçam Biyokütle Tabloları, Yüksek Lisans Tezi, KT Ü. *Fen Bilimleri Enstitüsü, Trabzon*.

Babalık, A. A., Fakir, H., 2017. Korunan ve otlatılan mera alanlarında vejetasyon özelliklerinin karşılaştırılması: Kocapınar Merası örneği. Turkish Journal of Forestry, 18(3), 207-211.

Bai, S.H., Dempsey, R., Reverchon, F., Blumfield, T. J., Ryan, S., Cernusak, L.A., 2017. Effects of forest thinning on soil-plant carbon and nitrogen dynamics. Plant and Soil, 411(1-2), 437-449.

Bayburtlu, Ş., 2007. Titrek Kavak (Populus Tremula L.) Hacim ve Bonitet Endeks Tablolarının Duzenlenmesi Yüksek Lisans Tezi, Karadeniz Teknik Ünİversitesi. *Fen Bilimleri Enstitüsü*, 62.

Bayramin, I., Basaran, M., Erpul, G., Dolarslan, M., & Canga, M. R., 2009. Comparison of soil organic carbon content, hydraulic conductivity, and particle size fractions between a grassland and a nearby black pine plantation of 40 years in two surface depths. Environmental geology, 56(8), 1563-1575.

Bellassen, V., Stephan, N. 2015. Accounting for Carbon. Cambridge University Press. UK.

Bolat, İ., 2011. Kayın, göknar ve göknar-kayın meşcerelerinde üst toprak ve ölü örtüdeki mikrobiyal biyokütle karbon (Cmic), azot (Nmic), fosfor (Pmic) ve mikrobiyal solunumun mevsimsel değişimi. Bartın Üniversitesi Fen Bilimleri Enstitüsü

Bolat, İ., 2014. The effect of thinning on microbial biomass C, N and basal respiration in black pine forest soils in Mudurnu, Turkey. European journal of forest research, 133(1), 131-139.

Bouyer, O., Serengil, Y., 2016. Carbon stored in harvested wood products in Turkey and projections for 2020. Journal of the Faculty of Forestry Istanbul University| İstanbul Üniversitesi Orman Fakültesi Dergisi, 66(1), 295-302.

Bozkuş, H., Carus, S., 2014. Toros göknarı (Abies cilicica Carr.) sedir (Cedrus libani Link.)'in çift girişli gövde hacmi tabloları ve mevcut tablolarla karşılaştırılması. İstanbul Üniversitesi Orman Fakültesi Dergisi, 47(1), 51-70.

Brookes, P.C., Landman, A., Pruden, G., & Jenkinson, D.S., 1985. Chloroform fumigation and release of soil nitrogen; a rapid extraction method to measure microbial biomass nitrogen in soil. Soil Biology and Biochemistry, 17, 837–842.

Cheng, X., Yu, M., Wang, G.G., 2017. Effects of Thinning on Soil Organic Carbon Fractions and Soil Properties in Cunninghamia lanceolata Stands in Eastern China. Forests, 8(6), 198.

Cole, C.V., Duxbury, J., Freney, J., Heinemeyer, O., Minami, K., Mosier, A., Paustian K., Rosenberg N., Sampson N., Sauerbeck D., Zhao, Q., 1997. Global estimates of potential mitigation of greenhouse gas emissions by agriculture. *Nutrient cycling in Agroecosystems*, *49*(1), 221-228.

Conant, R. T., & Paustian, K., 2004. Grassland management activity data: current sources and future needs. Environmental management, 33(4), 467-473.

Clarke, N., Gundersen, P., Jönsson-Belyazid, U., Kjønaas, O. J., Persson, T., Sigurdsson, B. D., Stupak, I., Vesterdal, L., 2015. Influence of different tree-harvesting intensities on forest soil carbon stocks in boreal and northern temperate forest ecosystems. Forest Ecology and Management, 351, 9-19.

Çakıl, E. (2008). Zonguldak Orman Bölge Müdürlüğü Karaçam Biyokütle Tablolarının Düzenlenmesi. *Zonguldak Karaelmas Üniversitesi Fen Bilimleri Enstitüsü, Basılmamış Yüksek Lisans Tezi, Bartın*.

Çelik, A., Sakin, E., Sakin, E., & Seyrek, A., 2017. Surface Carbon Stocks Of Soıl Under Pıstachıo Cover On Southeastern Turkey. Applıed Ecology and Envıronmental Research, 15(3), 747-758.

Demir, B., Kuş, Z. A., İrik, H. A., Çetin, N., 2015. Mersin İli Tarımsal Biyokütle Enerji Eşdeğer Potansiyeli. Alınteri Zirai Bilimler Dergisi, 29(2), 12-18.

Dengiz, O., Turan, İ.D., 2014. Uzaktan Algılama ve Coğrafi Bilgi Sistem Teknikleri Kullanılarak Arazi Örtüsü/Arazi Kullanımı Zamansal Değişiminin Belirlenmesi. Samsun Merkez İlçesi Örneği (1984-2011). Türkiye Tarımsal Araştırmalar Dergisi, 1(1), 78-90.

Dilly, O., Munch, J.C., 1996. Microbial biomass content, basal respiration and enzyme activities during the course of decomposition of leaf litter in a black alder (Alnus glutinosa (L.) Gaertn.) forest. Soil Biology and Biochemistry, 28(8), 1073-1081.

Doğan, N., 2010. Düzce Yöresinde Yetişen Uludağ Göknarı'nın (Abies nordmanniana (Stev.) Spach. Ssp. Bormulleriana (Mattf.) Code Et Cullen) Çapa Bağlı Biyokütle Denklemi İle Diri-Odun Yaprak Yüzey Alanı İlişkisi. *Düzce Üniversitesi Fen Bilimleri Enstitüsü, Basılmamış Yüksek Lisans Tezi, Düzce*.

Doğan, S.A., 2010. Düzce Yöresinde Yetişen Kayın'ın (Fagus *Orientalis* Lipsky.) Çap İle Biyokütle Ve Diri-Odun İle Yaprak Yüzey Alanı İlişkisi. *Düzce Üniversitesi Fen Bilimleri Enstitüsü, Basılmamış Yüksek Lisans Tezi, Düzce*.

Doygun, H., Oğuz, H., Atak, B. K., Nurlu, E., 2011. Alan Kullanım Değişimlerinin Doğal Karakterli Kıyı Alanları Üzerindeki Etkilerinin Uzaktan Algılama ve CBS Yardımıyla İncelenmesi. Çiğli/İzmir Örneği, I. Akdeniz Orman ve Çevre Sempozyumu, 26-28 Ekim 2011, Kahramanmaraş.

Durkaya, B., 1998. Zonguldak Orman Bölge Müdürlüğü Meşe Meşcerelerinin Biyokütle Tablolarının Düzenlenmesi. Yüksek Lisans Tezi, Zonguldak Karaelmas Üniversitesi. *Fen Bilimleri Enstitüsü*, 110.

Durkaya, B., Durkaya, A., Kocaman, M., 2017. Karbon Stok Değişimi; Bolu Sarıalan İşletme Şefliği. Bartın Orman Fakultesi Dergisi 19(1). 268-275.

Doygun, H., Kısakürek, Ş., Erdoğan, N., Hatipoğlu, İ. H., 2014. Kahramanmaraş–Ahir Dağı Bitki Örtüsü Değişiminin Uzaktan Algılama Yöntemi ile İncelenmesi, II. Ulusal Akdeniz Orman ve Çevre Sempozyumu, 22-24.

Edwards, N.T., 1982. The Use of Soda-Lime Measuring Respirasyon Rates in Terrestrial Systems. Pedobiologia, 23, 321-330.

Eraslan, T., 2009. Tesadüfi dal örneklemesi ve önem örneklemesi kullanarak karaçam (Pinus nigra Arnold) ağaç türü için toprak üstü biyokütle tahmini (Doctoral dissertation, SDÜ Fen Bilimleri Enstitüsü).

Ercanlı, İ., Güvendi, E., Güney, D., Günlü, A., Altun, L., 2008. Single and Double Entry Tree Volume Tables for Pinus pinaster Ait. Plantations Sinop Forest District. Kastamonu University Journal of Forestry Faculty, 8(1), 14-25.

Erkeleş, F., 2017. Aralama Ve Kireçlemenin Doğu Kayını İnce Kök Biyokütlesi Üzerine Etkisi (8 Yıllık Sonuçlar). Yüksek Lisans Tezi, Artvin Çoruh Üniversitesi Fen Bilimleri Enstitüsü Artvin.

Evrendilek, F., Celik, I., Kilic, S., 2004. Changes in soil organic carbon and other physical soil properties along adjacent Mediterranean forest, grassland, and cropland ecosystems in Turkey. Journal of Arid Environments, 59(4), 743-752.

Evrendilek, F., Berberoglu, S., Karakaya, N., Cilek, A., Aslan, G., Gungor, K., 2011. Historical spatiotemporal analysis of land-use/land-cover changes and carbon budget in a temperate peatland (Turkey) using remotely sensed data. Applied Geography, 31(3), 1166-1172.

Evrendilek, F., Berberoglu, S., Taskinsu-Meydan, S., Yilmaz, E. , 2006. Quantifying carbon budgets of conifer Mediterranean forest ecosystems, Turkey. Environmental monitoring and assessment, 119(1), 527-543.

European Environmental Agency (EEA), 2007. CLC2006 technical guidelines, EEA Technical report 17/2007. European Environmental Agency, Copenhagen.

Feger, K. H., Zöttl, H. W. and Brahmer, G. 1991. Assessment of the ecological effects of forest fertilization usingn an experimental watershed approach. Fert. Res., 27. 49-61

Food and Agriculture Organization of United States (FAO), 2000. Forest Resources of Europe, Cis, North America, Australia, Japan and New Zealand. Contribution to the Global Forest Resources Assessment 2000, Geneva Timber and Forest Study Papers No. 17, Rome.

Franzluebbers, A.J., Haney, R.L., Hons, F.M., Zuberer, D., 1999. Assessing biological soil quality with chloroform fumigation–incubation. why subtract a control? Can. J. Soil Sci. 79, 521–528.

Geren, H., Kavut, Y. T., Avcıoğlu, R., 2011. Akdeniz İklim Koşullarında Filotu (Miscanthus x giganteus)'nun Verim ve Verim Özellikleri ile Silolanabilirliği Üzerinde Bir Ön Araştırma. Ege Üniversitesi Ziraat Fakültesi Dergisi, 48(3).

Goodale, C.L., Apps, M.J., Birdsey, R.A., Field, C.B., Heath, L.S., Houghton, R.A., Jenkins, J.C., Kohlmaier, G.H., Kurz, W., Liu, S., Nabuurs, G., Nilsson, S., Shvidenko, A.Z., 2002. Forest Carbon Sinks in The Northern Hemisphere, Ecological Applications, 12, 891–899

Göl, C., 2017. Effects of aspect and changes in land use on organic carbon and soil properties in Uludere catchment, semi-arid region. Turkey. Rendiconti Lincei, 28(3), 463-469.

Guner, S., Tufekcioglu, A., Gulenay, S., Kucuk, M., 2010. Land-use type and slope position effects on soil respiration in black locust plantations in Artvin, Turkey. African Journal of Agricultural Research, 5(8), 719-724.

Günlü A., Ercanli İ., Başkent E.Z., Çakır G., 2014. Estimating aboveground biomass using Landsat TM imagery. A case study of Anatolian Crimean pine forests in Turkey. Ann. For. Res. 57(2). 289-298, 2014.

Hacisalihoglu, S., Misir, M., Misir, N., Yucesan, Z., Oktan, E., Gumus, S., Kezik, U., 2017. The Effects Of Land Use Change On Soıl Loss And Carbon Stock Amounts. Feb-Fresenıus Envıronmental Bulletın, 26(10). 6007-6016.

Houghton, R.A. 2008. Carbon Flux to the Atmosphere from Land-Use Changes. 1850-2005. In trends. A Compendium of Data on Global Change. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A.

Intergovernmental Panel on Climate Change Report (IPCC), 2000. Summary for Policymakers Land Use, Land Use Change and Foresty, Intergovernmental Panel on Climate Change, N.Y, USA, ISBN 92 -9169.

Intergovernmental Panel on Climate Change (IPCC), 2003. Penman J., Gytarsky M., Hiraishi T., Krug, T., Kruger D., Pipatti R., Buendia L., Miwa K., Ngara T., Tanabe K., and Wagner F (Eds). Good Practice Guidance for Land Use, land- Use Change and Forestry IPCC/IGES, Hayama, Japan.

Intergovernmental Panel on Climate Change (IPCC), 2006. IPCC Guidelines for National Greenhouse Gas Inventories Volume 4. Egglestone, H.S., L. Buendia, K. Miwa, T. Ngara and K. Tanabe (Eds). Intergovernmental Panel on Climate Change (IPCC), IPCC/IGES, Hayama, Japan. http.//www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.html

Intergovernmental Panel on Climate Change (IPCC), 2010. Datasets for use in the IPCC Guidelines, eds. Eggleston H.S., Srivastava N., Tanabe K., Baasansuren J., Meeting Report of the IPCC – FAO – IFAD Expert Meeting on FAO Data for AKAKDO/AFOLU Rome, Italy, 20-22 October, 2009, Pub. IGES, Hayama, Japan 2010

Işık, M., 2013. Orman Ekosistemlerinin Biyokütle Ve Karbon Depolama Miktarlarının Farklı Yöntemlere Göre Belirlenmesi (Kapıkaya Planlama Birimi Örneği). Yüksek lisans tezi, Kahramanmaraş Sütçü İmam Üniversitesi, Fen Bilimleri Enstitüsü, Kahramanmaraş.

Jenkinson, D.S., Ladd, J.N., 1981. Microbial biomass in soil. measurement and turnover. In. Paul, E.A., Ladd, J.M. (Eds.), Soil Biochemistry, vol. 5. Marcel Decker, New York, pp. 415–471.

Judithá Charles, M., Simmons, M. S., 1986. Methods For The Determination Of Carbon İn Soils And Sediments. A Review. Analyst, 111(4), 385-390.

Kara, O., Baykara, M., 2014. Changes in soil microbial biomass and aggregate stability under different land uses in the northeastern Turkey. Environmental monitoring and assessment, 186(6), 3801-3808.

Kara, Ö., Bolat, İ., 2008. The effect of different land uses on soil microbial biomass carbon and nitrogen in Bartın province. Turkish Journal of Agriculture and Forestry, 32(4), 281-288.

Kara, F., Karatepe, A., 2012. Uzaktan algılama teknolojileri ile Beykoz ilçesi (1986-2011) arazi kullanımı değişim analizi. Marmara Coğrafya Dergisi, 25. 378-389.

Karabürk, T., 2011. Bartın İli Göknar Meşcerelerinin Biyokütle Tablolarının Düzenlenmesi, Bartın Üniversitesi Fen Bilimleri Enstitüsü. *Basılmamış Yüksek Lisans Tezi, Bartın*.

Kezik, U., 2011. Güneydoğu Anadolu Bölgesindeki Bozuk Meşe Baltalıklarında Seyreltmenin Fotosentetik Özellikler ile Biyokütleye Etkileri. *KSÜ Fen Bilimleri Enstitüsü Orman Müh. Anabilim Dalı. KSÜ*, 72.

Koca, Y.K., Doran, İ., Kılıç, T., 2008. Arazi sınıflandırma yöntemi CORINE'e eleştirel bir yaklaşım, TÜCAUM V. Ulusal Coğrafya Sempozyumu 2008- Bildiri Kitabı, 71-80.

Korkanç, S. Y., 2014. Effects of afforestation on soil organic carbon and other soil properties. Catena, 123, 62-69.

Küçüker, M.A., 2011. Kriging-based estimation of the change in soil carbon stock in the coastal Black Sea region, Turkey, Boğaziçi University

Kucuker, M. A., Guney, M., Oral, H. V., Copty, N. K., Onay, T.T., 2015. Impact of deforestation on soil carbon stock and its spatial distribution in the Western Black Sea Region of Turkey. Journal of environmental management, 147, 227-235.

Le Quéré, C., Moriarty, R., Andrew, R. M., Peters, G. P., Ciais, P., Friedlingstein, P., Jones, S. D., Sitch, S., Tans, P., Arneth, A., Boden, T. A., Bopp, L., Bozec, Y., Canadell, J. G., Chini, L. P., Chevallier, F., Cosca, C. E., Harris, I., Hoppema, M., Houghton, R. A., House, J. I., Jain, A. K., Johannessen, T., Kato, E., Keeling, R. F., Kitidis, V., Klein Goldewijk, K., Koven, C., Landa, C. S., Landschützer, P., Lenton, A., Lima, I. D., Marland, G., Mathis, J. T., Metzl, N., Nojiri, Y., Olsen, A., Ono, T., Peng, S., Peters, W., Pfeil, B., Poulter, B., Raupach, M. R., Regnier, P., Rö- denbeck, C., Saito, S., Salisbury, J. E., Schuster, U., Schwinger, J., Lin, Q., & Brookes, P. C. (1999). An evaluation of the substrate-induced respiration method. Soil Biology and Biochemistry, 31(14), 1969-1983.

Lermi, A. G., Palta, Ş., 2014. Bartın Ekolojisindeki Medicago polymorpha L.'nın Bazı Bitkisel Özellikleri Üzerine Araştırma. ÇOMÜ Zir. Fak. Derg. (COMU J Agric. Fac.) 2 (2): 141–149

Lermi, A. G., Palta, Ş., 2016. Arı Otu Bitkisinin Sonbahar Ekim Periyodunda Farklı Ekim Zamanlarının Tohum Verimi ve Verim Komponentleri Üzerine Etkileri. Yüzüncü Yıl Üniversitesi Tarım Bilimleri Dergisi, 26(3), 366-371.

Lovett, G. M., Cole, J. J., Pace, M.L. 2006. Is net ecosystem production equal to ecosystem carbon accumulation? Ecosystems 9, 1–4.

Ma, W., 2006. Carbon storage in temperate grassland of Inner Mongolia (in Chinese) [D]. Peking University Beijing. pp. 34–49.

Macaroğlu, K., 2011. Bartın Yöresi Karışık Meşçerelerin Biyokütle Ve Karbon Depolama Kapasitesinin İrdelenmesi. Yüksek Lisans Tezi, Bartın Üniversitesi Fen Bilimleri Enstitüsü, Orman Mühendisliği Anabilim Dalı, Bartın.

Makineci, E., Ozdemir, E., Caliskan, S., Yilmaz, E., Kumbasli, M., Keten, A., ... & Yilmaz, H., 2015. Ecosystem carbon pools of coppice-originated oak forests at different development stages. European journal of forest research, 134(2), 319-333.

Mantlana, B., Arneth, A., Veenendaal, E., Wohland, P., Wolski, P., Kolle, O., Lloyd, J., 2009, Factors Determining Soil Respiration in Tropical Savanna-Wetland Mosaic in the Okavango Delta, Botswana, IOP Confernece Series, Earth Environmental Sciences, 6, 302.

Maral, Z., 2016. Kastamonu Yöresinde Arazi Kullanım Farklılığının (Orman-Çayırlık-Tarım Alanları Toprak Karbon Ve Azot Tutulumuna Olan Etkileri. Yüksek Lisans Tezi, Kastamonu Üniversitesi Fen Bilimleri Enstitüsü, Kastamonu.

McKechnie, J., Colombo, S., MacLean, H. L., 2014. Forest carbon accounting methods and the consequences of forest bioenergy for national greenhouse gas emissions inventories. Environmental Science & Policy, 44, 164-173.

Narayan, C., Fernandes, P. M., van Brusselen, J., Schuck, A., 2007. Potential for CO 2 emissions mitigation in Europe through prescribed burning in the context of the Kyoto Protocol. Forest Ecology and Management, 251(3), 164-173.

Nelson, D.E., Sommers, L.E., 1982. Total carbon, organic and organic matter. In. Page, A.L., Miller, R.H., Keeney, D.R. (Eds.), Methods of Soil Analyses. Part 2. Chemical and Microbiological Properties, 2nd ed. American Society of Agronomy, Wisconsin, pp. 539–758

Orhan, İ., 2013. Kızılçam, Karaçam Ve Sarıçam'ın Ticari Ve Ticari Olmayan Bileşenlerinin Biyokütle Miktarlarının Belirlenmesi. *Bartın Üniversitesi Fen Bilimleri Enstitüsü, Bartın.*

Özdemir, E., Oral, H. V., Akburak, S., Makineci, E., Yilmaz, E., 2013. Carbon and nitrogen accumulation in forest floor and surface soil under different geographic origins of Maritime pine (Pinus pinaster Aiton.) plantations. Forest Systems, 22(2), 214-221.

Özkaya, M.S., 2016. Mor Çiçekli Orman Gülü (Rhododendron Ponticum L.)'Nün Toprak Üstü Ve Toprak Altı Biyokütlesinin Belirlenmesi. Doktora Tezi, Artvin Çoruh Üniversitesi Fen Bilimleri Enstitüsü Artvin.

Özturk, M., Altay, V., Gucel, S. A. L. I. H., Aksoy, A., 2012. Aegean grasslands as endangered ecosystems in Turkey. Pak. J. Bot, 44(2), 7-17.

Polat, S., Polat, O., Kantarcı, M. D., Tüfekçi, S., Aksay, Y., 2014. Mersin-Kadıncık Havzası'ndaki Sedir (Cedrus libani A. Rich.) ve Karaçam (Pinus nigra Arnold.) ağaçlandırmalarının boy gelişimi ile bazı yetişme ortamı özellikleri arasındaki ilişkiler. Ormancılık Araştırma Dergisi, 1(1 A), 22-37.

Ponette, Q., Belkacem, S., Nys, C., 1996. Ion dynamics in acid forest soil as affected by addition of Ca fertilizers. Geoderma 71 (1996), 53-76.

Ravindranath, N.H., Ostwald, M., 2008, "Carbon Inventory Methods: Handbook for Greenhouse Gas Inventory, Carbon Mitigation and Roundwood Production Projects (Advances in Global Change Research)", Beijing China, Forestry Publishing House.

Richter, D.D., Markewitz, D., Trumbore, S. E., Wells, C.G., 1999. Rapid accumulation and turnover of soil carbon in a re-establishing forest. Nature, 400(6739), 56-58.

Ross C.W., Grunwald S., Myers, D.B., Xiong, X., 2016, Land use, land use change and soil carbon sequestration in the St. Johns River Basin, Florida, USA. Geoderma Reg 7.19–28.

Sabandüzen, B., Akçura, M., 2017. Bazı Yulaf Genotiplerinin Çanakkale Koşullarında Verim ve Verim Unsurlarının İncelenmesi. Türk Tarım ve Doğa Bilimleri Dergisi 4(2): 101–108.

Sakin, E., Deliboran, A., Sakin, E. D., Tutar, E., 2010. Carbon Stocks in Harran Plain Soils, Sanliurfa, Turkey. Notulae Botanicae Horti Agrobotanici Cluj-Napoca, 38(3), 151.

Sakin, E., Deliboran, A., Sakin, E. D., Tutar, E., 2010. Organic and inorganic carbon stocks and balance of Adana city soils in Turkey. African Journal of Agricultural Research, 5(19), 2737-2743.

Sakin, E., Sakin, E. D., Kızılgöz, İ., Seyrek, A., 2016. Orman Örtüsü Altındaki Toprakların Karbondioksit Emisyonunun Ölçülmesi. Harran Tarım ve Gıda Bilimleri Dergisi, 20(2). 127-134.

Saraçoğlu, N., 1988. Kızılağaç Gövde Hacim ve Biyokütle Tablolarının Düzenlenmesi. Doktora Tezi, Trabzon, XI+ 102 s.

Saraçoğlu, N., 1991. Kızılağaç (Alnus glutinosa Gaertn. subsp. barbata (CA Mey) Yalt.) gövde hacim ve biyokütle tablolarının düzenlenmesi. Journal of the Faculty of Forestry Istanbul University| İstanbul Üniversitesi Orman Fakültesi Dergisi, 41(1).

Saraçoğlu N., 1992. Kayın biyokütle tablolarının düzenlemesi. Turkish Journal of Agriculture and Forestry, 22. 93-100.

Sargıncı, M.,2014. Batı karadeniz orman ekosistemlerinde ölü örtü dinamiği. Düzce Üniversitesi Fen Bilimleri Enstitüsü, Basılmamış Doktora Tezi, Düzce.

Sariyildiz, T., 2003. Litter decomposition of Picea orientalis, Pinus sylvestris and Castanea sativa trees grown in Artvin in relation to their initial litter quality variables. Turkish Journal of Agriculture and Forestry, 27(4), 237-243.

Sarıyıldız, T., Savacı, G., Maral, Z. 2017, Effect of Different Land Uses (Mature and Young Fir Stands-Pasture and Agriculture Sites) on Soil Organic Carbon and Total Nitrogen Stock Capacity in Kastamonu Region. Kastamonu Uni., Orman Fakültesi Dergisi, ,17 (1). 132-142.

Sariyildiz, T., Tüfekçioğlu, A., Küçük, M., 2005. Comparison Of Decomposition Rates Of Beech (Fagus Orientalis Lipsky) And Spruce (Picea Orientalis (L.) Link) Litter İn Pure And Mixed Stands Of Both Species İn Artvin, Turkey. Turkish Journal of Agriculture And Forestry, 29(6), 429-438.

Sarmiento , J. L., Gruber, N., 2002. Sinks for Anthropogenic Carbon, Physics Today, 55, 30-36.

Say, Ş., 2016. *Çerkeş orman işletme şefliği doğal ve plantasyon genç sarıçam bireylerinin toprak üstü ve toprak altı biyokütle miktarlarının belirlenmesi* (Master's thesis, Bartın Üniversitesi, Fen Bilimleri Enstitüsü).

Sayı, Ö., Genç, L., 2013. Çanakkale Ili Arazi Kullanım ve Bitki Örtüsü Değişiminin Uzaktan Algılama Yardımı ile Belirlenmesi. JOTAF/Tekirdağ Ziraat Fakültesi Dergisi, 10(3), 64-73.

Schlesinger W.H., 1997. Biogeochemistry. An Analysis of Global Change 2nd edn (San Diego, CA. Academic)

Séférian, R., Segschneider, J., Steinhoff, T., Stocker, B. D., Sutton, A. J., Takahashi, T., Tilbrook, B., van der Werf, G. R., Viovy, N., Wang, Y.-P., Wanninkhof, R., Wiltshire, A., Zeng, N., 2016. Earth Syst. Sci. Data, 8, 605–649.

Seki, M., 2015. Taşköprü Orman İşletme Müdürlüğü Karaçam Meşcereleri İçin Dinamik Bonitet Endeks Modellerinin Geliştirilmesi. Yüksek Lisans Tezi, Kastamonu Üniversitesi Fen Bilimleri Enstitüsü, Kastamonu.

Sivrikaya, F., Baskent, E. Z., Bozali, N., 2013. Spatial dynamics of carbon storage. a case study from Turkey. Environmental monitoring and assessment, 185(11), 9403-9412.

Sivrikaya, F., Bozali, N., 2012. Karbon Depolama Kapasitesinin Belirlenmesi. Türkoğlu Planlama Birimi Örneği. Bartın Orman Fakültesi Dergisi, 14(21), 69-76.

Su, 2014. Korkuteli Yöresi Yapay Kızılçam Meşcereleri İçin Gövde Hacim Ve Bonitet Endeks Tablolarının Düzenlenmesi, Süleyman Demirel Üniversitesi, Yüksek Lisans Tezi, Isparta.

Şeflek, A., 2010. Dallı darı (Panicum virgatum L.) çeşitlerinin verim, bazı morfolojik, fenolojik ve fizyolojik özelliklerinin tespiti (Doctoral dissertation, Selçuk Üniversitesi Fen Bilimleri Enstitüsü).

Tecimen, H. B., Kavgaci, A., 2010. Comparison of soil and forest floor properties of floodplain and surrounding forests in Igneada, Turkey. Journal of Environmental Biology, 31, 129-134.

Tekin, B. A., 2008. *Isparta yöresi saf, aynı yaşlı ve doğal anadolu karaçamı [Pinus nigra Arnold subsp. pallasiana (Lamb.) Holmboe] meşcerelerinde artım ve büyüme yönünden meşcere yaşı-sıklık ve bonitetin etkileri* (Doctoral dissertation, SDÜ Fen Bilimleri Enstitüsü).

Tuna, G. S., Başer, İ., Tuna, M., 2016. Türkiye'nin Farklı Coğrafik Bölgelerinden Toplanan Brachypodium distachyon (L.) P. Beauv. Doğal Popülasyonlarının Morfolojik Karakterizasyonu. Tarım Bilimleri Dergisi, 22(2), 161-178.

Tüfekçioğlu, A., Küçük, M., 2004. Soil Respiration İn Young And Old Oriental Spruce Stands And İn Adjacent Grasslands İn Artvin, Turkey. Turkish Journal Of Agriculture And Forestry, 28(6), 429-434.

Tufekcioglu, A., Kucuk, M., Saglam, B., Bilgili, E., Altun, L., 2010. Soil properties and root biomass responses to prescribed burning in young corsican pine (Pinus nigra Arn.) stands. Journal of Environmental Biology, 31. 369-373.

Uludağ, M., 2006. Kastamonu Orman Bölge Müdürlüğü Çatalzeytin Orman İşletme Müdürlüğü Çınar (*Platanus Orientalis* L.) Gövde Hacim Tablolarının Düzenlenmesi. Yüksek Lisans Tezi, Zonguldak Karaelmas Üniversitesi. *Fen Bilimleri Enstitüsü*, 69.

United Nations Framework Convention on Climate Change (UNFCCC), 2013. CGE GHG Inventory Handbook (NAI). Consultative Group of Experts on National Communications from Parties not Included in Annex I to the Convention (CGE), Energy Sector. Fuel Combustion

Ülker, C.., 2010. Amasya Orman Bölge Müdürlüğü Sarıçam (Pinus sylvestris L.) Meşcerelerinin Biyokütle Tablolarının Düzenlenmesi (Kunduz Örneği), Yüksek Lisans Tezi, KT Ü. *Fen Bilimleri Enstitüsü, Trabzon*.

Ülküdür, M., 2010. *Antalya orman bölge müdürlüğü sedir meşcerelerinin biyokütle tablolarının düzenlenmesi* (Master's thesis, Bartın Üniversitesi Fen Bilimleri Enstitüsü).

Ünsal, A., 2007. Adana Orman Bölge Müdürlüğü Karaisali Orman İşletme Müdürlüğü Kızılçam Biyokütle Tablolarının Düzenlenmesi. Yüksek Lisans Tezi. Zonguldak Karaelmas Üniversitesi. *Fen Bilimleri Enstitüsü*, 51.

Vance, E.D., Brookes, P.C., Jenkinson, D.S., 1987. An extraction method for measuring soil microbial biomass C. Soil Biology and Biochemistry, 19, 703–707.

Wu, J., Liu, Z., Huang, G., Chen, D., Zhang, W., Shao, Y.,Wan, S., Fu, S., 2014. Response of soil respiration and ecosystem carbon budget to vegetation removal in Eucalyptus plantations with contrasting ages. Scientific reports, 4.6262, 1-6.

Yağcı, V., 2010. *Hopa Cankurtaran mevkiindeki sık ve seyrek yetiştirilen ve ilk aralama çağına gelen doğu kayını meşcerelerinin biyokütle özelliklerinin belirlenmesi* (Master's thesis, Artvin Çoruh Üniversitesi Fen Bilimleri Enstitüsü).

Yavaşlı, D.D., Masek, J.G., Franks, S., 2013. Muğla İlinde 2000-2010 Yılları Arasındaki Orman Bozunum ve Geri Kazanımının Landsat Görüntüleri İle İzlenmesi. Ege Coğrafya Dergisi, 22(2). 91-102.

YEGM (Yenilenebilir Enerji Genel Müdürlüğü), (2015) Erişim Tarihi: 02.11.2015 http://www.eie.gov.tr/eie-web/turkce/YEK/biyoenerji/01-biyogaz/bg_haykay.html

Yıldırımer, S., Özalp, M., Yüksel, E.E., 2015. Büyük baraj projeleri ve bağlantılı yol inşaatları sonucunda Çoruh Nehri Havzasında oluşan arazi kayıplarının ve tahribatlarının belirlenmesi. Artvin Çoruh Üniversitesi Orman Fakültesi Dergisi, 16(1), 1-17.

Yılmaz, B., 2014. Aynı yaşlı, saf ve doğal meşcerelerde hacim artımının yaş, bonitet ve sıklığa göre incelenmesi (kızılçam ve karaçam örneği) (Doctoral dissertation, Süleyman Demirel Üniversitesi Fen Bilimleri Enstitüsü).

Yılmaz, S., 2015. *Antalya yöresi aynı yaşlı saf kızılçam meşcerelerinde toprak üstü biyokütlenin belirlenmesi* (Master's thesis, Artvin Çoruh Üniversitesi, Fen Bilimleri Enstitüsü).

Yolasığmaz, H.A., Keleş, S., 2009. Changes in carbon storage and oxygen production in forest timber biomass of Balci Forest Management Unit in Turkey between 1984 and 2006. African Journal of Biotechnology, 8(19), 4872-4883.

Zhang P, Tang J, Sun W, Yu Y, Zhang W., 2015. Differential Effects of Conservational Management on SOC Accumulation in the Grasslands of China. PLoS ONE 10(9). e0137280. doi.10.1371/journal.pone.0137280.

8. ANNEX TABLES

Annex Table 1. *Alnus glutinosa* Gaertn. Subsp. Barbata (CA Mey.) Yalt.) Dry weight equations (Saraçoğlu, 1988).

Reference	Location	Species	Related parameter of dry weight	Individual Tree
Saraçoğlu, N. (1988). Construction of Stem Volume and Biomass Tables of Alders (Alnus glutinosa Gaertn. Subsp. Barbata (CA Mey.) Yalt.) . Doctoral Thesis, Trabzon, XI + 102 p.	East Black Sea Region (Pazar, Rize, Arhavi, Borçka, Dereli, Army, Tirebolu, Maçka, Sürmene, Trabzon)	Alnus glutinosa Gaertn. Subsp. Barbata (Mey Mey) Yalt.	**Stem wood**	DW= $-30.817+0.225.d^2+3.034h$
			Live Branches	DW = $0.643+0.011.d^2+0.135h$
			Twigs and Leaves	DW = $1.669+0.003.d^2-0.054h$
			Stem bark	DW = $1.429+0.020.d^2-0.119h$
			Whole tree	DW = $-27.076+0.261.d^2+3.234h$
d = Middle tree diameter at breast height, h = height, DW=Dry-Weight				

Annex Table 2. Wet and dry weight models in hectare with an individual tree of oak (*Q. robur* and *petrea*) species (Durkaya, 1998).

Reference	Location	Species	Related parameter of wet weight	Individual Tree	R^2 (F)	in hectare	R^2 (F)
Durkaya, B. (1998). Constructions of Biomass Tables of Quercus in Zonguldak Forest District Directorates. Master Thesis, Zonguldak Karaelmas University. Institute of Science, 110.	Zonguldak	Oak (Q. robur and petrea)	**Stem wood**	$Log(Y_{WW})_i = a+bLog(d_{1,3})_i$	0.92 (344.47)	$Log(Y_{WW})_i = a+bLog(d_{1,3})_i$	0.32 (13.82)
			Branch	$Log(Y_{WW})_i = a+bLog(d_{1,3})_i$	0.79 (113.19)	$(Y_{WW})_i = a+b(d_{1,3})_i$	0.45 (24.99)
			Leaf	$Log(Y_{WW})_i = a+bLog(d_{1,3})_i$	0.81 (125.64)	$Log(Y_{WW})_i = a+bLog(d_{1,3})_i$	0.15 (5.20)
			Crown	$Log(Y_{WW})_i = a+bLog(d_{1,3})_i$	0.80 (123.33)	$(Y_{WW})_i = a+b(d_{1,3})_i$	0.43 (22.76)
			Whole tree	$Log(Y_{WW})_i = a+bLog(d_{1,3})_i$	0.95 (559.01)	$Log(Y_{WW})_i = a+bLog(d_{1,3})_i$	0.40 (19.69)
			Related parameter of oven-dry weight	**Individual Tree**	**R^2 (F)**	**in hectare**	**R^2 (F)**
			Stem wood	$(Y_{DW})_i = a+b(d_{1,3})_i$	0.90 (262.32)	$Log(Y_{DW})_i = a+bLog(d_{1,3})_i$	0.34 (15.21)
			Branch	$(Y_{DW})_i = a+b(d_{1,3})_i$	0.73 (82.93)	$(Y_{DW})_i = a+b(d_{1,3})_i$	0.50 (30.54)
			Leaf	$(Y_{DW})_i = a+b(d_{1,3})_i$	0.73 (82.95)	$(Y_{DW})_i = a+b(d_{1,3})_i$	0.49 (28.56)
			Crown	$(Y_{DW})_i = a+b(d_{1,3})_i$	0.78 (105.03)	$(Y_{DW})_i = a+b(d_{1,3})_i$	0.49 (28.56)
			Whole tree	$(Y_{DW})_i = a+b(d_{1,3})_i$	0.91 (290.14)	$Log(_{DW})_i = a+bLog(d_{1,3})_i$	0.41 (20.67)
$d_{1,3}$= Middle tree diameter at breast height, WW= Wet Weight, DW=Dry Weight							

Annex Table 3. Wet and dry weight equations in hectare with an individual tree of *Pinus sylvestris* L. (Atmaca, 2008).

Reference	Location	Species	Related parameter of wet weight	Individual Tree	R^2 (F)	in hectares	R^2 (F)
Atmaca, S. (2008). Construction of Biomass Tables of Scotchpine in Erzurum Forest Regional Headquarter. MSc. Thesis, ZKU Institute of Science and Technology, Department of Forest Engineering, Zonguldak.	Erzurum	Yellow pine (*Pinus sylvestris* L.)	**Stem wood**	Y(Stemwood) = 6,8334237 + 0,6652(d)^2	0.884 (237)	Y(Stemwood) = -49061,7 + 10043,88(d)	0.729 (82,5)
			Branch	Y(Branch) = -99,3467 + 6,300197(d)	0.799 (123)	Y(Branch) = -6558,95 + 1274,063(d)	0.544 (37)
			Needleleaf	Y(Needleleaf) = -29,22 + 2,725314(d)	0.698 (71)	Y(Needleleaf) = 6215,769 + 455,3868(d)	0.312 (14)
			Crown	Y(Crown) = -128,567 + 9,025511(d)	0.776 (107)	Y(Crown) = -343,184 + 1729,45(d)	0.518 (16)
			Whole tree	Y(Whole tree) = 29,90707+ 0,778817(d)^2	0.884 (236)	Y(Whole tree) = -49404,9 + 11773,33(d)	0.706 (74)
			Related Parameter of oven-dry weight	**Individual Tree**	**R^2 (F)**	**in hectares**	**R^2 (F)**
			Stem wood	Y(Stemwood) = -32,72303 + 0,36755(d)^2	0.884 (238)	Y(Stemwood) = -44738 + 5633,637(d)	0.774 (106)
			Branch	Y(Branch) = -51,3178+ 3,22021(d)	0.750 (64.65)	Y(Branch) = -3678,27 + 651,3552(d)	0.462 (26)
			Needleleaf	Y(Needleleaf) = -10,8711 + 1,193225(d)	0.503 (31.4)	Y(Needleleaf) = 3213,191 + 205,8932(d)	0.197 (7)
			Crown	Y(Crown) = -62,1889 +4,413435(d)	0.649 (57)	Y(Crown) = -465,0771 + 857,248(d)	0.382 (19)
			Whole tree	Y(Wholetree) = -26,11437+0,436421(d)^2	0.873 (213)	Y(Wholetree) = -23589,1 + 6130,037(d)	0.709 (75)
d = Middle tree diameter at breast height (d1,3)							

Annex Table 4. Single and double entry tree volume equations of plane tree (*Platanus orientalis* l.) (Uludağ, 2006).

Reference	Location	Species	Related parameter of tree	Equation for single entry tree volume table	R^2 (F)	Equation for double entry tree volume table	R^2 (F)
Uludağ, M. (2006). Construction of Tree Volume Tables of Oriental Plane (Platanus Orientalis L.) for Kastamonu Forest District, Çatalzeytin Forest Enterprize. Master Thesis, Zonguldak Karaelmas University. Institute of Science, 69.	Catalzeytin (Kastamonu)	Plane Tree (*Platanus orientalis* l.)	Whole tree	$V= a_0 + a_1d + a_2d^2$	0.928 (1840)	$V= a_0 + a_1d^2 + a_2h^2 + a_3dh^2 + a_4d^2h^2$	0.98 (3491)
d = Middle tree diameter at breast height (d1,3), h = height							

Annex Table 5. Single and double entry tree volume equations for the *Populus Tremula* L. (Bayburtlu, 2007).

Reference	Location	Species	Related parameter of tree	Single enrty tree volume table	R^2 (F)	Double tree entry volume table	R^2 (F)
Bayburtlu, Ş. (2007) Construction of Stem Volume Tables and Site Index Tables for Trembling Aspen. Master Thesis, Karadeniz Technical University. Institute of Science, 62.	Eastern Anatolia and Eastern Black Sea Region	(*Populus Tremula* L.)	Whole tree	$LogV=-3.483+1.0931LogD+0.969(LogD)^2-0.135(LogD)^4$	0.98 (234.6)	$LogV=-4.754+2.636(LogD)^2+0.055H-0.103(LogD)^4-1.341(1/H)^2+1.18(1/H)-0.133(1/D)^2+1.045(1/D)$	0.99
d = Middle tree diameter at breast height (d1,3), h = height							

Annex Table 6. Wet and dry weight equations in the hectare with a single tree belonging to the red pine (*Pinus brutia*) species (Ünsal, 2007).

Reference	Location	Species	Related parameter of wet weight	Individual Tree	R^2 (F)	in hectares	R^2 (F)
Ünsal, A. (2007). Construction of Biomass Tables of Redpine In Karaisali Forest District Directorates in Adana Forest Regional Headquarter. Master Thesis. Zonguldak Karaelmas University. Institute of Science, 51.	Adana	*Pinus brutia*	**Stem wood**	ln (Stemwood) = -1,94269 + 2,366779 ln (d)	0.96 (697.3)	ln (Stemwood) = 7,14334627 + 1,53034597 ln (d)	0.85 (174)
			Branch	ln (branch) = -3,64273 + 2,425,347 ln (d)	0.93 (442.52)	ln (dA) = 5.443421 + 1.5889144 ln (d)	0.80 (122)
			Needleleaf	ln (needle) = -2.05392 + 1.688159 ln (d)	0.88 (244.58)	ln (needle) = 7,032,233 + 0,851726 ln (d)	0.62 (51)
			Crown	ln (crown) = -2,42598 + 2,171153 ln (d)	0.94 (449.5)	ln (crown) = 6.66017 + 1.3347203 ln (d)	0.78 (109)
			Whole tree	ln (whole tree) = -1,47292 + 2,311275 ln (d)	0.96 (779)	ln (wholetree) = 7.6132328 + 1.47484186 ln (d)	0.85 (175)
			Related parameter of oven-dry weight	**Individual Tree**	**R^2 (F)**	**in hectares**	**R^2 (F)**
			Stem wood	ln (Stemwood) = -2,52163 + 2,339236 ln (d)	0.945 (529.78)	ln (Stemwood) = 6.564528 + 1.5280256 ln (d)	0.83 (154)
			Branch	ln (branch) = -4, 99881 + 2,558273 ln (d)	0.82 (141.5)	ln (branch) = 3,525959 + 1,872,978 ln (d)	0.84 (162)
			Needleleaf	ln (needle) = -2,27693 + 1,565827 ln (d)	0.80 (123)	ln (needle) = 6.809221 + 0.729395 ln (d)	0.37 (18)
			Crown	ln (crown) = -3,16552 + 2,160043 ln (d)	0.84 (166.75)	ln (crown) = 5,474371 + 1,4437534 ln (d)	0.79 (117)
			Whole tree	ln (whole tree) = -1,92352 + 2,243357 ln (d)	0.95 (608.32)	ln (whole tree) = 6,9008376 + 1,4774043 ln (d)	0.85 (170)
d = Middle tree diameter at breast height (d1,3)							

Annex Table 7. Anatolian black pine (*Pinus nigra* Arn. subsp. pallasiana (Lamb.) Holmboe) and the wet and dry weight equations in the hectare (Çakıl, 2008).

Reference	Location	Species	Related parameter of wet weight	Individual Tree	R^2 (F)	in hectares	R^2 (F)
Çakıl, E. (2008). Constructıng Biomass Tables of Crimean Pine in Zonguldak Forest Regional Directorate. Zonguldak Karaelmas University Institute of Science, Unpublished Master Thesis, Bartın.	Zonguldak	Anatolian black pine (*Pinus nigra* Arn. Holmboe)	**Stem wood**	Y = 0.250099d2 + 16.07791d - 139.684	0.952 (407,92)	Y = 123.7265d2 + 10750.71d - 37045.8	0.88 (155)
			Branch	Y = -0.57773 +0.765152 d	0.663 (82.84)	Y = 4363,242 + 386,9295 d	0.396 (27.5)
			Needleleaf	Y = 3,828,411 + 0,307314 d	0.48 (39.34)	Y = 3909,994 Ln (d) - 3351, 23	0.15 (7.62)
			Crown	Y = 4.669382 + 0.99572 d	0.5892 (60.24)	Y = 13268.1 Ln (d) - 19063,7	0.28 (16.74)
			Whole tree	Y = 0.251062d2 + 17.01207d - 134.191	0.953 (419)	Y = 122,3603 d2 + 11294,48 d - 27033,1	0.87 (146)
			Related parameter of oven-dry weight	**Single Tree**	**R^2 (F)**	**in hectares**	**R^2 (F)**
			Stem wood	Y = 0.1335 d + + 9.773876 d - 103.221	0.939 (320.02)	Y = 49,41835 d & lt; 2 & gt; + 6448,48 d - 41607,1	0.88 (155)
			Branch	Y = 15,72827 Ln (d) - 35,8478	0.60 (64.12)	Y = 8328,839 Ln (d) - 16082,2	0.437 (32.64)
			Needleleaf	Y = 0.709426 + 0.002182 d & lt; 2 & gt;	0.54 (49.66)	Y = 1,155269 d & lt; 2 & gt; + 954,8952	0.299 (17.93)
			Crown	Y = 19.02144 In (d) - 43.8643	0.66 (81)	Y = 10037,1 Ln (d) - 19636,9	0.45 (34.84)
			Whole tree	Y = 0,100728d2 + 10,61818d - 106,555	0.939 (317)	Y = 46,58692 d ^{2} + 6980,122 d - 40920	0.878 (148)
Y = weight, d = Middle tree diameter at breast height (d1,3)							

Annex Table 8. Anatolian black pine (*Pinus nigra* Arn. subsp. pallasiana (Lamb.) Holmboe equilibrium and the equation of some stand parameters developed according to frequency degree, index of site quality and age of stands (Tekin, 2008).

Reference	Location	Species	Related parameter of tree	Double entry tree volume table equation	R^2 (F)
Tekin, BA (2008). Effects of Stand Age-Density–Site Quality On Increment and Growth For Pure, Even-Aged And Natural Anatolian Black Pine [Pinus Nigra Arnold Subsp. Pallasiana (Lamb.) Holmboe] Stands in Isparta Region (Doctoral dissertation, SDU Institute of Science).	Isparta	Anatolian black pine [*Pinus nigra* Arnold subsp. pallasiana (Lamb.) *Holmboe]*	**Whole tree**	ln v = -9.4497967 + 1.96542455n d + 0.81678563ln h	0.996 (60393)
Reference	**Location**	**Species**	**Stand volume elements**	**Developed equations by the degree of frequency, the Index of site quality and the age of the stands**	**R^2 (F)**
Tekin, BA (2008). Effects of Stand Age-Density–Site Quality On Increment and Growth For Pure, Even-Aged And Natural Anatolian Black Pine [Pinus Nigra Arnold Subsp. Pallasiana (Lamb.) Holmboe] Stands in Isparta Region (Doctoral dissertation, SDU Institute of Science).	Isparta	Anatolian black pine [*Pinus nigra* Arnold subsp. pallasiana (Lamb.) *Holmboe]*	**Number of trees**	ln N= 5.220-0.508 ln *SQI* +0.958 ln *FL* +67.956(1/*YAS)*	0.749 (138.093)
			Chest surface	lnG= 1.410+ 0.171 ln *SQI* + 1.012 ln *FL* - 22.700 (1/*YAS)*	0.969 (1456)
			Medium diameter	dg=- 21.526 + 1.297 ln[(*YAS SQI*²) / *FL*]ln*YAS*	0.732 (162.688)
			Medium size	lnhg= 0.732+ 0.827 ln *SQI* + 0.0096 *FL*-44.531 (1/*YAS)*	0.867 (302.313)
			Stand volume	ln V= 3.326+ 0.021 *SQI* + 1.215 ln *FL*- 46.955 (1/*YAS)*	0.846 (253.671)
d = diameter at breast height (d1,3) (cm), dg = Middle tree diameter at breast height (d1,3)(cm), G= stand diameter at breast height (m2 / ha), h = Tree height (m), SQI = Site Quality Index (m), hg = Height of middle tree at breast height (m), N = Number of trees (pieces / ha), FL = Frequency Level, T = Stand age (year), Vg = Overall stand volume (m3 / ha), V = Remaining stand volume (m3 / ha), Va = Separated stand volume (m3 / ha)					

Annex Table 9. Taurus Sediri (*Cedrus libani* A.Rich.) wet weight equations in individual and hectare (Ülküdür, 2010).

Reference	Location	Species	Related parameter of wet weight	Individual Tree	R^2 (F)	in hectares	R^2 (F)
Ülküdür, M (2010). Construction Biomass Tables of Cedar in Antalya Regional Forest Directorate (Master's thesis, Institute of Science and Technology, Bartın University).	Antalya	Toros Sediri (*Cedrus libani* A.Rich.)	**Stem wood**	Y = 60,08871-(12,3735$d_{1,30}$)+(0,89907$d_{1,30}^{2}$)	0,948 (290,55)	Y= -7149,7326+(314,517$d_{1,30}^{2}$)	0,724 (86,93)
			Stem bark	Y = 5,404055-(0,899$d_{1,30}$)+(0,116433$d_{1,30}^{2}$)	0,9649 (440,18)	Y= -1403,602+(567,848$d_{1,30}$)+(33,533$d_{1,30}^{2}$)	0,768 (53,14)
			Branch (bigger than 4 cm)	Y = -72,7493+(4,1271$d_{1,30}$)	0,83290 (89)	Y= -34724,4+(2069,434$d_{1,30}$)	0,603 (27,36)
			Branch bark (bigger than 4 cm)	Y = -8,51695+(0,03072$d_{1,30}^{2}$)	0,867 (117)	Y= -2817,65+(14,14037$d_{1,30}^{2}$)	0,714 (45,15)
			Branch (smaller than 4 cm)	Y = 6,787543+(-0,86105$d_{1,30}$)+(0,056416$d_{1,30}^{2}$)	0,840 (84)	Y= -7158,98+(852,5194$d_{1,30}$)	0,572 (44,11)
			Branch bark (smaller than 4 cm)	Y = 8,648221+(-1,03774$d_{1,30}$)+(0,044281$d_{1,30}^{2}$)	0,865 (102)	Y= 1977,497+(-135,546$d_{1,30}$)+(12,74286$d_{1,30}^{2}$)	0,762 (51,36)
			Twig	Y= 6,423101+(-0,66072$d_{1,30}$)+(0,042896$d_{1,30}^{2}$)	0,802 (66)	Y= 208,5182+(219,5702$d_{1,30}$)+(7,5388$d_{1,30}^{2}$)	0,737 (46,44)
			Needleleaf	Y= 13,60954+(-1,21543$d_{1,30}$)+(0,071512$d_{1,30}^{2}$)	0,840 (86)	Y= 3704,276+(139,9$d_{1,30}$)+(16,44674$d_{1,30}^{2}$)	0,694 (37,52)
			Crown	Y= 38,0413+(-6,01567$d_{1,30}$)+(0,356949$d_{1,30}^{2}$)	0,926 (208)	Y= -372,81+(108,8701$d_{1,30}^{2}$)	0,788 (127)
			Whole tree	Y= 103,6281+(-19,9041$d_{1,30}$)+(1,391016$d_{1,30}^{2}$)	0,964 (443)	Y= -7814,99+(472,6045$d_{1,302}$)	0,760 (108)
Y = weight, d = Middle tree diameter at breast height (d1,3)							

Annex Table 10. Taurus Cedar (*Cedrus libani* A.Rich.) dry weight equations in individual tree and hectare (Ülküdür, 2010).

Reference	Location	Species	Related parameter of oven-dry weight	Single Tree	R^2 (F)	in hectares	R^2 (F)
Ülküdür, M. (2010). Construction Biomass Tables of Cedar in Antalya Regional Forest Directorate (Master's thesis, Institute of Science and Technology, Bartın University).	Antalya	Taurus Cedar (*Cedrus libani A.Rich.*)	**Stem wood**	$Y = -31{,}0516+(0{,}303619d_{1,30}^2)$	0,929 (430,85)	$Y = -3136{,}159298+(150{,}177497d_{1,30}^2)$	0,685 (72,06)
			Stem bark	$Y = -0{,}7153+(0{,}056879d_{1,30}^2)$	0,90437 (312)	$Y = -9575{,}35+(1275{,}758d_{1,30})$	0,604 (50,34)
			Branch (bigger than 4 cm)	$Y = -34{,}7618+(1{,}974415d_{1,30})$	0,812 (78,09)	$Y= -17107{,}6+(1009{,}989d_{1,30})$	0,576 (24,54)
			Branch bark (bigger than 4 cm)	$Y = -14{,}5495+(0{,}828923d_{1,30})$	0,842 (95)	$Y= -7193{,}43+(426{,}3146d_{1,30})$	0,565 (23,46)
			Branch (smaller than 4 cm)	$Y = 9{,}692722+(-1{,}1675d_{1,30})+(0{,}046302d_{1,30}^2)$	0,882 (119)	$Y= -4713{,}3+(481{,}6293d_{1,30})$	0,539 (38,63)
			Branch bark (smaller than 4 cm)	$Y = 9{,}999136+(-1{,}22839d_{1,30})+(0{,}041916d_{1,30}^2)$	0,879 (116)	$Y= 3307{,}871+(-369{,}242d_{1,30})+(15{,}12371d_{1,30}^2)$	0,797 (62,97)
			Twig	$Y = -0{,}27283+(0{,}013135d_{1,30}^2)$	0,828 (163)	$Y= -751{,}373+(167{,}7509d_{1,30})+(2{,}038892d_{1,30}^2)$	0,813 (72,2)
			Needleleaf	$Y= 0{,}817584+(0{,}019014d_{1,30}^2)$	0,839 (177)	$Y = 2360{,}3947+(8{,}1061304d_{1,30}^2)$	0,595 (49,95)
			Crown	$Y= 20{,}73819+(-3{,}36526d_{1,30})+(0{,}186172d_{1,30}^2)$	0,953 (340)	$Y= -2209{,}33+(56{,}1556d_{1,30}^2)$	0,758 (106)
			Whole tree	$Y = 37{,}21449+(-8{,}08322d_{1,30})+(0{,}644812d_{1,30}^2)$	0,956 (360)	$Y = -2984{,}45+(234{,}3336d_{1,30}^2)$	0,713 (84,63)
Y = weight, d = Middle tree diameter at breast height (d1,3)							

Annex Table 11. Individual tree wet weight and dry weight equations for Yellow pine (*Pinus sylvestris* L.) (Ülker, 2010).

Reference	Location	Species	Related parameter of tree	Wet weight	R^2	Oven-dry weight	R^2
Ülker, C. (2010). Construction of Biomass Tables of Scotchpine in Amasya Forest Regional Headquarter (A Case Study of Kunduz Planing Unit), Master Thesis, KT Ü. Graduate School of Natural and Applied Sciences, Trabzon.	Amasya	Yellow Pine (*Pinus sylvestris* L.)	**Stem wood**	$y= 31.071+ (-4.202)xd_{1,3}+ 0.57xd_{1,3}^2$	0.991	$y= 21.969+ (-6.025)xd_{1,30}+ 0.518xd_{1,3}^2$	0.997
			Branch	$lny=ln\ 1.113+ln\ 1.120xd_{1,3}$	0.87	$lny=ln\ 0.709+ln\ 1.102xd_{1,3}$	0.794
			Needleleaf	$lny=ln\ 2.887+ln\ 1.089xd_{1,3}$	0.860	$lny=ln\ 1.045+ln\ 1.086xd_{1,3}$	0.827
			Bark	$lny=ln\ 0.013+ 2.089xd_{1,3}$	0.951**	$lny=ln\ 0.013+ 2.089xd_{1,3}$	0.951
			Whole tree	$y= 69.686+ (-8.960)xd_{1,30}+b_2xd_{1,3}^2$	0.974	$y= 12.581+ (-5.359)xd_{1,30}+ 0.565xd_{1,3}^2$	0.990
(y) = wet and dry weight (Kg) of the whole tree, branch, needle, (d1.3) = Middle tree diameter at breast height, **. p <0.05							

Annex Table 12. Individual tree dry weight equations for yellow pine (*Pinus sylvestris* L.) species (Ülker, 2010).

Reference	Location	Species	Related parameter of tree	Oven-dry weight	R^2
Aydın, Ç. (2010). Construction of Biomass Tables of Pinus sylvestris in Artvin Forest Regional Headquarter (A Case Study of Borçka Planning Unit), Graduate Thesis, KT Ü. Graduate School of Natural and Applied Sciences, Trabzon.	Artvin	Yellow pine (*Pinus sylvestris* L.)	**Stem wood**	$Y=-6.358+0.139d^2$	0.942 (456)
			Branch	$lnY=4.6431+(-48.739)/d$	0.838 (145)
			Needleleaf	$lnY= (-0.837) + 0.265\ ln^2d$	0.760 (89)
			Bark	$Y=- 1.186+ 0.05d^2$	0.887 (220)
			Whole tree	$Y=- 4.9289+ (-1.2465)d+ 0.226d^2$	0.987 (967)
d = Middle tree diameter at breast height					

Annex Table 13. Individual tree wet weight equations for the Uludağ Abies (*Abies nordmanniana* ssp. Bornmuelleriana) species (Karaburk, 2011)

Reference	Location	Species	Related parameter of tree	Wet weight equations for single entry biomass tables	R^2 (F)	Wet weight equations for double entry biomass tables	R^2 (F)
Karaburk, T. (2011). Estimation of Biomass Tables of Fir Stands nin Bartın, Bartın University Institute of Science and Technology. Unpublished Master Thesis, Bartın.	Bartin	Uludağ Abies (*Abies nordmanniana* ssp. Bornmuelleriana)	**Stem wood**	$y = -47.9177 + 0.785249d^2$	0.985 (2044)	$y=209.1143+(-42.79d)+(1.793023\ d_{1,30}h)+(1.0992232d^2)+(-0.01961d^2h)$	0.991 (805)
			Stem bark	$y = 0.962616 + 0.77894d^2$	0.975 (12.50)	$lny=-3.08135+(1.339836lnd)+(0.930758lnd)$	0.989 (1486)
			Branch (bigger than 4 cm)	$y = -996.539+ 299.7244lnd$	0.448 (7.33)	$y=-4340.56+(137.0154d)+(-9.28829\ dh)+(-0.33669d^2)+(247.3192h)+(0.064747d^2h)$	0.832 (4.9)
			Branch bark (bigger than 4 cm)	$y = -257.317+ 79.54567lnd$	0.291 (3.70)	$y=-2756.24+(128.3086d)+(-5.40055\ dh)+(-1.25886d^2)+(113.2421h)+(0.055849d^2h)$	0.798 (3.9)
			Branch (smaller than 4 cm)	$y = -72.6954+ 36.73594lnd$	0.512 (33.71)	$lny=-14.1309+10.44785lnd_{1,30}-(1.47567ln^2d)+(0.8493lnh)+(0.245131\ ln^2h$	0.886 (96)
			Branch bark (smaller than 4 cm)	$y = -26.5527+ 13.68606lnd$	0.556 (40)	$lny=-14.961+10.41949lnd-(1.51429ln^2d)-(0.7735lnh)+(0.270959\ ln^2h$	0.901 (66)
			Needleleaf	$y = -25,9847 + 2.73191d+0.041028d^2$	0.872 (105)	$y=-1.70381+(-1.52418d)+(0.01418\ dh)+(0.261887d^2)+(-0.0056d^2h)$	0.891 (59)
			Crown	$y = -78,8986 + 8.048291d+0.07608d^2$	0.847 (86)	$y=48.02209-(14.1117d)+(0.209896dh)+(1.0732289d^2)-(0.0263d^2h)$	0.902 (67)
			Whole tree	$y = -37,1051 +1.0672246d^2$	0.986 (2333)	$y=284.8001+(-62.5795d)+(2.158989dh)+(2.432863d^2)+(-0.04906d^2h)$	0.990 (737)
y = weight, d = Middle tree diameter at breast height (d1,3)							

Annex Table 14. Individual tree dry weight equations of Uludağ Abies (*Abies nordmanniana* ssp. Bornmuelleriana) species (Karaburk, 2011)

Reference	Location	Species	Related parameter of tree	Dry weight equations for single entry biomass tables	R^2 (F)	Dry weight equations for double entry biomass tables	R^2 (F)
Karaburk, T. (2011). Estimation of Biomass Tables of Fir Stands nin Bartın, Bartın University Institute of Science and Technology. Unpublished Master Thesis, Bartın.	Bartin	Uludağ Abies (*Abies nordmanniana* ssp. Bornmuelleriana)	**Stem wood**	y = -28,6553 +0.372705d^2	0.979 (1459)	y=47.5306+(-8.90955d)+(0.468435dh)+(0.16733d^2)+(0.003735d^{2}h)	0.991 (805)
			Stem bark	y = 0,042861 +0.04161d^2	0.961 (787)	lny=-3.63636+(1.36184lnd)-(0.874147lnh)	0.989 (1486)
			Branch (bigger than 4 cm)	y = -723.008+ 213.8092lnd	0.531 (10.22)	y=-29.2916+92.98339d$_{1,30}$+(-6.54215d$_{1,30}$h)+(-0.25893d$_{1,30}^2$)+(171.9641h)+(0.047813d$_{1,30}^2$h)	0.832 (4.9)
			Branch bark (bigger than 4 cm)	y = -115.128+36.83597lnd	0.180 (1.97)	y=-20.5802+103.1452d+(-3.94196dh)+(-1.13604d^2)+(77.00917h)+(0.004455d^{2}h)	0.798 (3.9)
			Branch (smaller than 4 cm)	y = -44.1821+22.23076lnd	0.512 (33.60)	lny=-14.3735+(9.548516lnd)-(1.29489ln^{2}d)+(0.051463lnh)+(0.020457ln^{2}h)	0.886 (96)
			Branch bark (smaller than 4 cm)	y = -13.965+7.211039lnd	0.559 (40)	lny=-15.6255+(9.893857lnd)-(1.41229ln^{2}d)+(0.04206lnh)+(0.097988ln^{2}h)	0.901 (66)
			Needleleaf	y = -11,6672 + 1.275487d+0.015577d^2	0.858 (94)	y=-6.91358+103.1452d+(-3.94196dh)+(-1.13604d^2)+(77.00917h)+(0.004455d^{2}h)	0.891 (59)
			Crown	y = -37,568 + 3.757374d+0.0495d^2	0.845 (84)	y=-18.65024+(-6.08655d)+(0.0502275dh)+(0.540787d^2)+(-0.01259d^{2}h)	0.902 (67)
			Whole tree	y = -24,7765 +0.525998d^2	0.987 (2520)	y=84.61739+(-20.9204d)+(0.599125dh)+(0.930834d^2)+(-0.0114d^{2}h)	0.990 (737)
y = weight, d = Middle tree diameter at breast height (d1,3)							

Annex Table 15. *Abies bornmulleriana*, *Fagus orientalis*, *Pinus silvestris, Quercus sp.* application of the previously formed equations of the species to the mixed stands in the boundaries of the Bartın Forest Management Directorate (Macaroğlu, 2011).

Reference	Location	Species	Single enrty biomass equation	Multi-entry biomass equation
Karaburk T (2011) Estimation of Biomass Tables of Fir Stands nin Bartın. Graduate Thesis, BÜ Institute of Science and Technology, Department of Forest Engineering, Bartın, 173 p.	Bartın Forest Management Directorate	Abies (*Abies bornmulleriana*)	y= -24,7765+0,525998 d^2	y= 86,61739+(-20,904d)+(0,599125dh)+(0,930834d2)+(-0,0114d^2h)
Saraçoğlu N (1992) Arrangement of beech biomass tables. Turkish Journal of Agriculture and Forestry, 22. 93-100.		Beech (*Fagus orientalis*)	-	Log (Y_{IDW}) = 2,8626+0,0124.$(d_{1,3})_i$ +((-14,9099).$(d_{1,3})_i^{-1}$)
Durkaya B (1998) Constructions of Biomass Tables of Quercus in Zonguldak Regional Directorate. Master Thesis (published), ZKU Institute of Science and Technology, Department of Forest Engineering, Zonguldak, 110 p.		Oak (*Quercus* sp.)	$(Y_{DW})_i$ = 302,193+26,56569.$(d_{1.30})_i$	-
Atmaca S. (2008) Construction of Biomass Tables of Scotchpine in Erzurum Forest Regional Headquarter. Master Thesis, ZKU Institute of Science and Technology, Department of Forest Engineering, Zonguldak, 111 p.		Yellow pine (*Pinus silvestris*)	$Y_{(wholetree)}$ = -26,11437+0,436421 d^2	$Y_{(WHOLETREE)}$ = -158,378+(18,39502d)+(-0,15635dh)+(-0,54561d2)+(0,031285 d^2 h)

Annex Table 16. Individual tree wet weight equations of *Abies nordmanniana* (*Abies nordmanniana* ssp. Bornmuelleriana) species (Doğan, 2010)

Source	**Location**	**Species**	**Related parameter of tree**	**Wet weight**
Dogan, N. (2010). Diameter-Based Biomass Prediction And Assesment of Leaf Area:Sapwood Ratio For Turkish-Fir (Abies Nordmanniana (Stev.) Spach. Ssp. Bormulleriana (Mattf.) Code Et Cullen) In Duzce Province. Düzce University Graduate School of Natural and Applied Sciences, Unpublished Master Thesis, Düzce.	Duzce	Uludağ Abies (*Abies nordmanniana* (Stev.) Spach. Ssp. Bormulleriana (Mattf.) Code Et Cullen)	**Whole tree**	*Total biomass (kg) = -388 + 29 x diameter (cm)*
			Stem wood	*Stem wood-biomass of the tree (kg) = -318 + 22 x diameter (cm)*
			Branch	*Branch biomass of the tree (kg) = -43 + 2.9 x diameter (cm)*
			Leaf	*Leaf biomass of the tree (kg) = -20 + 1.65 x diameter (cm)*
			Leaf surface area	*Leaf surface area (m2) = 20.52 + 0.2986 x (living-wood area, cm2)*

Annex Table 17. Individual tree wet weight equations for beech (Lipsky.) species (Dogan, 2010)

Source	Location	Species	Related parameter of tree	Wet weight	R2 (F)
Dogan, SA. (2010). Diameter-Based Biomass Prediction And Assesment Of Leaf Area:Sapwood Ratio For Eastern Beach (Fagus Orientalis Lipsky) In Duzce Province. Düzce University Graduate School of Natural and Applied Sciences, Unpublished Master Thesis, Düzce.	Duzce	Beech (*Fagus orientalis* Lipsky.)	**Whole tree**	*Total biomass (kg) = -253 + 27.55 x diameter (cm)*	*R^2 = 0.7674 (92)*
			Stem wood	*Aboveground main stem wood biomass (kg) = -214 + 21 x diameter (cm)*	*R^2 = 0.7075 (68)*
			Branch	*Branch biomass (kg) = 3.27 + 1.38 x diameter (cm)*	*R^2 = 0.19 (6.5)*
			Leaf	*Leaf biomass (kg) = 0.06264 + 0.14513 x diameter (cm)*	*R^2 = 0.27 (10.4)*
			Leaf surface area	*Leaf surface area (m2) = 19.4 + 503 x living wood area (m2)*	*R^2 = 0.157 (5.22)*

Annex Table 18. Individual tree wet weight equations belonging to red pine (*Pinus brutia* Ten.) Species (Orhan, 2013)

Source	Location	Species	Related parameter of tree	Wet weight	R2 (F)
Orhan, İ. (2013). Estimation of Biomass Amounts of Commercial and Noncommercial Parts of Red Pine, Scots Pine And Black Pine. *Bartın University Institute of Science, Bartin.*	Karaisalı (Adana), Erzurum, Zonguldak	Red-pine (*Pinus brutia* Ten.)	**Stem wood**	*y -186,1993181+16,39367767d+0,23033134d²*	0.959 (416.9)
			Stem bark	Lny= -3,56076216+2.206541854lnd	0.9 (332.1)
			Branch wood bigger than 4 cm	y= -27,6885587+2.084287033d+0,04465147d²	0.852 (69.15)
			Branch bark bigger than 4 cm	y= -7,706420624+0,675344727d	0.744 (72.53)
			Branch wood tree smaller than 4 cm	y= 32,32422797+(-1.197252979d+0.041983833d²)	0.418 (12.91)
			Branch bark less than 4 cm	y= 6,770807047+(-0,189897729d)+(0.00535402d²)	0.233 (5.459)
			Needleleaf	y= 2,843716365+(0.036621828d²)	0.797 (144.8)
			Crown	y= 14,68590216+(0,208030277d)+(0,151851012d²)	0.912 (186.6)
			Whole tree	y= 78,18013289+(-11.32367131d)+(1.00105469d²)	0.978 (788.5)
d = Middle tree diameter at breast height (d1,3), y = weight					

Annex Table 19. Individual tree wet weight equations of Yellow pine (*Pinus sylvestris* L.) (Orhan, 2013)

Source	Location	Species	Related parameter of tree	Wet weight	R^2 (F)
Orhan, İ. (2013). Determination of Biomass Amounts of Commercial and Noncommercial Components of Red Pine, Black Pine and Yellow Pine. *Bartın University Institute of Science, Bartin.*	Karaisalı (Adana), Erzurum, Zonguldak	Yellow pine (*Pinus sylvestris* L.)	**Stem wood**	Lny=-1,667373737+2,322183061lnd	0.962 (875.1)
			Stem bark	Lny= -1,621303007+1,534123999lnd	0.745 (102.2)
			Branch wood bigger than 4 cm	y= -120,2018111+6,087958932d	0.9 (232.8)
			Branch bark bigger than 4 cm	y= -9,75344991+0,465256756d+0,007486503d^2	0.867 (81.67)
			Branch wood smaller than 4 cm	y= 16,19239682+(0,014083129d^2)	0.623 (57.77)
			Branch bark smaller than 4 cm	y= 3,041487527+(0,00235305d^2)	0.586 (49.53)
			Needleleaf	Lny= 0,818204846+(0,131013714d)+(-0,00109227d^2)	0.834 (85.58)
			Crown	Lny= -1,338446592+(1,858033985lnd)	0.951 (681.8)
			Whole tree	y= -26,0339344+(0,846803359d^2)	0.938 (526.6)
d = Middle tree diameter at breast height (d1,3), y = weight					

Annex Table 20. Anatolian black pine (*Pinus nigra* Arn. Holmboe) individual tree wet weight equations (Orhan, 2013)

Source	Location	Species	Related parameter of tree	Wet weight	R^2 (F)
Orhan, İ. (2013). Determination of Biomass Amounts of Commercial and Noncommercial Components of Red Pine, Black Pine and Yellow Pine. *Bartın University Institute of Science, Bartin.*	Karaisalı (Adana), Erzurum, Zonguldak	Anatolian black pine (*Pinus nigra* Arn. Holmboe)	**Stemwood**	y= 9,556741631+-5,757566975d+0,662928956d^2	0.95 (323.7)
			Stem bark	Lny= -117,193776+52.31510055lnd	0.623 (57.83)
			Branch wood bigger than 4 cm	y= -52,4658138+3,822782002d	0.907 (122.3)
			Branch bark bigger than 4 cm	y= -11,044479+0,858528828d	0.886 (202.2)
			Branch wood smaller than 4 cm	y= 36,10607388+(-1.877506264lnd)	0.547 (42.32)
			Branch bark smaller than 4 cm	y= 2,405576856+(-0,02014739d)+(0,000109228d^2)	0.043 (1.57)
			Needleleaf	y= -16,6637556+(9.284300494lnd)	0.677 (73.34)
			Crown	y= -23,7105384+(4,914103465d)	0.919 (193.5)
			Whole tree	y= -229,2487743+(24.59420428d)+(0.208006024d^2)	0.979 (375.8)
d = Middle tree diameter at breast height (d1,3), y = weight					

Annex Table 21. Individual tree wet weight equations of the red-pine (*Pinus brutia* Ten.) species (Yilmaz, 2015)

Source	Location	Species	Related parameter of tree	Wet weight	R^2 (F)
Yilmaz,S.(2015). Determination of Biomass of Even Aged And Pure Stands of Pinus Brutia In Antalya Region (Master's thesis, Artvin Coruh University, Institute of Science).	Antalya	Red-pine (*Pinus brutia* Ten.)	**Whole tree**	$y=1.467.d_{1,3}^{1.681}$	0.93 (1442)
			Stem wood	$y=0.175.d_{1,3}^{2.199}$	0.95 (2247)
			Branch	$y=0.197.d_{1,3}^{1.685}$	0.87 (715)
			Needleleaf	$y=0.867.d_{1,3}^{1.120}$	0.79 (339)
			Bark	$y=0.070.d_{1,3}^{1.884}$	0.90 (1094)
d = Middle tree diameter at breast height (d1,3), y = weight					

Annex Table 22. Single and double entry volume equations for the red-pine (*Pinus brutia* Ten.) Species (Su, 2014).

Source	Location	Species	Related parameter of tree	Single entry volume table	R^2 (F)	Double entry volume table	R^2 (F)
Su (2014), Construction of Stem Volume And Site Index Tables for Brutian Pine Artificial Stands in Korkuteli Region, Süleyman Demirel University, Master Thesis, Isparta.	Korkuteli (Antalya) Directorate of Forestry Operations	Red-pine (*Pinus brutia* Ten.)	Whole tree	log v=-1.115344+2.481811*logd+0.767174*1/d	0.96 (2479)	$v=0.076024*d^2+0.01697*d*h^2+0.026366*d^2*h$	0.995 (20335)
d = Middle tree diameter at breast height (d1,3), h = height, v = volume							

Annex Table 23. Individual tree wet weight equations for Yellow pine (*Pinus sylvestris* L.) (single entry) (Say, 2016)

Source	Location	Species	Related parameter of wet weight	Wet Weight Single entry biomass (Natural)	R^2 (F)	Wet weight Single entry biomass (Plantation)	R^2 (F)
Say, Ş. (2016). Determination of Biomass Amounts Above-Ground And Belowground of Natural And Plantation Young Scots Pine Individuals In Çerkeş Forest Management Chiefdom (Master's thesis, Bartin University, Institute of Science).	Çerkeş (Çankırı)	Yellow pine (*Pinus sylvestris* L.)	**Stem wood**	$\ln y = -1{,}5973 + 2{,}579 \ln d_{1.30}$	0,97 (549,4)	$y = 8{,}0771 + 0{,}2697\, d_{1.30}$	0,92 (197,3)
			Stem bark	$\ln y = -2{,}6755 + 1{,}7623 \ln d_{1,30}$	0,97 (576,9)	$y = 1{,}6101 + 0{,}0237\, d_{1,30}^2$	0,88 (137)
			Branch wood	$\ln y = -7{,}1949 + 3{,}3679 \ln d_{1,30}$	0,87 (122)	$y = -1{,}1884 + 0{,}1038\, d^2_{1,30}$	0,78 (63)
			Branch bark	$y = -1{,}4131 + 0{,}0207\, d_{1,30}^2$	0,83 (87)	$y = 0{,}3718 + 0{,}0255\, d_{1,30}^2$	0,71 (43)
			Needleleaf	$\ln y = -3{,}5389 + 2{,}2613 \ln d_{1,30}$	0,90 (157,8)	$y = 16{,}3879 - 3{,}0272\, d_{1,30} + 0{,}2465\, d_{1,30}^2$	0,94 (144,5)
			Crown	$\ln y = -4{,}0045 + 2{,}6416 \ln d_{1,30}$	0,90 (158)	$y = -4{,}9520 + 0{,}2801\, d_{1,30}^2$	0,91 (192)
			Whole tree	$\ln y = -1{,}3820 + 2{,}2918 \ln d_{1,30}$	0,97 (504)	$y = 4{,}7351 + 0{,}5735\, d^2_{1,30}$	0,96 (395)
			Bottom log wood	$y = -10{,}5270 + 1{,}5067\, d_{1,30}$	0,79 (68,4)	$y = -0{,}4667 + 0{,}0498\, d^2_{1,30}$	0,90 (167)
			Bottom log bark	$y = -1{,}3550 + 0{,}2368\, d_{1,30}$	0,65 (34)	$y = -0{,}8088 + 0{,}1549\, d_{1,30}$	0,80 (74)
			Root wood bigger than 4 cm	$y = -1{,}0661 + 0{,}0440\, d_{1,30}^2$	0,66 (31)	$y = 16{,}6718 - 2{,}6880\, d_{1,30} + 0{,}1189\, d^2_{1,30}$	0,85 (42)
			Root bark bigger than 4 cm	$y = -0{,}1901 + 0{,}0092\, d_{1,30}^2$	0,68 (33)	$y = -0{,}1901 + 0{,}0092\, d_{1,30}^2$	0,69 (17)
			Root wood smaller than 4 cm	$y = -1{,}2535 + 0{,}2591\, d_{1,30}$	0,57 (22)	$y = 0{,}0132 + 0{,}0144\, d_{1,30}^2$	0,84 (92)
			Root bark smaller than 4 cm	$y = -0{,}3995 + 0{,}0940\, d_{1,30}$	0,60 (25)	$y = 0{,}2309 + 0{,}0029\, d^2_{1,30}$	0,60 (26)
			Whole root	$\ln y = 5{,}3208 + (-30{,}1525/d_{1,30})$	0,94 (298)	$y = 15{,}8260 - 2{,}7311\, d_{1,30} + 0{,}1993\, d_{1,30}^2$	0,95 (163)
d = Middle tree diameter at breast height (d1,3), y = weight							

Annex Table 24. Individual tree dry weight equations for Yellow Pine (*Pinus sylvestris* L.) (Say, 2016)

Source	Location	Species	Related parameter of dry weight	Dry weight single entry biomass (Natural)	R^2 (F)	Dry weight single entry biomass (Plantation)	R^2 (F)
Say, Ş. (2016). Determination of Biomass Amounts Above-Ground And Belowground of Natural And Plantation Young Scots Pine Individuals In Çerkeş Forest Management Chiefdom (Master's thesis, Bartin University, Institute of Science).	Çerkeş (Çankırı)	Yellow pine (*Pinus sylvestris* L.)	**Stem wood**	$lny = -2,2581 + 2,2123\ lnd_{1,30}$	0,96 (429,5)	$y = 4,8426 + 0,0957\ d_{1,30}^2$	0,87 (119,6)
			Stem bark	$lny = -3,8902 + 1,9602\ lnd_{1,30}$	0,96 (435,5)	$y = -1,6326 + 0,3638\ d_{1,30}$	0,79 (66,1)
			Branch wood	$lny = -8,4065 + 3,4748\ lnd_{1,30}$	0,84 (95)	$y = -1,1187 + 0,0486\ d_{1,30}^2$	0,78 (64)
			Branch bark	$y = -0,7235 + 0,0099\ d_{1,30}^2$	0,83 (88)	$y = 0,7540 + 0,0104\ d_{1,30}^2$	0,58 (24)
			Needleleaf	$y = -0,7235 + 0,0099\ d_{1,30}^2$	0,89 (154)	$y = 0,7540 + 0,0104\ d_{1,30}^2$	0,94 (134,7)
			Crown	$lny = -4,8726 + 2,6494\ lnd_{1,30}$	0,90 (165)	$y = -2,0496 + 0,1189\ d_{1,30}^2$	0,91 (178)
			Whole tree	$lny = -2,1186 + 2,2727\ lnd_{1,30}$	0,96 (459)	$y = 3,5398 + 0,2265\ d_{1,30}^2$	0,93 (250)
			Bottom log wood	$y = -5,0985 + 0,7379\ d_{1,30}$	0,71 (45)	$y = 0,0094 + 0,0198\ d_{1,30}^2$	0,83 (89)
			Bottom log bark	$y = -0,7444 + 0,1275\ d_{1,30}$	0,63 (31)	$y = -0,3157 + 0,0639\ d_{1,30}$	0,80 (71)
			Root wood bigger than 4 cm	$y = -0,5864 + 0,0216\ d_{1,30}^2$	0,63 (27)	$y = 5,8604 - 0,9292\ d_{1,30} + 0,0421\ d_{1,30}^2$	0,84 (40)
			Root bark bigger than 4 cm	$lny = -0,1666 + 0,0050\ d_{1,30}^2$	0,67 (33)	$lny = -0,1666 + 0,0050\ d_{1,30}^2$	0,77 (25)
			Root wood smaller than 4 cm	$y = -0,5515 + 0,1125\ d_{1,30}$	0,53 (19)	$y = 0,0269 + 0,0060\ d_{1,30}^2$	0,78 (65)
			Root bark smaller than 4 cm	$y = -0,1997 + 0,0496\ d_{1,30}$	0,35 (9)	$y = 0,0516 + 0,0013\ d_{1,30}^2$	0,73 (50)
			Whole root	$lny = 4,4971 + (-28,6715/d_{1,30})$	0,9 (167)	$y = 4,7934 - 0,8140\ d_{1,30} + 0,0705\ d_{1,30}^2$	0,92 (103)
d = Middle tree diameter at breast height (d1,3), y = weight							

Annex Table 25. Individual tree wet weight equations for Yellow Pine (*Pinus sylvestris* L.) (Double entry) (Say, 2016)

Source	Location	Species	Related parameter of wet weight	Wet weight biomass with double entry (Natural)	R^2 (F)	Wet weight biomass with double entry (Plantation)	R^2 (F)
Say, Ş. (2016). Determination of Biomass Amounts Above-Ground And Belowground of Natural And Plantation Young Scots Pine Individuals In Çerkeş Forest Management Chiefdom (Master's thesis, Bartin University, Institute of Science).	Çerkeş (Çankırı)	Yellow pine (*Pinus sylvestris* L.)	**Stem wood**	$\ln y = -3{,}4101 + 1{,}4496 \ln d_{1,30} + 1{,}6632 \ln h$	0,98 (481)	$y = -16{,}3360 + 5{,}4504\, d1{,}30 - 7{,}0925\, h + 0{,}0872\, d_{1,30}^2 + 0{,}7524\, h^2$	0,94 (62)
			Stem bark	$\ln y = -3{,}1508 + 1{,}5504 \ln d_{1,30} + 0{,}4361 \ln h$	0,97 (288)	$y = 0{,}5934 + 0{,}5677\, d_{1,30} - 1{,}1045\, h + 0{,}0057\, d_{1,30}^2 + 0{,}0935\, h^2$	0,91 (36)
			Branch wood	$y = 29{,}9973 - 7{,}1554\, d_{1,30} + 0{,}3018\, d_{1,30}h + 0{,}3404\, d_{1,30}^2 - 0{,}0113\, d_{1,30}^2h$	0,85 (21)	$y = -7{,}6407 - 0{,}0439\, d_{1,30} + 1{,}0640\, h + 0{,}0983\, d_{1,30}^2 + 0{,}0183\, h^2$	0,79 (14)
			Branch bark	$y = 3{,}4437 - 0{,}6263\, d_{1,30} + 0{,}3932\, h + 0{,}0367\, d_{1,30}^2 + 0{,}0622\, h^2$	0,88 (26)	$y = -8{,}1019 - 0{,}1917\, d_{1,30} + 2{,}5981\, h + 0{,}0263\, d_{1,30}^2 - 0{,}060\, h^2$	0,73 (10)
			Needleleaf	$y = 25{,}2530 - 3{,}1946\, d_{1,30} - 3{,}0260\, h + 0{,}1479\, d_{1,30}^2 + 0{,}3037\, h^2$	0,98 (481)	$y = 20{,}0022 - 1{,}2148\, d_{1,30} - 6{,}0066\, h + 0{,}1897\, d_{1,30}^2 + 0{,}4948\, h^2$	0,94 (62)
			Crown	$y = -1{,}3767 - 9{,}2304\, d_{1,30} + 9{,}9883\, h + 0{,}4675\, d_{1,30}^2 - 0{,}0993\, h^2$	0,90 (34,6)	$y = 4{,}2596 - 1{,}4504\, d_{1,30} - 2{,}3445\, h + 0{,}3143\, d^2_{1,30} + 0{,}3772\, h^2$	0,93 (50,6)
			Whole tree	$y = 161{,}3174 - 15{,}1770\, d_{1,30} - 29{,}1893\, h + 0{,}8793\, d_{1,30}^2 + 2{,}5232\, h^2$	0,95 (68,5)	$y = -11{,}4830 + 4{,}5676\, d_{1,30} - 10{,}5415\, h + 0{,}4071\, d_{1,30}^2 + 1{,}2230\, h^2$	0,97 (145)
			Bottom log wood	$y = 20{,}5305 - 0{,}0552\, d_{1,30} - 5{,}5808\, h + 0{,}0221\, d_{1,30}^2 + 0{,}3841\, h^2$	0,88 (28)	$y = -1{,}5495 + 0{,}344\, d_{1,30} - 0{,}8643\, h + 0{,}0372\, d_{1,30}^2 + 0{,}0992\, h^2$	0,92 (41)
			Bottom log bark	$y = 0{,}6717 + 0{,}4037\, d_{1,30} - 0{,}6990\, h - 0{,}0069\, d^2 + 0{,}0394\, h^2$	0,68 (7)	$y = -0{,}1353 + 0{,}2044\, d_{1,30} - 0{,}414\, h - 0{,}0015\, d^2 + 0{,}0357\, h^2$	0,88 (27)
			Root wood bigger than 4 cm	$y = 88{,}1269 + 2{,}3262\, d1{,}30 - 21{,}5842\, h + 0{,}0497\, d_{1,30}^2 + 1{,}0940\, h^2$	0,87 (22)	$y = 14{,}2216 - 1{,}6872\, d_{1,30} - 0{,}068\, d_{1,30}h + 0{,}0471\, d_{1,30}^2 + 0{,}0068\, d_{1,30}^2h$	0,85 (18)
			Root bark bigger than 4 cm	$y = 1{,}9233 + 0{,}7965\, d_{1,30} + 0{,}0407\, d_{1,30}h - 0{,}0603 d_{1,30}^2 - 1{,}0345h + 0{,}0025 d_{1,30}^2h$	0,81 (10,2)	$y = -0{,}6875 - 0{,}7915\, d_{1,30} + 1{,}8695\, h + 0{,}0264\, d_{1,30}^2 - 0{,}1199\, h^2$	0,76 (10)
			Root wood smaller than 4 cm	$y = 2{,}7487 - 0{,}3144\, d_{1,30} + 0{,}716\, h + 0{,}0117\, d_{1,30} - 0{,}0058\, h^2$	0,63 (6)	$y = 1{,}3198 - 0{,}4501\, d_{1,30} - 0{,}4389\, h - 0{,}0279\, d_{1,30}^2 - 0{,}0205\, h^2$	0,59 (5)
			Root bark smaller than 4 cm	$y = -1{,}2431 - 0{,}216\, d_{1,30} + 0{,}8367\, h + 0{,}0075\, d_{1,30}^2 - 0{,}0287\, h^2$	0,65 (6)	$y = 1{,}2243 - 0{,}0192\, d_{1,30} + 0{,}8631\, h + 0{,}0087\, d_{1,30}^2 - 0{,}0434\, h^2$	0,64 (6,5)
			Whole root	$y = 78{,}5879 + 1{,}2011\, d1{,}30 - 21{,}0951\, h + 0{,}0127\, d_{1,30}^2 + 1{,}2950\, h^2$	0,93 (52)	$y = 0{,}7240 - 3{,}4065\, d_{1,30} + 4{,}9592\, h + 0{,}2090\, d_{1,30}^2 - 0{,}2320\, h^2$	0,96 (92)
d = Middle tree diameter at breast height (d1,3), y = weight, h= height							

Annex Table 26. Individual tree dry weight equations for Yellow pine (*Pinus sylvestris* L.) (Double entry) (Say, 2016)

Source	Location	Species	Related parameter of dry weight	Dry weight biomass with double entry (Natural)	R^2 (F)	Dry weight biomass with double entry (Plantation)	R^2 (F)
Say, Ş. (2016). Determination of Biomass Amounts Above-Ground And Belowground of Natural And Plantation Young Scots Pine Individuals In Çerkeş Forest Management Chiefdom (Master's thesis, Bartin University, Institute of Science).	Çerkeş (Çankırı)	Yellow pine (*Pinus sylvestris* L.)	**Stem wood**	y= - 4,2619 + 1,3188 ln$d_{1,30}$ + 1,8384 lnh	0,98 (376)	y= - 2,8887 + 3,0115 $d_{1,30}$ - 4,9743 h + 0,00004 $d_{1,30}^2$ + 0,4228 h^2	0,90 (34)
			Stem bark	y= - 3,7746 + 2,0117 ln$d_{1,30}$ - 0,1060 lnh	0,96 (206)	y = 0,1662 + 0,2755 $d_{1,30}$ - 0,5519 h + 0,0029 $d_{1,30}^2$ + 0,0502 h^2	0,83 (18)
			Branch wood	y = 11,7913 - 2,4208 $d_{1,30}$ + 0,0769 $d_{1,30}$h + 0,0977 d1,302 - 0,0008 $d_{1,30}^2$h	0,88 (26)	y = -10,3673 - 0,3725 $d_{1,30}$ + 3,2391 h + 0,0546 $d_{1,30}^2$ - 0,1806 h^2	0,79 (13)
			Branch bark	y= 0,9075 - 0,3572 d1,30 + 0,0634 h + 0,0203 $d_{1,30}^2$ + 0,0176 h^2	0,88 (26)	y = - 2,7972 + 0,1177 $d_{1,30}$ + 0,4278 h + 0,0038 $d_{1,30}^2$ + 0,0084 h^2	0,72 (9)
			Needleleaf	y = 5,8671 - 1,2222 d1,30 - 0,4615 h + 0,0659 d1,302 + 0,0914 h2	0,98 (376)	y = 20,0022 - 1,2148 $d_{1,30}$ - 6,0066 h + 0,1897 $d_{1,30}^2$ + 0,4948 h^2	0,90 (34)
			Crown	y= - 1,5226 - 4,4390 $d_{1,30}$ + 4,9840 h + 0,2273 $d_{1,30}^2$ - 0,0567 h^2	0,91 (37,3)	y= - 5,9846 - 0,7753 $d_{1,30}$ + 1,6313 h + 0,1349 $d_{1,30}^2$ - 0,0031 h^2	0,92 (45,12)
			Whole tree	y = 80,5963 - 8,9552 $d_{1,30}$ - 13,0737 h + 0,4534 $d_{1,30}^2$ + 1,2102 h^2	0,95 (72,1)	y= - 8,707 + 2,5117 $d_{1,30}$ - 3,8949 h + 0,1378 $d_{1,30}^2$ + 0,4699 h^2	0,95 (74)
			Bottom log wood	y= 37,1265 + 0,2256 $d_{1,30}$ - 9,6165 h + 0,0180 $d_{1,30}^2$ + 0,6027 h^2	0,8 (14)	y = 0,1472 - 0,8139 $d_{1,30}$ + 0,9186 h + 0,0666 $d_{1,30}^2$ - 0,0160 h^2	0,86 (22)
			Bottom log bark	y= 7,2732 - 0,3336 $d_{1,30}$ - 1,7935 h + 0,0202 $d_{1,30}^2$ + 0,1458 h^2	0,66 (7)	y = 1,0774 + 0,3149 $d_{1,30}$ - 0,5670 h + 0,0091 $d_{1,30}^2$ + 0,0589 h^2	0,88 (15)
			Root wood bigger than 4 cm	y = 0,5063 + 0,2102 $d_{1,30}$ - 0,4075 h - 0,0037 $d_{1,30}^2$ + 0,0234 h^2	0,82 (14)	y= - 0,6741 + 0,1069 $d_{1,30}$ - 0,2084 h - 0,0013 $d_{1,30}^2$ + 0,0175 h^2	0,84 (17)
			Root bark bigger than 4 cm	y = 44,8008 + 1,1290 $d_{1,30}$ - 10,8207 h + 0,0231 $d_{1,30}^2$ + 0,5431 h^2	0,78 (11)	y = 6,0084 - 0,9784 $d_{1,30}$ + 0,0024 $d_{1,30}$h + 0,0460 $d_{1,30}^2$ - 0,0003 $d_{1,30}^2$h	0,78 (11)
			Root wood smaller than 4 cm	y= 5,4944 + 0,0593 $d_{1,30}$ - 1,3008 h + 0,0008 $d_{1,30}^2$ + 0,0705 h^2	0,59 (5)	y= 0,3348 - 0,1913 $d_{1,30}$ + 0,2737 h + 0,0074 $d_{1,30}^2$ - 0,0170 h^2	0,8 (15)
			Root bark smaller than 4 cm	y= 0,2915 - 0,1614 $d_{1,30}$ + 0,1783 h + 0,0060 $d_{1,30}^2$ + 0,0031 h^2	0,42 (2,56)	y= 0,0170 - 0,1631 $d_{1,30}$ + 0,2856 h + 0,0105 $d^{1,302}$ - 0,0138 h^2	0,75 (11,09)
			Whole root	y= - 0,1272 - 0,0509 d1,30 + 0,2247 h + 0,0016 $d_{1,30}^2$ - 0,0034 h^2	0,88 (27)	y= 0,0712 - 0,0098 $d_{1,30}$ + 0,0031 h + 0,0015 $d_{1,30}^2$ - 0,0008 h^2	0,94 (58)
d = Middle tree diameter at breast height (d1,3), y = weight, h= height							

Annex Table 27. Individual tree dry weight equations (with double entry) belonging to the species of *Rhododendron ponticum* (Say, 2016)

Source	Location	Species	Related parameter	Biomass equation	R2 (F)
Özkaya, MS (2016). Determination of Above and Below Soil Biomass of the Rhododendron Ponticum L.. Doctorate Thesis, Artvin Coruh University Institute of Science Artvin	Artvin	*Rhododendron ponticum*	**Total Biomass**	Total Biomass = 10.3202 – (2.21414*Lnh) - (0.00030925*CC^2)+ (0.0005063*Boy*CC)	0.604 (33.5)
			Above Ground Biomass	Above Ground Biomass =9.658 + (0.0002102*h^2) - (3.476*Lnh) + (0.617*Ln(h*CC))	0.718 (55.422)
			Leaf Biomass	Leaf Biomass = 0.780 – (0.01536*h) + (0.00009384*h^2) + (0.002002*CC)	0.768 (71.519)
			Stem Biomass	Stem Biomass =6.813 – (2.53808*Lnh) + (0.00015115*h^2) + (0.48009*Ln(h*CC))	0.659 (42.246)
			Belowground Biomass	Belowground Biomass =3.450 - (0.30022*Ln(h*CC))	0.549 (64.226)
			Belowground Thick Root Biomass	Belowground Thick Root Biomass =0.759 - (0.000008087*h^2) - (0.0034705*CC)	0.495 (26.017)
			Belowground Fine Root Biomass	Belowground Fine Root Biomass =2.016 - (0.17736*Ln(h*CC))	0.406 (35.215)
h = height, CC= canopy cover					

Annex Table 28. Individual (according to the index of the site quality) and double entry volume equations belonging to the red pine (*Pinus brutia* Ten.) (Su, 2014).

Source	Location	Species	Index of the site quality	Dry weight equations for single entry biomass tables	R^2 (S_{yx})	Dry weight equations for double entry biomass tables	R^2 (S_{yx})
Kahriman, A., Sonmez, T., & Şahin, A. (2017). Wooden Volume Tables for Red pine of Antalya and Mersin . Kastamonu Uni., Journal of Forestry, 2017, 17 (1). 9-22	Antalya Myrtle	Red pine (*Pinus brutia* Ten.)	-	$V = 0.1654x\ d^{2.3784}$	0.975 52.84	$LnV = -3.292 + 2.834/d + 1.024/h + 0.978 \ln d^{2}h$	0.992 41.26
			1	$V = 0.1655x\ d^{2.3999}$	0.978 44.84		
			2	$V = 0.1569x\ d^{2.3965}$	0.976 54.45		
			3	$V = 0.1855x\ d^{2.3216}$	0.969 52.96		
V = volume, d = Middle tree diameter at breast height (d1,3)							

Annex Table 29. Methane (CH4) gas emissions by IPCC

Methane (CH4)						
EF Number	**IPCC 1996 Source / Pool category**	**CRF code / Subdivision of AKAKDO**	**Definitions ***	**Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features**	**Value of 1996/2006**	**Unit**
56109	5B1 - Tropical forests	4.A - Forest lands	1	Tropical forests: Asia; (Dry, annual rainfall less than 1000 mm / year)	20-55	t dm / ha
56763	5E - Other (Please Specify)	4.D - Wetlands	2	Wetland Categories: Bogs	11 (1-38)	mg CH4 / m2-day
56764	5E - Other (Please Specify)	4.D - Wetlands	2	Wetland categories: Fens	60 (21-162)	mg CH4 / m2-day
56765	5E - Other (Please Specify)	4.D - Wetlands	2	Wetland categories: swamps	63 (43-84)	mg CH4 / m2-day
56766	5E - Other (Please Specify)	4.D - Wetlands	2	Wetland categories: Marshes	189 (103-299)	mg CH4 / m2-day
56767	5E - Other (Please Specify)	4.D - Wetlands	2	Wetland categories: Flood plain	75 (37-150)	mg CH4 / m2-day
56768	5E - Other (Please Specify)	4.D - Wetlands	2	Wetland categories: Lakes	32 (13-67)	mg CH4 / m2-day
513605	5-WL-1 - Wetlands Remaining Wetlands	4.D.1 - Wetlands Remaining Wetlands	3	Turkey	0:56	Mha
56652	5B2 - Temperate forests	4.A - Forest land	4	Temperate forest; coniferous	220-295	t dm / ha
56653	5B2 - Temperate forests	4.A - Forest land	4	Temperate forest; broad-leaved	175-250	t dm / ha
513238	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	5	Moist/infertile broad-leaved savanna	3	g / kg dry matter combusted
513243	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	5	Dry, fertile fine-leaved savannah	2	g / kg dry matter combusted
513248	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	5	Moist-infertile grassland	2	g / kg dry matter combusted
513253	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	5	Arid-fertile grassland	3	g / kg dry matter combusted
513258	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	5	Wetland	2	g / kg dry matter combusted
513263	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	5	All types of vegetation	4 - 7	g / kg dry matter combusted
513268	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	5	Forest fires	7.1	g / kg dry matter combusted
513274	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	5	Savanna fires	10.8	g / kg dry matter combusted
513278	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	5	Forest fires	9	g / kg dry matter combusted
513284	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	5	Savanna fires	2.4	g / kg dry matter combusted
513290	5-GL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	5	Moist/infertile broad-leaved savanna	3	g / kg dry matter combusted
513295	5-GL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	5	Arid fertile fine-leaved savanna	2	g / kg dry matter combusted
513300	5-GL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	5	Moist-infertile grassland	2	g / kg dry matter combusted

Methane (CH4) (Continued)						
EF Number	**IPCC 1996 Source / Pool category**	**CRF code / Subdivision of AKAKDO**	**Definitions ***	**Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features**	**Value of 1996/2006**	**Unit**
513305	5-GL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	5	Aird-fertile grassland	3	g / kg dry matter combusted
513310	5-GL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	5	Wetlands	2	g / kg dry matter combusted
513315	5-GL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	5	All types of vegetation	4 - 7	g / kg dry matter combusted
513320	5-GL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	5	Forest fires	7.1	g / kg dry matter combusted
513326	5-GL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	5	Savanna fires	10.8	g / kg dry matter combusted
513330	5-GL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	5	Forest fires	9	g / kg dry matter combusted
513336	5-GL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	5	Savanna fires	2.4	g / kg dry matter combusted
513394	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	5	Moist/infertile broad-leaved savanna	3	g / kg dry matter combusted
513399	5-OL-2 - Areas where lands converted into lands	4.F.2 - Land Converted to Other Land	5	Arid fertile fine-leaved savanna	2	g / kg dry matter combusted
513404	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	5	Moist-infertile grassland	2	g / kg dry matter combusted
513409	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	5	Aird-fertile grassland	3	g / kg dry matter combusted
513414	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	5	Wetlands	2	g / kg dry matter combusted
513419	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	5	All types of vegetation	4 - 7	g / kg dry matter combusted
513424	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	5	Forest land	7.1	g / kg dry matter combusted
513430	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	5	Savanna fires	10.8	g / kg dry matter combusted
513434	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	5	Forest fires	9	g / kg dry matter combusted
513440	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	5	Savanna fires	2.4	g / kg dry matter combusted
513342	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	5	Moist/infertile broad-leaved savanna	3	g / kg dry matter combusted
513347	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	5	Arid fertile fine-leaved savanna	2	g / kg dry matter combusted
513352	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	5	Moist-infertile grassland	2	g / kg dry matter combusted
513 357	5-SL-2 - Land	4.E.2 - Land	5	Arid-fertile grassland	3	g / kg dry

EF Number	IPCC 1996 Source / Pool category	CRF code / Subdivision of AKAKDO	Definitions *	Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features	Value of 1996/2006	Unit
	Converted to Settlements	Converted to Settlements				matter combusted
Methane (CH4) (Continued)						
513362	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	5	Wetlands	2	g / kg dry matter combusted
513367	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	5	All types of vegetation	4 - 7	g / kg dry matter combusted
513372	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	5	Forest fires	7.1	g / kg dry matter combusted
513378	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	5	Savanna fires	10.8	g / kg dry matter combusted
513382	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	5	Forest fires	9	g / kg dry matter combusted
513388	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	5	Savanna fires	2.4	g / kg dry matter combusted
522871	5-WL-1 - Wetlands Remaining Wetlands	4.D.1 - Wetlands Remaining Wetlands	6	Soil type: Organic soil / Boreal and temperate	542	kg CH4 / ha / year
522868	5-WL-1 - Wetlands Remaining Wetlands	4.D.1 - Wetlands Remaining Wetlands	7	Soil type: Organic soil / Boreal and temperate	217	kg CH4 / ha / year
522870	5-WL-1 - Wetlands Remaining Wetlands	4.D.1 - Wetlands Remaining Wetlands	8	Soil type: Organic soil / Boreal and temperate	1165	kg CH4 / ha / year
522869	5-WL-1 - Wetlands Remaining Wetlands	4.D.1 - Wetlands Remaining Wetlands	9	Soil type: Organic soil / Boreal and temperate	527	kg CH4 / ha / year
522892	5-WL - Wetlands	4.D - Wetlands	10	Soil type: Inland Wetland Mineral Soil / Raising of water table or wetland creation / Temperate	235	kg CH4 / ha / year
522906	5-WL - Wetlands	4.D - Wetlands	10	Soil type: Inland Wetland Mineral Soil / Raising of water table or wetland creation / Temperate	153	kg CH4 / ha / year
522889	5-WL - Wetlands	4.D - Wetlands	11	Soil type: Inland Wetland Mineral Soil / Temperate (continuous underwater for a period of years)	572	kg CH4 / ha / year
522890	5-WL - Wetlands	4.D - Wetlands	11	Soil type: Inland Wetland Mineral Soil / Temperate (Intermittent inundation over an annual time period)	126	kg CH4 / ha / year
522907	5-WL - Wetlands	4.D - Wetlands	12	Soil type: Inland Wetland Mineral Soil / Temperate	136	kg CH4 / ha / year
522849	5-CL-1 - Cropland Remaining Cropland	4.B.1 - Cropland Remaining Cropland	13	Soil Type: Drained organic soil planted in various crops; nutrient status unspecified but generally rich / Boreal and temperate	0	kg CH4 / ha / year
522848	5-FL-1 - Forest Land Remaining Forest Land	4.A.1 - Forest Land Remaining Forest Land	14	Soil Type: Drained organic soil regardless of nutrient status / Temperate	2.5	kg CH4 / ha / year
522851	5-GL-1 - Grassland Remaining Grassland	4.C.1 - Grassland Remaining Grassland	15	Soil Type: Organic soil planted in various grasses and drained to various or unspecified depths; nutrient status is poor / temperate	1.8	kg CH4 / ha / year

Methane (CH4) (Continued)						
EF Number	**IPCC 1996 Source / Pool category**	**CRF code / Subdivision of AKAKDO**	**Definitions ***	**Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features**	**Value of 1996/2006**	**Unit**
522852	5-GL-1 - Grassland Remaining Grassland	4.C.1 - Grassland Remaining Grassland	15	Soil Type: Organic soil planted in various grasses and drained to depths >30 cm; nutrient status is rich / temperate	16	kg CH4 / ha / year
522853	5-GL-1 - Grassland Remaining Grassland	4.C.1 - Grassland Remaining Grassland	15	Soil Type: Organic soil planted in various grasses and drained to depths =30 cm; nutrient status is rich / temperate	39	kg CH4 / ha / year
522854	5-WL - Wetlands	4.D.1 - Wetlands Remaining Wetlands	16	Soil Type: Drained peatland that is managed for peat extraction / Boreal and temperate	6.1	kg CH4 / ha / year
513536	5-WL-1 - Wetlands Remaining Wetlands	4.D.1 - Wetlands Remaining Wetlands	17	Climate: Warm temperate, dry	0063	kg / ha / day
513538	5-WL-1 - Wetlands Remaining Wetlands	4.D.1 - Wetlands Remaining Wetlands	17	Climate: Warm Temperate, wet	0096	kg / ha / day
513220	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	18		0.012 (0.009-0.015)	No dimension
513224	5-GL-2 - Land Converted to Grassland	4.B.2 - Land Converted to Grassland	18		0.012 (0.009-0.015)	No dimension
513232	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	18		0.012 (0.009-0.015)	No dimension
513228	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	18		0.012 (0.009-0.015)	No dimension
56672	5B - Forest and Grassland Conversion	4.A - Forest land	18		0.012 (0.009-0.015)	fraction

Definitions *

1. Average Aboveground Biomass Estimates for Tropical Forests by Climatic Zone
2. Average Methane Emissions and Production Periods of Natural Wetlands
3. Default Reservoir Surface Area Data (International Commission on Large Dams (ICOLD))
4. Dry Matter in Aboveground Biomass in Temperate and Boreal Forests
5. Emission factor (applicable to fuels combusted in various types of vegetation fires)
6. Emission Factor for CH4 from drainage ditches in drained organic soils (organic soils drained for peat extraction)
7. Emission Factor for CH4 from drainage ditches in drained organic soils (organic soils managed for forestry, and drained wetlands not subject to other land-use modification)
8. Emission Factor for CH4 from drainage ditches in drained organic soils (organic soils managed for grassland subject to deep drainage, and cropland)
9. Emission Factor for CH4 from drainage ditches in drained organic soils (organic soils managed for grassland subject to shallow drainage)
10. Emission Factor for CH4 from managed lands with Inland Wetland Mineral Soils where water table level has been raised, for example as in rewetting or in wetland creation
11. Emission Factor for CH4 from managed lands with Inland Wetland Mineral Soils where water table level has been raised, for example as in rewetting or in wetland creation, or from unmanaged natural wetlands stratitifed by period of inundation
12. Emission Factor for CH4 from natural unmanaged wetlands with Inland Wetland Mineral Soils
13. Emission Factor for CH4-C from drained Cropland
14. Emission Factor for CH4-C from drained Forest Land
15. Emission Factor for CH4-C from drained Grassland
16. Emission factor for CH4-C from drainage Peatlands
17. Emission Factor for Diffusive Emissions from Reservoirs (Ice-free period)
18. Emissions Ratios for Open Burning of Cleared Forests

Annex Table 30. Emissions of Nitrous Oxide (N2O) gases according to IPCC

Nitrous Oxide (N2O)						
EF Number	**IPCC 1996 Source / Pool category**	**CRF code / Subdivision of AKAKDO**	**Definitions ***	**Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features**	**Value of 1996/2006**	**Unit**
56662	5B2 - Temperate forests	4.A - Forest land	1	Temperate forest; coniferous	220-295	t dm / ha
56663	5B2 - Temperate forests	4.A - Forest land	2	Temperate forest; broadleaf	175-250	t dm / ha
513511	5-FL - Forest land	4.A - Forest land	3	Temperate and Boreal climate / Soil type: Nutrient Poor Organic Soil	0.1	kg N2O-N / ha / year
513 512	5-FL - Forest land	4.A - Forest land	3	Temperate and Boreal Climate / Soil type: nutrient rich organic soil	0.6	kg N2O-N / ha / year
513513	5-FL - Forest land	4.A - Forest land	3	Temperate and Boreal climate Climate type: Mineral soil	0:06	kg N2O-N / ha / year
522857	5-FL-1 - Forest Land Remaining Forest Land	4.A.1 - Forest Land Remaining Forest Land	4	Temperate / Soil type: Drained organic soil regardless of nutrient status	2.8	kg N2O-N / ha / year
522858	5-CL-1 - Cropland Remaining Cropland	4.B.1 - Cropland Remaining Cropland	5	Boreal and temperate / Soil type: Drained organic soil planted in various crops; nutrient status unspecified but generally rich	13	kg N2O-N / ha / year
513222	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	6		0.007 (0.005-0.009)	No dimension
513240	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	7	Moist/infertile broad-leaved savanna	0:11	g / kg dry matter combusted
513245	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	7	Arid fertile fine-leaved savanna	0:11	g / kg dry matter combusted
513250	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	7	Moist-infertile grassland	12:10	g / kg dry matter combusted
513255	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	7	Arid-fertile grassland	0:11	g / kg dry matter combusted
513 260	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	7	Wetlands	0:11	g / kg dry matter combusted
513265	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	7	All types of vegetation	12:10	g / kg dry matter combusted
513270	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	7	Forest fires	0:11	g / kg dry matter combusted
513275	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	7	Savanna fires	0:11	g / kg dry matter combusted
513280	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	7	Forest fires	0:11	g / kg dry matter combusted
513286	5-CL-2 - Land Converted to Cropland	4.B.2 - Land Converted to Cropland	7	Savanna fires	12:15	g / kg dry matter combusted
522860	5-GL-1 - Grassland Remaining Grassland	4.C.1 - Grassland Remaining Grassland	8	Climate type: Temperate / Organic soil planted in various grasses and drained to various or unspecified depths; nutrient status is poor	4.3	kg N2O-N / ha / year
522861	5-GL-1 - Grassland Remaining	4.C.1 - Grassland Remaining Grassland	8	Temperate / Organic soil: Organic soil planted in various grasses and drained to depths	8.2	kg N2O-N / ha / year

	Grassland			>30 cm; nutrient status is rich		
Nitrous Oxide (N2O) (Continued)						
EF Number	**IPCC 1996 Source / Pool category**	**CRF code / Subdivision of AKAKDO**	**Definitions ***	**Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features**	**Value of 1996/2006**	**Unit**
522862	5-GL-1 - Grassland Remaining Grassland	4.C.1 - Grassland Remaining Grassland	8	Temperate / Soil type: Organic soil planted in various grasses and drained to depths =30 cm; nutrient status is rich	1.6	kg N2O-N / ha / year
513226	5-GL-2 - Land Converted to Grassland	4.B.2 - Land Converted to Grassland	6		0.007 (0.005-0.009)	No dimension
513292	5-GL-2 - Land Converted to Grassland	4.B.2 - Land Converted to Grassland	7	Moist/infertile broadleaf savanna	0:11	g / kg dry matter combusted
513297	5-GL-2 - Land Converted to Grassland	4.B.2 - Land Converted to Grassland	7	Arid fertile fine-leaved savanna	0:11	g / kg dry matter combusted
513302	5-GL-2 - Land Converted to Grassland	4.B.2 - Land Converted to Grassland	7	Moist-infertile grassland	12:10	g / kg dry matter combusted
513307	5-GL-2 - Land Converted to Grassland	4.B.2 - Land Converted to Grassland	7	Aird-fertile grassland	0:11	g / kg dry matter combusted
513312	5-GL-2 - Land Converted to Grassland	4.B.2 - Land Converted to Grassland	7	Wetland	0:11	g / kg dry matter combusted
513317	5-GL-2 - Land Converted to Grassland	4.B.2 - Land Converted to Grassland	7	All types of vegetation	12:10	g / kg dry matter combusted
513322	5-GL-2 - Land Converted to Grassland	4.B.2 - Land Converted to Grassland	7	Forest fires	0:11	g / kg dry matter combusted
513327	5-GL-2 - Land Converted to Grassland	4.B.2 - Land Converted to Grassland	7	Savanna fires	0:11	g / kg dry matter combusted
513332	5-GL-2 - Land Converted to Grassland	4.B.2 - Land Converted to Grassland	7	Forest fires	0:11	g / kg dry matter combusted
513338	5-GL-2 - Land Converted to Grassland	4.B.2 - Land Converted to Grassland	7	Savanna fires	12:15	g / kg dry matter combusted
515857	5-WL - Wetlands	4.D - Wetlands	9	Climate zone: Boreal and Temperate / Peat type: Nutrient-rich organic soil	1.8	kg N2O-N / ha / year
513 528	5-WL-1 - Wetlands Remaining Wetlands	4.D.1 - Wetlands Remaining Wetlands	10	Temperate and Boreal climate / Soil type: Nutrient Poor Organic Soil	0.1	kg N2O-N / ha / year
513529	5-WL-1 - Wetlands Remaining Wetlands	4.D.1 - Wetlands Remaining Wetlands	10	Temperate and Boreal climate / Soil type: Nutrient Poor Organic Soil	1.8	kg N2O-N / ha / year
513607	5-WL-1 - Wetlands Remaining Wetlands	4.D.1 - Wetlands Remaining Wetlands	11	Turkey	0:56	Mha
522863	5-WL - Wetlands	4.D.1 - Wetlands Remaining Wetlands	12	Boreal and temperate / Soil Type: Drained peatland that is managed for peat extraction	0.3	kg N2O-N / ha / year
513230	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	6		0.007 (0.005-0.009)	No dimension
513344	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	7	Moist/infertile broad-leaved savanna	0:11	g / kg dry matter combusted
Nitrous Oxide (N2O) (Continued)						

EF Number	IPCC 1996 Source / Pool category	CRF code / Subdivision of AKAKDO	Definitions *	Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features	Value of 1996/2006	Unit
513349	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	7	Arid fertile fine-leaved savanna	0:11	g / kg dry matter combusted
513354	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	7	Moist-infertile grassland	12:10	g / kg dry matter combusted
513359	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	7	Arid-fertile grassland	0:11	g / kg dry matter combusted
513364	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	7	Wetland	0:11	g / kg dry matter combusted
513369	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	7	All types of vegetation	12:10	g / kg dry matter combusted
513374	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	7	Forest fires	0:11	g / kg dry matter combusted
513379	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	7	Savan fires	0:11	g / kg dry matter combusted
513384	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	7	Forest fires	0:11	g / kg dry matter combusted
513390	5-SL-2 - Land Converted to Settlements	4.E.2 - Land Converted to Settlements	7	Savan fires	12:15	g / kg dry matter combusted
513234	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	6		0.007 (0.005-0.009)	No dimension
513 396	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	7	Moist/infertile broad-leaved savanna	0:11	g / kg dry matter combusted
513 401	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	7	Arid fertile fine-leaved savanna	0:11	g / kg dry matter combusted
513 406	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	7	Moist-infertile grassland	12:10	g / kg dry matter combusted
513 411	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	7	Aird-fertile grassland	0:11	g / kg dry matter combusted
513 416	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	7	Wetland	0:11	g / kg dry matter combusted
513 421	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	7	All types of vegetation	12:10	g / kg dry matter combusted
513 426	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	7	Forest fires	0:11	g / kg dry matter combusted
513 431	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	7	Savan fires	0:11	g / kg dry matter combusted
513 436	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	7	Forest fires	0:11	g / kg dry matter combusted
513 442	5-OL-2 - Land Converted to Other Land	4.F.2 - Land Converted to Other Land	7	Savan fires	12:15	g / kg dry matter combusted

Definitions *
1. Dry Matter in Aboveground Biomass in Temperate and Boreal Forests
2. Dry Matter in Aboveground Biomass in Temperate and Boreal Forests
3. Emission Factor for N2O from Drainage of Forest Soils

4. Direct emission factor for N2O-N from drained Forest land 5. Direct Emission Factor for N2O-N from drained Cropland 6. Emission ratios for open burning of cleared forest 7. Emission factor (applicable to fuels combusted in various types of vegetation fires) 8. Direct Emission Factor for N2O-N from drained Grassland 9. Default emission factors for N2O emissions from managed peatlands 10. Emission Factor for N2O from Wetlands (Drained Peatland) 11. Default Reservoir Surface Area Data (International Commission on Large Dams (ICOLD)) 12. Direct Emission Factor for N2O-N from drained Peatland

Annex Table 31. Emissions of carbon dioxide (CO_2) according to the IPCC

Carbon dioxide (CO2)						
EF Number	**IPCC 1996 Source / Pool category**	**CRF code / Subdivision of AKAKDO**	**Definitions ***	**Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features**	**Value of 1996/2006**	**Unit**
56071	5A2 - Temperate Forests	4.A - Forest land	1	Naturally regrowth forests / moist forests; 0-20 years old / Temperate Forests: Coniferous	3	t dm / ha
56072	5A2 - Temperate Forests	4.A - Forest land	1	Naturally regrowth forests / moist forests; 20-100 years old / Temperate Forests: Coniferous	3	t dm / ha
56073	5A2 - Temperate Forests	4.A - Forest land	1	Naturally regrowth forests / Seasonal forests; 0-20 years old / Temperate Forests: Broadleaf	2	t dm / ha
56074	5A2 - Temperate Forests	4.A - Forest land	1	Naturally regrowth forests / Seasonal forests; 20-100 years old / Temperate Forests: Broadleaf	2	t dm / ha
56085	5A2 - Temperate Forests	4.A - Forest land	2	Plantation type / Duglas fir / Temperate forests	6	tonnes dm / ha / year
56086	5A2 - Temperate Forests	4.A - Forest land	2	Plantation type / Loblolly pine / temperate forests	4	tonnes dm / ha / year
56647	5B2 - Temperate Forests	4.A - Forest land	3	Temperate forests; coniferous	220-295	t dm / ha
56648	5B2 - Temperate Forests	4.A - Forest land	3	Temperate forests; Broadleaf	175-250	t dm / ha
56758	5E - Other (please specify)	4.A - Forest land	4	Coniferous / Type: Temperate Forests	12:20	No dimension
56759	5E - Other (please specify)	4.A - Forest land	4	Broadleaf / Type: Temperate Forests	12:25	No dimension
510727	5-FL - Forest land	4.A - Forest land	5	Forest type: Broadleaf / Climate type: cool Temperate, dry	28 (23-33)	tonnes C / ha
510728	5-FL - Forest land	4.A - Forest land	5	Forest type: Broadleaf / Climate type: cool Temperate, moist	16 (5-31)	tonnes C / ha
510729	5-FL - Forest land	4.A - Forest land	5	Forest type: Broadleaf / Climate type: cool Temperate, dry	28.2 (23.4-33.0)	tonnes C / ha
510730	5-FL - Forest land	4.A - Forest land	5	Forest type: Broadleaf / Climate type: warm Temperate, moist	13 (2-31)	tonnes C / ha
510735	5-FL - Forest land	4.A - Forest land	5	Forest type: Coniferous / Climate type: cool Temperate, dry	27 (17-42)	tonnes C / ha
510736	5-FL - Forest land	4.A - Forest land	5	Forest type: Coniferous/ Climate type: cool Temperate, moist	26 (10-48)	tonnes C / ha
510737	5-FL - Forest land	4.A - Forest land	5	Forest type: Coniferous / Climate type: warm Temperate, dry	20.3 (17.3-21.1)	tonnes C / ha
510738	5-FL - Forest land	4.A - Forest land	5	Forest type: Coniferous / Climate type: warm Temperate, moist	22 (6-42)	tonnes C / ha
510743	5-FL - Forest land	4.A - Forest land	6	Forest type: Broadleaf / Climate type: cool Temperate, dry	50	year
510744	5-FL - Forest land	4.A - Forest land	6	Forest type: broad leavedLarge leaf / Climate type: cool Temperate, moist	50	year
510745	5-FL - Forest land	4.A - Forest land	6	Forest type: broad leavedLarge leaf / Climate type: warm Temperate, dry	75	year

Carbon dioxide (CO2) (Continued)

EF Number	IPCC 1996 Source / Pool category	CRF code / Subdivision of AKAKDO	Definitions *	Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features	Value of 1996/2006	Unit
510746	5-FL - Forest land	4.A - Forest land	6	Forest type: Broadleaf / Climate type: warm Temperate, moist	50	year
510751	5-FL - Forest land	4.A - Forest land	6	Forest type: Coniferous/ Climate type: cool Temperate, dry	80	year
510752	5-FL - Forest land	4.A - Forest land	6	Forest type: Coniferous/ Climate type: cool Temperate, moist	50	year
510753	5-FL - Forest land	4.A - Forest land	6	Forest type: Coniferous/ Climate type: warm Temperate, dry	75	year
510754	5-FL - Forest land	4.A - Forest land	6	Forest type: Coniferous/ Climate type: warm Temperate, moist	30	year
510759	5-FL - Forest land	4.A - Forest land	7	Forest type: Broadleaf / Climate type: cool Temperate, dry	0.6	tonnes C / ha / year
510760	5-FL - Forest land	4.A - Forest land	7	Forest type: Broadleaf / Climate type: cool Temperate, moist	0.3	tonnes C / ha / year
510761	5-FL - Forest land	4.A - Forest land	7	Forest type: Broadleaf / Climate type: warm Temperate, dry	0.4	tonnes C / ha / year
510762	5-FL - Forest land	4.A - Forest land	7	Forest type: Broadleaf / Climate type: warm Temperate, moist	0.3	tonnes C / ha / year
510767	5-FL - Forest land	4.A - Forest land	7	Forest type: Coniferous/ Climate type: cool Temperate, dry	0.4	tonnes C / ha / year
510768	5-FL - Forest land	4.A - Forest land	7	Forest type: Coniferous/ Climate type: cool Temperate, moist	0.5	tonnes C / ha / year
510769	5-FL - Forest land	4.A - Forest land	7	Forest type: Coniferous/ Climate type: warm Temperate, dry	0.3	tonnes C / ha / year
510770	5-FL - Forest land	4.A - Forest land	7	Forest type: Coniferous	0.7	tonnes C / ha / year
510775	5-FL - Forest land	4.A - Forest land	8	Forest type: Broadleaf / Climate type: warm Temperate, moist	1.4	tonnes C / ha / year
510776	5-FL - Forest land	4.A - Forest land	8	Forest type: Broadleaf / Climate type: cool Temperate, moist	0.8	tonnes C / ha / year
510777	5-FL - Forest land	4.A - Forest land	8	Forest type: Broadleaf / Climate type: warm Temperate, dry	1.4	tonnes C / ha / year
510778	5-FL - Forest land	4.A - Forest land	8	Forest type: Broadleaf / Climate type: warm Temperate, moist	0.6	tonnes C / ha / year
510783	5-FL - Forest land	4.A - Forest land	8	Forest type: Coniferous/ Climate type: cold Temperate, dry	1.4	tonnes C / ha / year
510784	5-FL - Forest land	4.A - Forest land	8	Forest type: Coniferous/ Climate type: cold Temperate, moist	1.3	tonnes C / ha / year
510785	5-FL - Forest land	4.A - Forest land	8	Forest type: Coniferous/ Climate type: warm Temperate, dry	1	tonnes C / ha / year
510786	5-FL - Forest land	4.A - Forest land	8	Forest type: Coniferous/ Climate type: warm Temperate, moist	1.1	tonnes C / ha / year
510790	5-FL - Forest land	4.A - Forest land	9	Biome: Evergreen Forest	0.0116	fraction
510791	5-FL - Forest land	4.A - Forest land	9	Biome: Broadleaf forest	0.0117	fraction
510793	5-FL - Forest land	4.A - Forest land	10	Biome: Evergreen Forest	43.4	t dm / ha
510794	5-FL - Forest land	4.A - Forest land	10	Biome: Broadleaf forest	34.7	t dm / ha
510796	5-FL - Forest land	4.A - Forest land	11	Biome: Evergreen Forest	12:20	No dimension
510797	5-FL - Forest land	4.A - Forest land	10	Biome: Broadleaf forest	0.14	No dimension
510799	5-FL - Forest land	4.A - Forest land	12	Biome: Temperate Forests	0.68 (0.41-1.91)	tonnes C / ha / year
510802	5-FL - Forest land	4.A - Forest land	13	Region: cold Temperate, dry	50	tonnes C / ha
510803	5-FL - Forest land	4.A - Forest land	13	Region: cool Temperate, moist	95	tonnes C / ha
510804	5-FL - Forest land	4.A - Forest land	13	Region: warm temperature, dry	38	tonnes C / ha
510805	5-FL - Forest land	4.A - Forest land	13	Region: warm temperature, moist	88	tonnes C / ha
510810	5-FL - Forest land	4.A - Forest land	14	Region: cold Temperate, dry	33	tonnes C / ha
510811	5-FL - Forest land	4.A - Forest land	14	Region: cold Temperate, moist	85	tonnes C / ha
510812	5-FL - Forest land	4.A - Forest land	14	Region: warm temperature, dry	24	tonnes C / ha
510813	5-FL - Forest land	4.A - Forest land	14	Region: warm temperature, moist	63	tonnes C / ha
510818	5-FL - Forest land	4.A - Forest land	15	Region: cold Temperate, dry	34	tonnes C / ha
510819	5-FL - Forest land	4.A - Forest land	15	Region: cold Temperate, moist	71	tonnes C / ha
510820	5-FL - Forest land	4.A - Forest land	15	Region: warm mild, dry	19	tonnes C / ha
510821	5-FL - Forest land	4.A - Forest land	15	Region: warm , moist	34	tonnes C / ha

Carbon dioxide (CO2) (Continued)

EF Number	IPCC 1996 Source / Pool category	CRF code / Subdivision of AKAKDO	Definitions *	Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features	Value of 1996/2006	Unit
510826	5-FL - Forest land	4.A - Forest land	16	Region: cold Temperate, dry	Not applicable	
510827	5-FL - Forest land	4.A - Forest land	16	Region: cold Temperate, moist	115	tonnes C / ha
510828	5-FL - Forest land	4.A - Forest land	16	Region: warm temperature, dry	Not applicable	
510829	5-FL - Forest land	4.A - Forest land	16	Region: warm temperature, moist	Not applicable	
510834	5-FL - Forest land	4.A - Forest land	17	Region: cold Temperate, dry	20	tonnes C / ha
510 835	5-FL - Forest land	4.A - Forest land	17	Region: cold Temperate, moist	130	tonnes C / ha
510 836	5-FL - Forest land	4.A - Forest land	17	Region: warm mild, dry	70	tonnes C / ha
510 837	5-FL - Forest land	4.A - Forest land	17	Region: warm , moist	80	tonnes C / ha
510842	5-FL - Forest land	4.A - Forest land	18	Region: cold Temperate, dry	87	tonnes C / ha
510843	5-FL - Forest land	4.A - Forest land	18	Region: cold Temperate, moist	87	tonnes C / ha
510844	5-FL - Forest land	4.A - Forest land	18	Region: warm temperature, dry	88	tonnes C / ha
510845	5-FL - Forest land	4.A - Forest land	18	Region: warm temperature, moist	88	tonnes C / ha
511074	5-FL - Forest land	4.A - Forest land	19	Forest type: Temperate forests, coniferous; Age class: equal or less than 20 years, Region: Eurasia and Oceania	100 (17 - 183)	t dm / ha
511075	5-FL - Forest land	4.A - Forest land	19	Forest type: Temperate forests, broadleaf; Age class: equal or less than 20 years, Region: Eurasia and Oceania	17	t dm / ha
511076	5-FL - Forest land	4.A - Forest land	19	Forest type: Temperate forests, mixed broadleaf-coniferous; Age class: equal or less than 20 years, Region: Eurasia and Oceania	40	t dm / ha
511077	5-FL - Forest land	4.A - Forest land	19	Forest type: Temperate forests, coniferous; Age class: more than 20 years, Region: Eurasia and Oceania	134 (20 - 600)	t dm / ha
511078	5-FL - Forest land	4.A - Forest land	19	Forest type: Temperate forests, broadleaf; Age class: more than 20 years , Region: Eurasia and Oceania	122 (18- 320)	t dm / ha
511079	5-FL - Forest land	4.A - Forest land	19	Forest type: Temperate forests, mixed broadleaf-coniferous; Age class: more than 20 years, Region: Eurasia and Oceania	128 (20 - 330)	t dm / ha
511739	5-FL - Forest land	4.A - Forest land	20	Area: Asia Country: Turkey	74	t dm / ha
512201	5-FL - Forest land	4.A - Forest land	21	Coniferous, Age class: = <20 years / Temperate forests	3.0 (0.5- 6.0)	tonnes dm / ha / year
512202	5-FL - Forest land	4.A - Forest land	21	Broadleaf, Age class: = <20 years / Temperate forests	4.0 (0.5- 8.0)	tonnes dm / ha / year
512203	5-FL - Forest land	4.A - Forest land	21	Conifers, Age class:> 20 years / Temperate forests	3.0 (0.5- 6.0)	tonnes dm / ha / year
512204	5-FL - Forest land	4.A - Forest land	21	broad leaved, Age class:> 20 years / Temperate forests	4.0 (0.5- 7.5)	tonnes dm / ha / year
512242	5-FL - Forest land	4.A - Forest land	21	Eucalyptus spp, Age class: All / Montane Moist, Annual rainfall > 1000 mm/yr, Region: Asia	3.1	tonnes dm / ha / year
512246	5-FL - Forest land	4.A - Forest land	21	Species different from eucalyptus species / dry, Annual precipitation <1000 mm / yr, Area: Asia	6.45 (1.2- 11.7)	tonnes dm / ha / year
512247	5-FL - Forest land	4.A - Forest land	21	Different species from Eucalyptus species / Mountain Damp, Annual precipitation> 1000 mm / yr, Region: Asia	5.0 (1.3- 10.0)	tonnes dm / ha / year
512276	5-FL - Forest land	4.A - Forest land	22	Species: Pinus radiata	23.5 (12 - 35)	m3 / ha / year
512296	5-FL - Forest land	4.A - Forest land	23	Vegetation type: Coniferous forest - plantation, Aboveground biomass (t / ha) <50	0.46 (0.21 - 1.06)	fraction
512297	5-FL - Forest land	4.A - Forest land	23	Vegetation type: coniferous forest - plantation, Aboveground biomass	0.32 (0.24 - 0.5)	fraction

				(t / ha) = 50-150		
Carbon dioxide (CO2) (Continued)						
EF Number	**IPCC 1996 Source / Pool category**	**CRF code / Subdivision of AKAKDO**	**Definitions ***	**Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features**	**Value of 1996/2006**	**Unit**
512298	5-FL - Forest land	4.A - Forest land	23	Vegetation type: Conifer forest / plantation, Coniferious forest / plantation, Aboveground biomass (t / ha)> 150	0.23 (0.12-0.49)	fraction
512299	5-FL - Forest land	4.A - Forest land	23	Vegetation type: Temperate broad leaved forest - plantation, Oak forest, Above soil biomass (t / ha)> 70	0.35 (0.2 - 1.16)	fraction
512300	5-FL - Forest land	4.A - Forest land	23	Vegetation type: Temperate broad leaved forest - plantation, Eucalyptus plantation, Aboveground biomass (t / ha) <50	0.45 (0.29 - 0.81)	fraction
512301	5-FL - Forest land	4.A - Forest land	23	Vegetation type: Temperate broad leaved forest - plantation, Eucalyptus plantation, Aboveground biomass (t / ha) = 50-150	0.35 (0.15 - 0.81)	fraction
512302	5-FL - Forest land	4.A - Forest land	23	Vegetation type: Temperate broad leaved forest - plantation, Eucalyptus forest / plantation, Aboveground biomass (t / ha)> 150	0.2 (0.1 - 0.33)	fraction
512303	5-FL - Forest land	4.A - Forest land	23	Vegetation type: Temperate broad leaved forest - plantation, Other wide leaved forest, Aboveground biomass (t / ha) <75	0.43 (0.12-0.93)	fraction
512304	5-FL - Forest land	4.A - Forest land	23	Vegetation type: Temperate broad leaved forest - plantation, Other broad leaved forest, Aboveground biomass (t / ha) = 75-150	0.26 (0.13-0.52)	fraction
512305	5-FL - Forest land	4.A - Forest land	23	Vegetation type: Temperate Broadleaf forest-plantation, Other Broadleaf forest, Upper soil biomass (t / ha)> 150	0.24 (0.17 - 0.3)	fraction
512306	5-FL - Forest land	4.A - Forest land	23	Vegetation type: Grassland, Steppe/tundra/prairie grassland, Aboveground biomass (t / ha): Not specified	3.95 (1.92 - 10.51)	fraction
512307	5-FL - Forest land	4.A - Forest land	23	Vegetation type: grassland, temperate-sub-tropical- tropical grassland, aboveground biomass (t / ha): Not specified	1.58 (0.59 - 3.11)	fraction
512308	5-FL - Forest land	4.A - Forest land	23	Vegetation type: grassland, Semi-arid grassland, Aboveground biomass (t / ha): Not specified	2.8 (1.43-4.92)	fraction
512309	5-FL - Forest land	4.A - Forest land	23	Type of vegetation: Other, Forest-savanna, Aboveground biomass (t / ha): Not specified	0.48 (0.26 - 1.01)	fraction
512310	5-FL - Forest land	4.A - Forest land	23	Vegetation type: Other, Shrubland, Aboveground biomass (t / ha): Not specified	2.83 (0.34 - 6.49)	fraction
512311	5-FL - Forest land	4.A - Forest land	23	Vegetation type: Other, Tidal marsh, Aboveground biomass (t / ha): Not specified	1.04 (0.74 - 1.23)	fraction
512312	5-FL - Forest land	4.A - Forest land	24	Species or genus: Abies	0.4	tonnes dm / m3 fresh volume
512313	5-FL - Forest land	4.A - Forest land	24	Species or genus: Acer	0:52	tonnes dm / m3 fresh volume
512314	5-FL - Forest land	4.A - Forest land	24	Species or genus: Alnus	12:45	tonnes dm / m3 fresh volume
512315	5-FL - Forest land	4.A - Forest land	24	Species or genus: Betula	0:51	tonnes dm / m3 fresh volume

Carbon dioxide (CO_2) (Continued)

EF Number	IPCC 1996 Source / Pool category	CRF code / Subdivision of AKAKDO	Definitions *	Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features	Value of 1996/2006	Unit
512316	5-FL - Forest land	4.A - Forest land	24	Species or genus: Carpinus betulus	0.63	tonnes dm / m3 fresh volume
512317	5-FL - Forest land	4.A - Forest land	24	Species or genus: Castanea sativa	0:48	tonnes dm / m3 fresh volume
512318	5-FL - Forest land	4.A - Forest land	24	Species or genus: Fagus sylvatica	0:58	tonnes dm / m3 fresh volume
512319	5-FL - Forest land	4.A - Forest land	24	Species or genus: Fraxinus	0:57	tonnes dm / m3 fresh volume
512320	5-FL - Forest land	4.A - Forest land	24	Species or genus: Juglans	0:53	tonnes dm / m3 fresh volume
512321	5-FL - Forest land	4.A - Forest land	24	Species or genus: Larix decidua	0:46	tonnes dm / m3 fresh volume
512322	5-FL - Forest land	4.A - Forest land	24	Species or genus: Larix kaempferi	0:49	tonnes dm / m3 fresh volume
512323	5-FL - Forest land	4.A - Forest land	24	Species or genus: Picea abies	0.4	tonnes dm / m3 fresh volume
512324	5-FL - Forest land	4.A - Forest land	24	Species or genus: Picea sitchensis	0.4	tonnes dm / m3 fresh volume
512325	5-FL - Forest land	4.A - Forest land	24	Species or genus: Pinus pinaster	0:44	tonnes dm / m3 fresh volume
512326	5-FL - Forest land	4.A - Forest land	24	Species or genus: Pinus strobus	0:32	tonnes dm / m3 fresh volume
512327	5-FL - Forest land	4.A - Forest land	24	Species or genus: Pinus sylvestris	0:42	tonnes dm / m3 fresh volume
512328	5-FL - Forest land	4.A - Forest land	24	Species or genus: Populus	0:35	tonnes dm / m3 fresh volume
512329	5-FL - Forest land	4.A - Forest land	24	Species or genus: Prunus	0:49	tonnes dm / m3 fresh volume
512330	5-FL - Forest land	4.A - Forest land	24	Species or genus: Pseudotsuga menziesii	12:45	tonnes dm / m3 fresh volume
512331	5-FL - Forest land	4.A - Forest land	24	Species or genus: Quercus	0:58	tonnes dm / m3 fresh volume
512332	5-FL - Forest land	4.A - Forest land	24	Species or genus: Salix	12:45	tonnes dm / m3 fresh volume
512333	5-FL - Forest land	4.A - Forest land	24	Species or genus: Thuja plicata	12:31	tonnes dm / m3 fresh volume
512334	5-FL - Forest land	4.A - Forest land	24	Species or genus: Tilia	0:43	tonnes dm / m3 fresh volume
512335	5-FL - Forest land	4.A - Forest land	24	Species or genus: Tsuga	0:42	tonnes dm / m3 fresh volume
513025	5-FL - Forest land	4.A - Forest land	25	Forest type: Coniferous- Spruce fir / Region: Temperate / Minimum dbH (cms): 0-12.5	1.3 (1.15-4.2)	fraction
513026	5-FL - Forest land	4.A - Forest land	25	Forest type: Coniferous- Pines / Region: Temperate / Minimum dbH (cms): 0-12.5	1.3 (1.15-3.4)	fraction
513027	5-FL - Forest land	4.A - Forest land	25	Forest type: Coniferous- broadleaf/ Region: Temperate / Minimum dbH (cms): 0-12.5	1.4 (1.15-3.2)	fraction
513032	5-FL - Forest land	4.A - Forest land	26	Forest type: Coniferous- Spruce fir / Region: Temperate / Minimum dbH (cms): 0-12.5	1.15 (1-1.3)	fraction
513033	5-FL - Forest land	4.A - Forest land	26	Forest type: Coniferous- Pines / Region: Temperate / Minimum dbH (cms): 0-12.5	1.05 (1-1.2)	fraction
513034	5-FL - Forest land	4.A - Forest land	26	Forest type: Coniferous- broadleaf/ Region: Temperate / Minimum dbH (cms): 0-12.5	1.2 (1.1-1.3)	fraction
513038	5-FL - Forest land	4.A - Forest land	27	Annual carbon loss due to commercial felling / Temperate intensively managed	0.1	fraction
513039	5-FL - Forest land	4.A - Forest land	27	Annual carbon loss due to commercial felling / Temperate	12.15	fraction

				semi natural forests		
Carbon dioxide (CO2) (Continued)						
EF Number	**IPCC 1996 Source / Pool category**	**CRF code / Subdivision of AKAKDO**	**Definitions ***	**Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features**	**Value of 1996/2006**	**Unit**
513062	5-FL - Forest land	4.A - Forest land	28	Other temperate forests: Post logging slash burn / Region: Temperate	0.62 (0.48 - 0.84)	fraction
513063	5-FL - Forest land	4.A - Forest land	28	Other temperate forests: Felled and burned (land-clearing fire) / Region: Temperate	0.51 (0.16 - 0.58)	fraction
513064	5-FL - Forest land	4.A - Forest land	28	All "other" temperate forests / Territory: Temperate	0.45 (0.16 - 0.84)	fraction
513065	5-FL - Forest land	4.A - Forest land	28	Shrublands: Shrubland (general)	0.95	fraction
513068	5-FL - Forest land	4.A - Forest land	28	All Shrublands	0.72 (0.27-0.98)	fraction
513070	5-FL - Forest land	4.A - Forest land	28	Savanna Woodlands (early dry season burns)*: Savanna parkland	0.73 (0.44 - 0.87)	fraction
513071	5-FL - Forest land	4.A - Forest land	28	Savanna Woodlands (early dry season burns)*: Other savanna woodlands	0.37 (0.14-0.63)	fraction
513072	5-FL - Forest land	4.A - Forest land	28	All savanna woodlands (early dry season burns)	0.40 (0.01 - 0.87)	fraction
513073	5-FL - Forest land	4.A - Forest land	28	Savanna Woodlands (mid/late dry season burns)	0.72 (0.71 - 0.88)	fraction
513074	5-FL - Forest land	4.A - Forest land	28	Savanna Woodlands (mid/late dry season burns)*: Savanna parkland	0.82 (0.49-0.96)	fraction
513076	5-FL - Forest land	4.A - Forest land	28	Savanna Woodlands (mid/late dry season burns)*:Other savanna woodlands	0.68 (0.38-0.96)	fraction
513077	5-FL - Forest land	4.A - Forest land	28	All savanna woodlands (mid/late dry season burns)*	0.74 (0.29 - 0.96)	fraction
513079	5-FL - Forest land	4.A - Forest land	28	Savanna Grasslands / Pastures (early dry season burns)*: Grassland	0.18 - 0.78	fraction
513080	5-FL - Forest land	4.A - Forest land	28	All savanna grasslands (early dry season burns)*	0.74 (0.18-0.98)	fraction
513083	5-FL - Forest land	4.A - Forest land	28	Savanna Grasslands / Pastures (mid/late dry season burns)*: Savanna	0.86 (0.44 - 1.00)	fraction
513084	5-FL - Forest land	4.A - Forest land	28	All savanna grasslands (mid/late dry season burns)*	0.77 (0.19 - 1.00)	fraction
513085	5-FL - Forest land	4.A - Forest land	28	Other Vegetation Types: Peatland	0.50 (0.50 - 0.68)	fraction
513103	5-FL - Forest land	4.A - Forest land	29	Eucalypt forests: Wildfire	53.0 (20 - 179)	t dm / ha
513104	5-FL - Forest land	4.A - Forest land	29	Eucalypt forests:Prescribed fire – (surface)	16.0 (4.2-17)	t dm / ha
513105	5-FL - Forest land	4.A - Forest land	29	Eucalypt forests: Post logging slash burn	168.4 (34 - 453)	t dm / ha
513106	5-FL - Forest land	4.A - Forest land	29	Eucalypt forests: Felled and burned (land-clearing fire)	132.6 (50 - 133)	t dm / ha
513107	5-FL - Forest land	4.A - Forest land	29	All Eucalyptus Forests	69.4 (4.2 - 453)	t dm / ha
513108	5-FL - Forest land	4.A - Forest land	29	Other temperate forests: Wildfire / area: Temperate	19.8 (11 - 25)	t dm / ha
513109	5-FL - Forest land	4.A - Forest land	29	Other temperate forests: Post logging slash burn / Region: Temperate	77.5 (15 - 220)	t dm / ha
513110	5-FL - Forest land	4.A - Forest land	29	Other temperate forests: Felled and burned (land-clearing fire) / Region: Temperate	48.4 (3 - 130)	t dm / ha
513111	5-FL - Forest land	4.A - Forest land	29	All "other" temperate forests / Territory: Temperate	50.4 (3 - 220)	t dm / ha
513112	5-FL - Forest land	4.A - Forest land	29	Shrublands: Shrubland (general)	26.7 (22 - 30)	t dm / ha
513117	5-FL - Forest land	4.A - Forest land	29	Savanna Woodlands (early dry	2.5 (0.1 -	t dm / ha

				season burns)*: Savanna woodland	5.3)	

Carbon dioxide (CO2) (Continued)

EF Number	IPCC 1996 Source / Pool category	CRF code / Subdivision of AKAKDO	Definitions *	Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features	Value of 1996/2006	Unit
513118	5-FL - Forest land	4.A - Forest land	29	Savanna Woodlands (early dry season burns)*: Savanna parkland	2.7 (1.4- 3.9)	t dm / ha
513119	5-FL - Forest land	4.A - Forest land	29	All savanna woodlands (early dry season burns)	2.6 (0.07 - 3.9)	t dm / ha
513121	5-FL - Forest land	4.A - Forest land	29	Savanna Woodlands (mid/late dry season burns)*: Savanna parkland	4.0 (1 - 10.6)	t dm / ha
513124	5-FL - Forest land	4.A - Forest land	29	All savanna woodlands (mid/late dry season burns)*	4.6 (1.0 - 10.6)	t dm / ha
513127	5-FL - Forest land	4.A - Forest land	29	All savanna grasslands (early dry season burns)*	2.1 (1.2 - 11)	t dm / ha
513129	5-FL - Forest land	4.A - Forest land	29	Savanna Grasslands / Pastures (mid/late dry season burns)*: Grassland	4.1 (1.5 - 10)	t dm / ha
513131	5-FL - Forest land	4.A - Forest land	29	Savanna Grasslands / Pastures (mid/late dry season burns)*: Savanna	7.0 (0.5 - 18)	t dm / ha
513132	5-FL - Forest land	4.A - Forest land	29	All savanna grasslands (mid/late dry season burns)*	10.0 (0.5 - 45)	t dm / ha
513133	5-FL - Forest land	4.A - Forest land	29	Other Vegetation Types: Peatland	41.0 (40 - 42)	t dm / ha
513134	5-FL - Forest land	4.A - Forest land	29	Other vegetation types: Tundra	10	t dm / ha
513444	5-FL - Forest land	4.A - Forest land	30	Relevant FAO Product Data: Roundwood harvest (Coniferous)	12.45	Mm / m3
513445	5-FL - Forest land	4.A - Forest land	30	Relevant FAO Product Data: Roundwood harvest (Non-coniferous)	0.56	Mm / m3
513446	5-FL - Forest land	4.A - Forest land	30	Relevant FAO Product Data: Solidwood products - Saw wood (Coniferous)	12.45	Mm / m3
513447	5-FL - Forest land	4.A - Forest land	30	Relevant FAO Product Data: Solidwood products - Saw wood (Non Coniferous)	0:56	Mm / m3
513448	5-FL - Forest land	4.A - Forest land	30	Relevant FAO Product Data: Solidwood products - Veneer sheets	0:59	Mm / m3
513449	5-FL - Forest land	4.A - Forest land	30	Relevant FAO Product Data: Solidwood products - Plywood	0:48	Mm / m3
513450	5-FL - Forest land	4.A - Forest land	30	Relevant FAO Product Data: Solidwood products - Particle board	0:26	Mm / m3
513451	5-FL - Forest land	4.A - Forest land	30	Relevant FAO Product Data: Solidwood products - Fibreboard Compressed	1:02	Mm / m3
513452	5-FL - Forest land	4.A - Forest land	30	Relevant FAO Product Data: Solidwood products - Hardboard	1:02	Mm / m3
513453	5-FL - Forest land	4.A - Forest land	30	Relevant FAO Product Data: Solidwood products - MDF	0:50	Mm / m3
513454	5-FL - Forest land	4.A - Forest land	30	Relevant FAO Product Data: Pulp, Paper and Paperboard - Paper and paperboard	0.9	Mm / dd
513455	5-FL - Forest land	4.A - Forest land	30	Relevant FAO Product Data: Pulp, Paper and Paperboard - Recovered paper	0.9	Mm / dd
513456	5-FL - Forest land	4.A - Forest land	30	Relevant FAO Product Data: Pulp, Paper and Paperboard - Wood pulp	0.9	Mm / dd
513457	5-FL - Forest land	4.A - Forest land	30	Relevant FAO Product Data: Pulp, Paper and Paperboard - Recovered fibre pulp	0.9	Mm / dd
513458	5-FL - Forest land	4.A - Forest land	30	Relevant FAO Product Data: Pulp, Paper and Paperboard - Other fiber pulp	0.9	Mm / dd
513459	5-FL - Forest land	4.A - Forest land	30	Relevant FAO Product Data:	0:49	Mm / m3

				Industrial roundwood (Coniferous)		
Carbon dioxide (CO2) (Continued)						
EF Number	**IPCC 1996 Source / Pool category**	**CRF code / Subdivision of AKAKDO**	**Definitions ***	**Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features**	**Value of 1996/2006**	**Unit**
513460	5-FL - Forest land	4.A - Forest land	30	Relevant FAO Product Data: Industrial roundwood (Non-Coniferous)	0:56	Mm / m3
513461	5-FL - Forest land	4.A - Forest land	30	Relevant FAO Product Data: Industrial roundwood (Coniferous)	0:49	Mm / m3
513462	5-FL - Forest land	4.A - Forest land	30	Relevant FAO Product Data: Industrial roundwood (Non-Coniferous)	0:56	Mm / m3
513463	5-FL - Forest land	4.A - Forest land	31	Harvested Wood Product Category: Saw wood / Not specified (Default)	35	year
513464	5-FL - Forest land	4.A - Forest land	31	Harvested Wood Product Category: Veneer, plywood and structural panels / Not specified (Default)	30	year
513465	5-FL - Forest land	4.A - Forest land	31	Harvested Wood Product Category: Non structural panels / Not specified (Default)	20	year
513466	5-FL - Forest land	4.A - Forest land	31	Harvested Wood Product Category: Paper / Not specified (Default)	2	year
513487	5-FL - Forest land	4.A - Forest land	32	Harvested Wood Product Category: Saw wood / Not specified (Default)	0.0198	fraction
513488	5-FL - Forest land	4.A - Forest land	32	Harvested Wood Product Category: Veneer, plywood and structural panels / Not specified (Default)	0.0231	fraction
513489	5-FL - Forest land	4.A - Forest land	32	Harvested Wood Product Category: Non structural panels / Not specified (Default)	0.0347	fraction
513490	5-FL - Forest land	4.A - Forest land	32	Harvested Wood Product Category: Paper / Not specified (Default)	0.3466	fraction
515172	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	33	Temperate oceanic forest, Temperate continental forest, Temperate mountain systems: conifers above-ground biomass <50 tonnes/ha / temperate	0.40 (0.21 - 1.06)	Tonnes root dm / Tonnes sak dm
515173	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	33	Temperate oceanic forest, Temperate continental forest, Temperate mountain systems: conifers above-ground biomass (50-150 tonnes / ha) / temperate	0.29 (0.24 - 0.50)	Tonnes root dm / Tonnes sak dm
515174	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	33	Temperate oceanic forest, Temperate continental forest, Temperate mountain systems: conifers above-ground biomass (> 150 tonnes / ha) / Temperate	0.20 (0.12-0.49)	Tonnes root dm / Tonnes sak dm
515175	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	33	Temperate oceanic forest, Temperate continental forest, Temperate mountain systems: Quercus spp. above-ground biomass (> 70 tonnes / ha) / temperate	0.30 (0.20 - 1.16)	Tonnes root dm / Tonnes sak dm
515176	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	33	Temperate oceanic forest, Temperate continental forest, Temperate mountain systems: Eucalyptus spp. above-ground biomass (<50 tonnes / ha) / Temperate	0.44 (0.29 - 0.81)	Tonnes root dm / Tonnes sak dm
515177	5A - Changes in Forest	4.A - Forest land	33	Temperate oceanic forest,	0.28 (0.15 -	Tonnes root dm /

	and Other Woody Biomass Stocks			Temperate continental forest, Temperate mountain systems: Eucalyptus spp. above-ground biomass (50-150 tonnes / ha) / temperate	0.81)	Tonnes sak dm

Carbon dioxide (CO2) (Continued)

EF Number	IPCC 1996 Source / Pool category	CRF code / Subdivision of AKAKDO	Definitions *	Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features	Value of 1996/2006	Unit
515178	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	33	Temperate oceanic forest, Temperate continental forest, Temperate mountain systems: Eucalyptus spp. above-ground biomass (> 150 tonnes / ha) / Temperate	0.20 (0.10 - 0.33)	Tonnes root dm / Tonnes sak dm
515179	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	33	Temperate oceanic forest, Temperate continental forest, Temperate mountain systems: other broadleaf above-ground biomass (<75 tonnes / ha) / temperate	0.46 (0.12- 0.93)	Tonnes root dm / Tonnes sak dm
515180	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	33	Temperate oceanic forest, Temperate continental forest, Temperate mountain systems: other broadleaf above-ground biomass (75-150 tonnes / ha) / moderate	0.23 (0.13 - 0.37)	Tonnes root dm / Tonnes sak dm
515181	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	33	Temperate oceanic forest, Temperate continental forest, Temperate mountain systems: other broadleaf above-ground biomass (> 150 tonnes / ha) / temperate	0.24 (0.17 - 0.44)	Tonnes root dm / Tonnes sak dm
515232	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	34	Forest type: hardwoods / temperate	3.0 (0.8- 4.5)	tonnes biomass / wood volume (m3)
515233	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	34	Forest type: hardwoods / temperate	1.5	tonnes biomass / wood volume (m3)
515234	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	35	Forest type: hardwoods / temperate	3:33	tonnes biomass / wood volume (m3)
515235	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	36	Forest type: pines / temperate	1.8 (0.6- 2.4)	tonnes biomass / wood volume (m3)
515236	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	34	Forest type: pines / temperate	1.5	tonnes biomass / wood volume (m3)
515237	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	35	Forest type: pines / temperate	2	tonnes biomass / wood volume (m3)
515238	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	36	Forest type: Other Coniferous/ temperate	3.0 (0.7- 4.0)	tonnes biomass / wood volume (m3)
515239	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	34	Forest type: Other Coniferous/ temperate	1	tonnes biomass / wood volume (m3)
515240	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	35	Forest type: Other Coniferous/ temperate	3:33	tonnes biomass / wood volume (m3)
51 241	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	36	Forest type: hardwoods / temperate	1.7 (0.8- 2.6)	tonnes biomass / wood volume (m3)
515242	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	34	Forest type: hardwoods / temperate	1.3	tonnes biomass / wood volume (m3)

Carbon dioxide (CO2) (Continued)

EF Number	IPCC 1996 Source / Pool category	CRF code / Subdivision of AKAKDO	Definitions *	Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features	Value of 1996/2006	Unit
515243	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	35	Forest type: hardwoods / temperate	1.89	tonnes biomass / wood volume (m3)
515244	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	36	Forest type: pines / temperate	1.0 (0.65 - 1.5)	tonnes biomass / wood volume (m3)
515245	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	34	Forest type: pines / temperate	0.75	tonnes biomass / wood volume (m3)
515246	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	35	Forest type: pines / temperate	1:11	tonnes biomass / wood volume (m3)
515247	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	36	Forest type: Other Coniferous/ temperate	1.4 (0.5- 2.5)	tonnes biomass / wood volume (m3)
515248	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	34	Forest type: Other Coniferous/ temperate	0.83	tonnes biomass / wood volume (m3)
515249	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	35	Forest type: Other Coniferous/ temperate	1:55	tonnes biomass / wood volume (m3)
515250	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	36	Forest type: hardwoods / temperate	1.4 (0.7- 1.9)	tonnes biomass / wood volume (m ^ 3)
515251	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	34	Forest type: hardwoods / temperate	0.9	tonnes biomass / wood volume (m3)
515252	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	35	Forest type: hardwoods / temperate	1:55	tonnes biomass / wood volume (m3)
515253	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	36	Forest type: pines / temperate	0.75 (0.6- 1.0)	tonnes biomass / wood volume (m3)
515254	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	34	Forest type: pines / temperate	0.6	tonnes biomass / wood volume (m3)
515255	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	35	Forest type: pines / temperate	0.83	tonnes biomass / wood volume (m3)
515256	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	36	Forest type: Other Coniferous/ temperate	1.0 (0.5- 1.4)	tonnes biomass / wood volume (m3)
515257	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	34	Forest type: Other Coniferous/ temperate	0:57	tonnes biomass / wood volume (m3)
515258	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	35	Forest type: Other Coniferous/ temperate	1:11	tonnes biomass / wood volume (m3)
515259	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	36	Forest type: hardwoods / temperate	1.05 (0.6- 1.4)	tonnes biomass / wood volume (m3)
515260	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	34	Forest type: hardwoods / temperate	0.6	tonnes biomass / wood volume (m3)
515261	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	35	Forest type: hardwoods / temperate	1:17	tonnes biomass / wood volume (m3)
515262	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	36	Forest type: pines / temperate	0.7 (0.4- 1.0)	tonnes biomass / wood volume (m3)
515263	5A - Changes in Forest and Other Woody	4.A - Forest land	34	Forest type: pines / temperate	0.67	tonnes biomass / wood volume

	Biomass Stocks					(m3)
Carbon dioxide (CO2) (Continued)						
EF Number	**IPCC 1996 Source / Pool category**	**CRF code / Subdivision of AKAKDO**	**Definitions ***	**Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features**	**Value of 1996/2006**	**Unit**
515264	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	35	Forest type: pines / temperate	0.77	tonnes biomass / wood volume (m3)
515265	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	36	Forest type: Other Coniferous/ temperate	0.75 (0.4-1.2)	tonnes biomass / wood volume (m3)
515266	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	34	Forest type: Other Coniferous/ temperate	0:53	tonnes biomass / wood volume (m3)
515267	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	35	Forest type: Other Coniferous/ temperate	0.83	tonnes biomass / wood volume (m3)
515268	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	36	Forest type: hardwoods / temperate	0.8 (0.55-1.1)	tonnes biomass / wood volume (m3)
515269	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	34	Forest type: hardwoods / temperate	0:48	tonnes biomass / wood volume (m3)
515270	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	35	Forest type: hardwoods / temperate	0.89	tonnes biomass / wood volume (m3)
515271	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	36	Forest type: pines / temperate	0.7 (0.4-1.0)	tonnes biomass / wood volume (m3)
515272	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	34	Forest type: pines / temperate	0.69	tonnes biomass / wood volume (m3)
515273	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	35	Forest type: pines / temperate	0.77	tonnes biomass / wood volume (m3)
515274	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	36	Forest type: Other Coniferous/ temperate	0.7 (0.35-0.9)	tonnes biomass / wood volume (m3)
515275	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	34	Forest type: Other Coniferous/ temperate	0.6	tonnes biomass / wood volume (m3)
515276	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	35	Forest type: Other Coniferous/ temperate	0.77	tonnes biomass / wood volume (m3)
515388	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	37	Temperate continental forests / temperate; Asia, Europe (= 20 y)	20	tonness of dry matter / ha
515389	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	37	Temperate continental forests / temperate; Asia, Europe (> 20 y)	120 (20-320)	tonness of dry matter / ha
515392	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	37	Temperate mountain systems / Temperate; Asia, Europe (= 20 y)	100 (20-180)	tonness of dry matter / ha
515393	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	37	Temperate mountain systems / Temperate; Asia, Europe (> 20 y)	130 (20-600)	tonness of dry matter / ha
515494	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	38	Temperate continental forests and mountain systems / Temperate; Asia, Europe, broad leaf> 20 y	200	tonness of dry matter / ha
515495	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	38	Temperate continental forests and mountain systems / Temperate; Asia, Europe, wide leaf = 20 y	15	tonness of dry matter / ha
515496	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	38	Temperate continental forests and mountain systems / Temperate; Asia, Europe, conifer> 20 y	150-200	tonness of dry matter / ha

Carbon dioxide (CO2) (Continued)

EF Number	IPCC 1996 Source / Pool category	CRF code / Subdivision of AKAKDO	Definitions *	Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features	Value of 1996/2006	Unit
515497	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	38	Temperate continental forests and mountain systems	25-30	tonness of dry matter / ha
515581	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	39	Temperate continental forests / temperate; Asia, Europe, North America (= 20 y)	4.0 (0.5-8.0)	tonnes dm / ha / year
515582	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	39	Temperate continental forests / temperate; Asia, Europe, North America (> 20 y)	4.0 (0.5-7.5)	tonnes dm / ha / year
515583	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	39	Temperate mountain systems / Temperate; Asia, Europe, North America	3.0 (0.5-6.0)	tonnes dm / ha / year
515725	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	40	Ecological zone: Temperate continental forests / Climate type area: Temperate	120	tonness of dry matter / ha
515726	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	40	Ecological zone: Temperate mountain systems / Climate type area: Temperate	100	tonness of dry matter / ha
515740	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	40	Ecological zone: Temperate continental forests / Climate type area: Temperate	100	tonness of dry matter / ha
515741	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	40	Ecological zone: Temperate mountain systems / Climate type area: Temperate	100	tonness of dry matter / ha
515755	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	39	Ecological zone: Temperate continental forests / Climate type area: Temperate	4.0	tonnes dm / ha / year
515756	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	39	Ecological zone: Temperate mountain systems / Climate type area: Temperate	3.0	tonnes dm / ha / year
515770	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	39	Ecological zone: Temperate continental forests / Climate type area: Temperate	4.0	tonnes dm / ha / year
515771	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	39	Ecological zone: Temperate mountain systems / Climate type area: Temperate	3.0	tonnes dm / ha / year
515775	5A - Changes in Forest and Other Woody Biomass Stocks	4.A - Forest land	41	Species or genus: Pinus radiata / Climate type area: Temperate and Boreal	0.38 (0.33 - 0.45)	tonnes dm / m3 fresh volume
511565	5-FL-1 - Forest Land Remaining Forest Land	4.A.1 - Forest land Remaining Forest land	42	Area: Asia Country: Turkey	136	m3 / ha
522839	5-FL-1 - Forest Land Remaining Forest Land	4.A.1 - Forest land Remaining Forest land	43	Soil Type: Drained organic soil regardless of nutrient status / temperate	2.6	tonnes CO2-C / ha / year
511254	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Temperate forests, Pine; Age class: equal or less than 20 years, Region: Eurasia; Climate type Type: marine	40	t dm / ha
511255	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Temperate forests, other coniferous; Age class: equal or less than 20 years Region: Eurasia; Climate type Type: marine	40	t dm / ha
511256	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Temperate forests are Broadleaf; Age class: Equal to or less than 20 years old Region: Eurasia; Climate type: maritime	30	t dm / ha
511257	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Temperate Forests, Pine; Age class: More than 20 years old / Region: Eurasia; Climate type Type: maritime	150	t dm / ha
511258	5-FL-2 - Land Converted	4.A.2 - Land	44	Forest type: Temperate Forests,	250	t dm / ha

	to Forest Land	Converted to Forest Land		Other Coniferous; Age class: More than 20 years old / Region: Eurasia; Climate type Type: marine		
Carbon dioxide (CO2) (Continued)						
EF Number	**IPCC 1996 Source / Pool category**	**CRF code / Subdivision of AKAKDO**	**Definitions ***	**Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features**	**Value of 1996/2006**	**Unit**
511259	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Temperate forests are Broadleaf; Age class: More than 20 years old / Region: Eurasia; Climate type Type: maritime	200	t dm / ha
511260	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Temperate Forests, Pine; Age class: Equal to or less than 20 years old Region: Eurasia; Type: continental	25	t dm / ha
511261	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Temperate Forests, Other Coniferous; Age class: Equal to or less than 20 years old Region: Eurasia; Type: continental	30	t dm / ha
511262	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Temperate forests are Broadleaf; Age class: Equal to or less than 20 years old Region: Eurasia; Type: continental	15	t dm / ha
511263	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Temperate Forests, Pine; Age class: More than 20 years old / Region: Eurasia; Type: continental	150	t dm / ha
511264	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Temperate Forests, Other Coniferous; Age class: More than 20 years old / Region: Eurasia; Type: continental	200	t dm / ha
511265	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Temperate forests are Broadleaf; Age class: More than 20 years old / Region: Eurasia; Type: continental	200	t dm / ha
511266	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Temperate Forests, Pine; Age class: Equal to or less than 20 years old Region: Eurasia; Climate type Type: Mediterranean and step	17	t dm / ha
511267	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Temperate Forests, Other Coniferous; Age class: Equal to or less than 20 years old Region: Eurasia; Climate type Type: Mediterranean and step	20	t dm / ha
511268	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Temperate forests are Broadleaf; Age class: Equal to or less than 20 years old Region: Eurasia; Climate type Type: Mediterranean and step	10	t dm / ha
511269	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Temperate Forests, Pine; Age class: More than 20 years old / Region: Eurasia; Climate type Type: Mediterranean and step	one hundred	t dm / ha
511270	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Temperate Forests, Other Coniferous; Age class: More than 20 years old / Region: Eurasia; Climate type Type: Mediterranean and step	120	t dm / ha
511271	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Temperate forests are Broadleaf; Age class: More than 20 years old / Region: Eurasia; Climate type Type: Mediterranean and step	80	t dm / ha
511277	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Boreal Forests, Pine; Age class: Equal to or less than 20 years old Region: Eurasia	5	t dm / ha
511278	5-FL-2 - Land Converted	4.A.2 - Land	44	Forest type: Boreal Forests, Other	5	t dm / ha

EF Number	IPCC 1996 Source / Pool category	CRF code / Subdivision of AKAKDO	Definitions *	Technologies - Applications / Parameters - Conditions / Territory - Regional conditions / Other features	Value of 1996/2006	Unit
	to Forest Land	Converted to Forest Land		Coniferous; Age class: Equal to or less than 20 years old Region: Eurasia		
Carbon dioxide (CO2) (Continued)						
511279	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Boreal forests are Broadleaf; Age class: Equal to or less than 20 years old Region: Eurasia	5	t dm / ha
511280	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Boreal Forests, Pine; Age class: More than 20 years old / Region: Eurasia	40	t dm / ha
511281	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Boreal Forests, Other Coniferous; Age class: More than 20 years old / Region: Eurasia	40	t dm / ha
511282	5-FL-2 - Land Converted to Forest Land	4.A.2 - Land Converted to Forest Land	44	Forest type: Boreal forests are Broadleaf; Age class: More than 20 years old / Region: Eurasia	25	t dm / ha

Definitions *

1. Annual Average Aboveground Biomass Uptake by Natural Regeneration
2. Average Annual Accumulation of Dry Matter as Biomass in Plantations
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6. Length of transition period
7. Net annual accumulation of litter carbon over length of transition period
8. Net annual accumulation of litter carbon, based on 20 year default
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10. Average (median) dead wood stock
11. Average (median) dead:live ratio
12. Default values for CO2 (expressed as carbon) Emission Factor for drained organic soils in managed forests
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14. Default reference (under native vegetation) soil organic C stocks (SOC ref) for soils with low activity clay (LAC soils); for 0-30 cm depth; see Comments from Data Provider for the definition of LAC soils
15. Default reference (under native vegetation) soil organic C stocks (SOC ref) for sandy soils; for 0-30 cm depth; see Comments from Data Provider for the definition of sandy soils
16. Default reference (under native vegetation) soil organic C stocks (SOC ref) for spodic soils; for 0-30 cm depth; see Comments from Data Provider for the definition of spodic soils
17. Default reference (under native vegetation) soil organic C stocks (SOC ref) for volcanic soils; for 0-30 cm depth; see Comments from Data Provider for the definition of volcanic soils
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