

**THE REPUBLIC OF CYPRUS
MINISTRY OF AGRICULTURE, RURAL DEVELOPMENT AND ENVIRONMENT**

CYPRUS'

NATIONAL FORESTRY ACCOUNTING PLAN

IN ACCORDANCE WITH REGULATION (EU) 2018/841

December 2019

Title of Report	National Forestry Accounting Plan for Cyprus
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1. General Introduction

This document has been prepared for Cyprus as a European Union Member State and shall be referenced as the “National Forestry Accounting Plan of Cyprus”, which includes the forest reference level for the member state. The document is in accordance with the Regulation (EU) 2018/841 and shall be submitted to European Commission (DG CLIMA).

1.1 General description of the forest reference level for Cyprus

The forests of Cyprus are an important national resource as they provide renewable wood and non-wood products and services.

They are threatened, however, by various risks and pressures exerted from several directions and are constantly facing new challenges as the result of changing needs and demands of society and changes in local, regional and global level. The main risks, the forests of Cyprus are facing, are forest fires, harms from biotic and abiotic factors and land and other development for tourism or for residential and industrial purposes.

The area of state forests remains relatively constant while the area of private forests seems to be expanding due to natural afforestation of abandoned agricultural land, especially in mountainous and hilly areas, although there is some pressure due to fires and development.

The forests of Cyprus are also characterized by high biodiversity, which is threatened mainly by forest fires, excessive development and climate change. Overgrazing and alien plant species threaten, in some cases, the natural vegetation.

Climate change is expected to affect the Mediterranean region and cause serious problems to Cyprus forests, mainly due to increasing temperature, decreasing rainfall and increasing frequency and intensity of droughts.

Cyprus adopted the following definition of Forest for GHG reporting under the Convention and the Kyoto Protocol:

Forest comprises of land covered by forest trees which covers at least 0,3 hectares, where the tree crown cover is at least 10 per cent and the minimum tree height is of 5 meters (at maturity).

The forest definition adopted by Cyprus is in line with the Forest National Law of 2012 (25 (I)/2012) and in accordance with the definition used for its reporting for the Global Forest Resource assessment under the Food and Agriculture Organization of the United Nations (FAO FRA 2015). This definition is also consistent with the guidance of the national definition of forest contained in Decision 16/CMP.1.

It should be noted that the Department of Forests (Department of Forests, CY-1414 Nicosia, Cyprus) applied the following definition of forest in its reporting under the FRA 201564: Forest comprises land spanning more than 0,5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent, or trees able to reach these thresholds at maturity in situ. It does not include land that is predominantly under agricultural or urban land use. However, the area threshold of 0,5 hectares according to the Forest national Law of 2012 (25 (I)/2012) is reduced to 0,3.

The Forest Land category for GHG reporting under the Convention and the Kyoto Protocol contains all lands that meet the definition of forest. It also includes forest roads, cleared tracts, firebreaks and other small open areas within the forest as well as reforested areas or burnt areas or other areas that temporarily have low plant cover due to human intervention or natural causes, but does not include municipal parks and gardens. Forest land contains only areas covered with trees that according to the Forest National Law of 2012 (25 (I)/2012) are considered as forest trees.

The forest land is further divided into two subcategories: coniferous forest and broadleaved forest based on the dominant tree species.

1.2 Consideration to the criteria as set in Annex IV of the LULUCF Regulation

A. Criteria and guidance for determining forest reference level

The available and more recent data was utilized for the determination of the forest reference level. In summary, the forest reference level was determined by taking into account the national forest inventories for *Pinus brutia*, conducted by the Department of Forests for the years 2001 and 2011, which was considered as closest to the reference period (2000-2009). *Pinus brutia* is the main species for Cyprus forested land and accounts for a large percentage of the carbon removals. The average biomass increment has been determined for the period and assuming constant harvesting rates the FRL has been determined as ΔC -conifers (change of biomass for coniferous forest) + ΔC - broadleaves (change of biomass for broadleaved forest) + Harvested Wood Products (determined using the Production Approach) for the period 2010-2025. For its calculation the forest area was stratified in two main categories, conifers and broadleaves. For broadleaves, due to lack of data, default emission factors were used as applied in the NIR. Also, the level of Harvested Wood Products emissions was calculated using the template utilized for NIR using FAO Stat as an average for the period 2000-2009 and reporting the results for the Production Method.

B. Elements of the national forestry accounting plan

The national forestry accounting plan has been reported according to the criteria set out in the Regulation utilizing available data for the reference period. The pools that were determined were living biomass (above + below) and Harvested Wood Products in CO₂ eq. emissions.

2. Preamble for the forest reference level

2.1 Carbon pools and greenhouse gases included in the forest reference level

As mentioned before, forest land comprises of land covered by forest trees which covers at least 0,3 hectares, where the tree crown cover is at least 10 per cent and the minimum tree height is of 5 meters (at maturity).

For the calculation of the forest reference level, forest land was divided into two subcategories: coniferous forest and broadleaved forest based on the dominant tree species. The carbon pools calculated were **living biomass for coniferous forests, living biomass for broadleaved forest and Harvested Wood Products**.

2.2 Demonstration of consistency between the carbon pools included in the forest reference level

For the calculation of the specific carbon pools, the same categorization was used that is utilized in the National Inventory. The methodologies applied were in accordance to IPCC2006 Guidelines.

2.3 Description of the long-term forest strategy

For the sustainable management of forests, the Department of Forests has developed, adopted and is responsible for the implementation of the National Forest Policy Statement (2013) and the National Forest Program through Strategic Planning as stated in the following paragraphs.

NFI's are conducted every 10 years and result in the estimation of the sustainable harvest rate which is applied for the next period. The harvest rate is set to be approximately 9% of the annual production of the productive. In order to ensure the continuation of the sustainable forest management practices, the harvest rate is re-evaluated every 10 years. The methodology used for the calculation of the sustainable harvest level follows the Bristow categorization according to the equation:

$Ea = Z + (Vw - Vn) / a$, where,

Ea = sustainable harvest based on current forest productivity

Z = the current forest increment

Vw = the actual stock level

Vn = the intended stock level

The harvest rates for round wood are not expected to increase beyond 4000-5000 cubic meters per year for the decade 2012-2021 as this is estimated to be the sustainable harvest rate for Cyprus's forests, as determined by the latest NFI (2011-2012). Nevertheless, increased salvage logging due to increased forest fires could affect the overall harvest. This is obvious below, where despite the fact that the overall trend in harvest is decreasing, following the desired sustainable harvest level estimation, in years of increased fires (i.e. 2007 and 2016, together with the immediately subsequent years) harvest is higher than expected due to

salvage logging. The sustainable harvest rate will be re-estimated at the next NFI that will be conducted at 2021-2022.

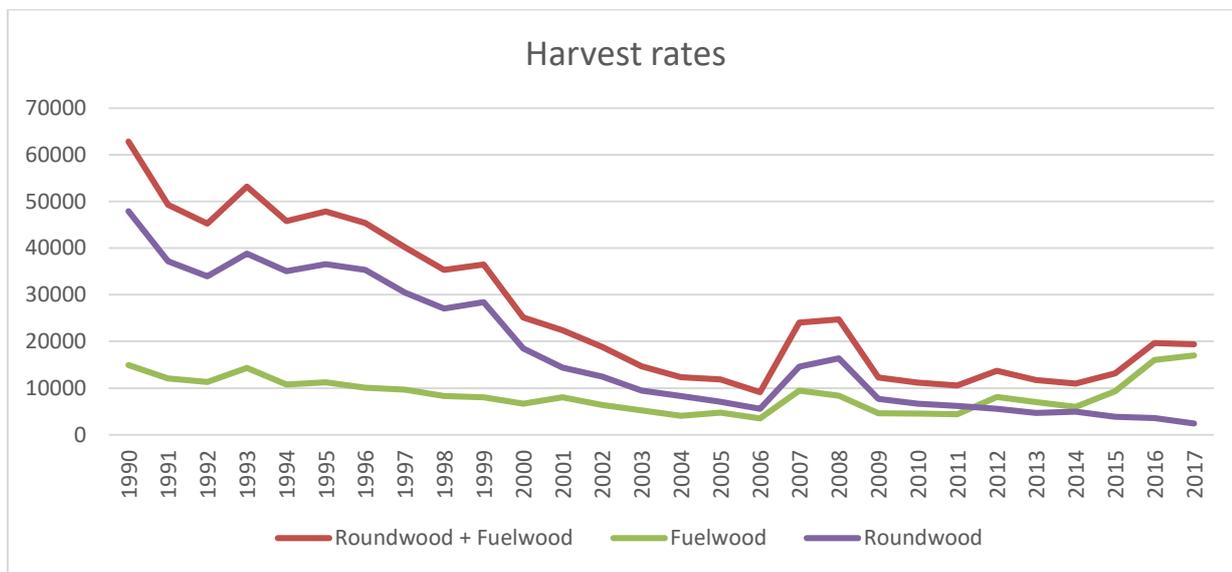


Figure 1. The total harvest rates for round wood and fuelwood for the period 1990-2017

2.3.1. Strategic objective 1: enhancement of the environmental role of forests

The forests of Cyprus are an important national resource as they provide renewable wood and non-wood products and services.

They are threatened, however, by various risks and pressure exerted from several directions and are constantly facing new challenges as the result of changing needs and demands of society and changes in local, regional and global level.

Climate change is expected to affect the Mediterranean region and cause serious problems to Cyprus forests, mainly due to increasing temperature, decreasing rainfall and increasing frequency and intensity of droughts.

Within this framework, the Ministry of Agriculture, Rural Development and Environment, aims in enhancing the environmental role of forests. The protective role of forests is crucial, especially for the protection of soil and water. This is partly due to the mountainous nature of forests and because of the fact that most forests are located in the major water catchment areas. Along with the protection of soil and water, forests help to prevent floods affecting agricultural lands, infrastructure and settlements located downstream.

Another important function of forests is the preservation of biodiversity of flora and fauna. A large percentage of the forested areas in Cyprus are included in the Natura 2000 network, both for the Birds and the Habitat Directives. Due to the fact that Cyprus is an island, it scores high on the biodiversity index. In fact, the presence of 42 terrestrial habitats has been confirmed, of which 11 are priority habitats, e.g. habitat types that are threatened with extinction, with a natural distribution that falls mainly within the territory of the European Union.

Some of the most typical Annex I habitat types that occur in Cyprus are (* denotes priority habitats):

- A) Mediterranean pine forests with endemic species of Mediterranean pine (habitat type 9540), represented in Cyprus by the Calabrian pine (*Pinus brutia*).
- (B) Black pine forest (*Pinus nigra subsp. palassiana*) (habitat type 9530 *).
- (C) Oriental plane forests (*Platanion orientalis*) (habitat type 92C0)
- (D) Olive and carob tree forests (habitat type 9320)
- (E) Arborescent matorral with *Juniperus spp. (Juniperus phoenicea)* (habitat type 5210)
- (F) *Sarcopoterium spinosum* (Cisto-Micromerietea) (habitat type 5420).

It is worth noting that Cyprus, as a new entrant, proposed nine new types of habitats. Of these, five were approved and included in Annex I as new habitats, while the others were used to amend the definitions of the existing habitats so that their description corresponds to the particularities they present in Cyprus. The five priority habitats proposed by Cyprus and included in Annex I are:

- (A) Forests of *Cedrus brevifolia* (Cedrosetum brevifoliae) (habitat type 9530 *).
- (B) Shrubs and forest stands of *Quercus alnifolia* (habitat type 9390 *).
- (C) Forest stands of *Quercus infectoria subsp. Veneris* (Anagyro foetidae-Quercetum infectoriae) (habitat type 93A0).
- D) Serpentine-leaved meadows of Cyprus (habitat type 62B0 *).
- (E) Troodos (habitat type 6460 *).

In the forest areas a large number of endemic species and subspecies can also be found that are also protected under the Bird and Habitat Directives. Some examples are: *Cedrus brevifolia*, the Cyprus cedar, closely related to the Lebanese cedar, *Quercus alnifolia*, an endemic oak species, *Ovis orientalis ophion*, the Cyprus Mouflon, which is the largest animal in the Cypriot fauna, a subspecies of the wild sheep found only in Cyprus, *Oenanthe cypriaca*, the Cyprus wheatear, a small, 14–15 cm long, passerine bird and *Coluber cypriensis*, the Cyprus Whip Snake. It is worth to note, that at the Troodos mountain range, within the National Forest Park, one can find 102 endemic species and subspecies, (71,8% of the endemics), 47 of which are local endemics, which means that are only found at this specific site.

2.3.2. Contribution of the strategic objective 1 to the strategic intentions

The specific strategic objective contributes to the achievement of the following strategic intentions:

1. Promotion of Green and Blue Development, contributing to the restructuring of the economy
2. Protection of the environment and promotion of resource efficiency
3. Reduction of greenhouse gas emissions, climate change adaptation and risk prevention

The strategic intention "Protection of the environment and promotion of resource efficiency" is achieved through the protection of forests from fires, overgrazing, human interventions and other biotic and abiotic factors that affect them. It is also achieved through the maintenance and improvement of biodiversity in forests. In particular, the conservation of biodiversity is enhanced by the protection of flora and fauna and the protection and restoration of their habitats.

The strategic intention “Reduction of greenhouse gas emissions, climate change adaptation and risk prevention” is achieved through the creation of new forest areas and the prevention and remediation of damages to forests, actions leading to increased carbon storage.

Furthermore, the measures proposed under Strategic Objective 1, contribute to the strategic intention related to the "Promotion of Green and Blue development, contributing to the restructuring of the economy" because, forests are one of the most important terrestrial ecosystems on the planet and the goods and services derived from them are an important part of the green economy.

2.3.3. Operational objectives

- a) Protection and expansion of forests
- b) Protection of biodiversity and other functions of forest ecosystems

2.3.3.1. ACTIONS/ ACTIVITIES UNDER OPERATIONAL OBJECTIVES

- a) Operational objective 1:
 - i) Protection of forests
 - ii) Expansion and tending of forests and greenery
- b) Operational objective 2:
 - i) Protection of habitats and species of flora and fauna
 - ii) Raising public awareness

2.3.4. Overall description of the forests and forest management in Cyprus and the adopted national policies

The forest management in Cyprus is based on the New Forest Policy Statement which was approved by the Council of Ministers on January 2013 and Strategic Planning, which provide for the development of forest and forestry as an integral part of the national development strategy. The provisions of the strategic Planning were stated previously in paragraph 2.3.

2.3.4.1. Criteria and Indicators for Sustainable Forest Management

The Department of Forests has formulated and adopted a set of Criteria and Indicators for the Sustainable Management of Forests in Cyprus, based on the Improved Pan-European Criteria and Indicators, as they were finalized and adopted by the Ministerial Conference on the Protection of Forests in Europe in 2002. The Criteria and Indicators for the Sustainable Management of Forests in Cyprus which were published in 2006, analyze the state of Cyprus forests for the period 1993 – 2003, setting the basis for a quantitative and qualitative assessment of Cyprus forests and their management, as well as for the monitoring of future changes.

2.3.4.2. Forest Inventories

Forest inventories cover only the area of state forests. The purpose of the inventory is the collection of all the necessary data (raw data) on forests, aiming at the rational design of forest management as well as monitoring the dynamic development of stands.

In 2013, Management and Computerization Sector of the Department of Forests, presented the results of the fourth Forest Inventory (2011 – 2012). Inventory covered Exploitable Forests, Non Exploitable Forests and Reforestations.

2.3.4.3. Climate Change and Forests

According to the United Nation Framework Convention on Climate Change (UNFCCC), the term of climate change means «a change of climate which is attributed directly or indirectly to human activity» differentiating the term by climate variability due to natural causes.

Recently, at the 21st Meeting of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC - COP21), an agreement (the Paris Agreement) was reached, which culminated in a series of efforts by the global community to tackle climate change effectively.

The Republic of Cyprus ratified the Paris Agreement on 9 December 2016, while internationally entered into force on 4 November 2016.

Cyprus Forests unfortunately could not remain uninfluenced by Climate Change and other Changes. In particular, the period 2005 – 2008 was affected by prolonged droughts, resulting on Cyprus forests ecosystems been intensively stress due to lack of soil moisture, high temperature and high competition between forest species.

The Department of Forests adopts and applies mostly repeated actions which are designed to adapt on forest stands (natural and artificial) to climate change. Also the object of these actions is the reduction of emissions and increase the absorption of greenhouse gases. These actions can be grouped into three main areas as listed in the Statement of Forest Policy:

- Protecting forests against forest fires
 - Adaptation of forests to climate change and enhancing the contribution of forests in addressing climate change and improvement of main forests and forested areas
 - Improvement and expansion of forests. Such measures are:
 - Protection of forests from illegal logging: With the implementation of Law 139 (I) / 2013 is controlled most the available firewood locally and criminal penalties for any illegal or uncontrolled logging and / or disposal of the local timber market without authorization
 - Reforestation of Amiantos (asbestos) Mine as well as restoration of abandoned mines in cooperation with the Competent Authority (the Mines Service)
 - Protection of forests and enhancement of their structure and resistance to climate change through the Rural Development Program 2014 – 2020.
 - Production in forest nurseries resistant to drought plants and trees (e.g. *Olea europaea*, *Ceratonia siliqua* and *Pistacia lentiscus*) to be used in afforestation or reforestation.
 - Participation of the Department of Forests in co-funded projects (e.g. Life Kedros), aiming to develop management tools (management rules) aimed at protecting, preserving and further upgrading protected forest habitats.

In particular, on the Rural Development Program, a number of activities and actions have been integrated under Measure 8 (Investments in forest area development and improvement of the viability of forests). The Action 8.5.3 includes thinning operations in thick stands created by afforestation / reforestation, with the purpose of:

Improving the structure of forests created by afforestation or/and reforestation operations. Furthermore, they will help in the adaptation of forest stands in climate change as well as contribute to the adaptation of forest stands to climate change, the reduction of emissions and increase the absorption of greenhouse gases.

The implementation of targeted thinnings is expected to improve stability and resistance capacity to other disturbances, such as drought, increase in average temperatures and prolonged heat waves (as a result of climate change).

2.3.5. Description of future harvesting rates under different policy scenarios

Current policies include the implementation of targeted thinning of the forest is expected to improve stability and resistance capacity to other disturbances, such as drought, increase in average temperatures and prolonged heat waves (as a result of climate change). Also, the sustainable harvest rate is implemented and recalculated to ensure that forests are not overharvested. Current forest policies regarding harvest is not expected to change in the future.

A future policy scenario might be that productive forest areas increase as forested areas increase. A current campaign for reforestation is underway by the Department of Forests to establish new plantations in now

non-forested lands with the involvement of the public. The campaign is titled “I plant for Climate” and is directed towards public or private organizations such as municipalities, churches, schools, NGOs and firms who wish to forest public or privately owned lands and who will agree to be responsible to provide the funds and care (i.e. water) of these areas for a minimum of three years. The Department of Forests, after evaluating the applications, will be providing the trees for free, taking into account the area of the plot and the specificities of the location, i.e. elevation. The plants supplied will be selected from a specific list of mostly indigenous, non-invasive species that are suited to the climatic conditions of Cyprus such as: *Pinus brutia*, *Cupressus sempervivines*, *Quercus spp.*, *Juniperus spp.*, *Tamarix spp.*, *Laurus nobilis*, *Ceratonia silique*, *Myrtus nobilis*, *Nerium oleander* and *Rosmarinus officinalis*. It is assumed that 200 trees will be planted per hectare. This could lead to an increase of forest land remaining forest land by 11690 hectares and Land converted to Forest by 30000 hectares by 2050, as presented below.

Year	No of trees produced	Hectares planted (200 trees/ ha) per year	Land to Forest in ha (total area)	Forest to Forest (20 year transition period) in ha
2018	9000	45	45	0
2019	9000	45	90	0
2020	70000	350	440	0
2021	150000	750	1190	0
2022	150000	750	1940	0
2023	150000	750	2690	0
2024	150000	750	3440	0
2025	150000	750	4190	0
2026	300000	1500	5690	0
2027	300000	1500	7190	0
2028	300000	1500	8690	0
2029	300000	1500	10190	0
2030	300000	1500	11690	0
2031	300000	1500	13190	0
2032	300000	1500	14690	0
2033	300000	1500	16190	0
2034	300000	1500	17690	0
2035	300000	1500	19190	0
2036	300000	1500	20690	0
2037	300000	1500	22190	0
2038	300000	1500	23645	45
2039	300000	1500	25100	90
2040	300000	1500	26250	440
2041	300000	1500	27000	1190
2042	300000	1500	27750	1940
2043	300000	1500	28500	2690
2044	300000	1500	29250	3440
2045	300000	1500	30000	4190
2046	300000	1500	30000	5690

2047	300000	1500	30000	7190
2048	300000	1500	30000	8690
2049	300000	1500	30000	10190
2050	300000	1500	30000	11690

Nevertheless, currently there is no assumption that this will lead to a change in **forest harvest policy**.

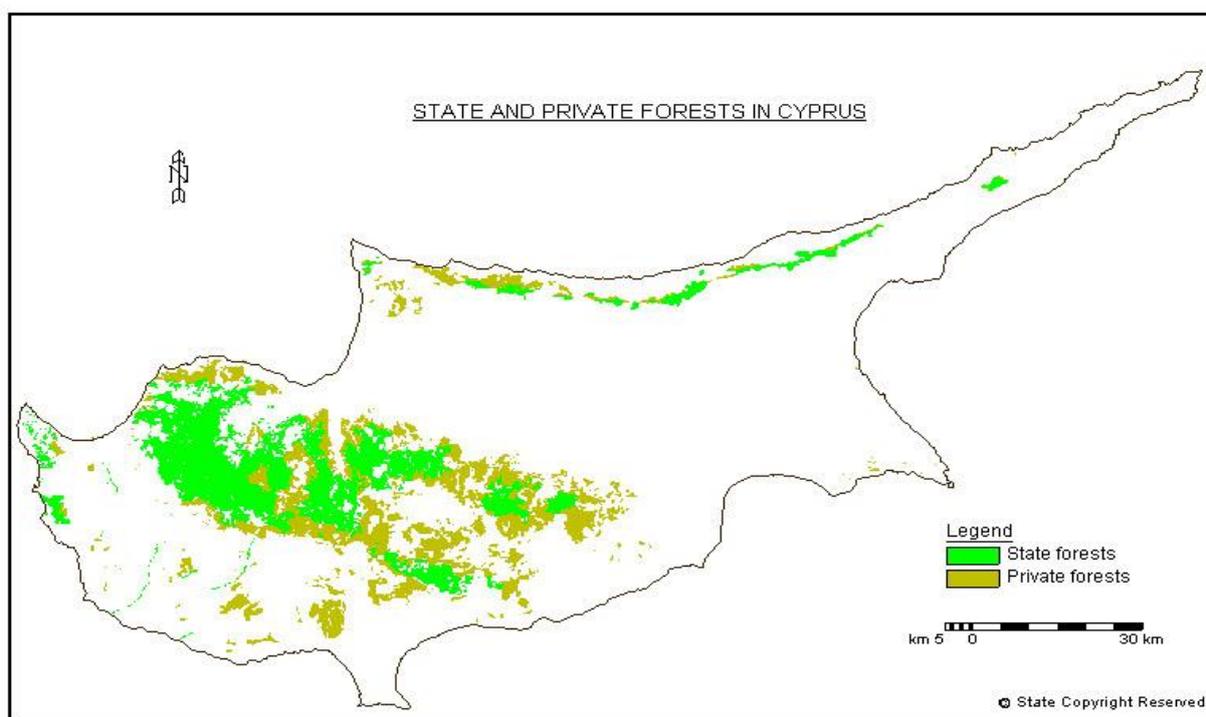
3. Description of the modeling approach

3.1 Description of the general approach as applied for estimating the forest reference level

3.1.1. Area and ownership of Cyprus forests

The total area of high forests is about 172,700 ha and occupies the 18.68 % of the total area of Cyprus, including the occupied areas in the northern part of the island. An area of about 139,053 ha or 80,46 % of the total State forest area is situated in the area under the control of the Government whilst the remaining 19,54 % is found in the area of Cyprus beyond the control of the Government. According to the last survey, private forests and other forested State land cover 24,74 % of the total area of Cyprus (Map.1).

Private forests are small holdings scattered all over Cyprus and are mainly located in distant mountainous and rural areas. However, the practice of private forestry as such, is not existed in Cyprus. The existence of these forests is due to the emigration of people from the mountainous or semi-mountainous to urban areas, the abandonment of agricultural land adjacent to the State forests and the natural expansion of the forest vegetation. The emigration of people resulted in the declination of grazing, in the reduction of the needs for fuel wood, in the reduction of forest fires on the lands outside State forests and in the transformation of parts of them into forest.

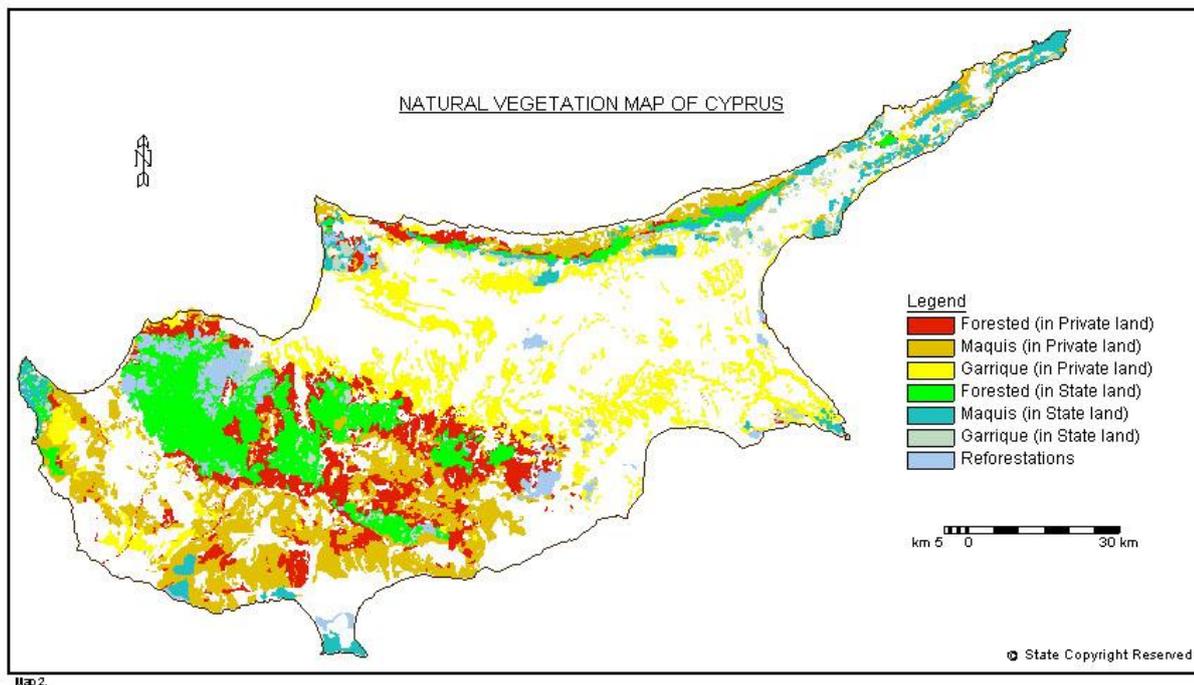


Map 1.

Map 1 State and Private Forests in Cyprus (Source: Department of Forests)

3.1.2. Floristic composition of Cyprus forests

Nearly half the area of the island is covered by tree vegetation that has been degraded by human activities. Forest is composed mainly of coniferous species like the Calabrian pine (*Pinus brutia*), the black pine (*Pinus nigra subsp. pallasiana*), the Cedar (*Cedrus libani subsp. brevifolia* (Hook. f.) Meikle) and the Cypress (*Cupressus sempervirens* L.). Maquis vegetation includes species like Lentisk (*Pistacia lentiscus* L.), Juniper (*Juniperus phoenicea* L.), Maple (*Acer obtusifolium* Sm.) and Strawberry tree (*Arbutus andrachne* L.), while garigue lands consist of the Rock rose (Cistus spp.), Thyme (*Thymus capitatus* L.), Thorny-broom (*Calycotome villosa* (Poir.) Link), Thorny gorse (*Genista fasselata* Decne. var. *fasselata*) and Spiny burnet (*Sarcopoterium spinosum* L.). There are also minor areas consisting of young coniferous plantations (source: Forest Department, Ministry of Agriculture, Rural Development and Environment, Cyprus).



Map 2. Natural Vegetation map of Cyprus. (Source: Natural Resources Information and Remote Sensing Center, Ministry of Agriculture, Natural Resources and Environment).

The changes in the land use in the public forests are prohibited by the Forest Laws of 1967, 1987, 1991 and 2012. Changes in the use of the private forests or of the other wooded land may occur. Private forested land which formerly was agricultural land, may reclaim its former use. Another reason of private forest land use change is the building of country houses or ecotourism development.

- **State Forest:** The Forest Law of 2012, provides for the designation (through Article 10) of any forest or forest land to State Forest for the benefit of the residents of the area or for the protection and management of biodiversity and / or the natural environment in general or covers an area larger of 100 ha. The State Forests are managed under sustainable forest management practices and in the concept of multiple use forests, unless there is a different provision in the Forest Law.
- **Private Forest:** Any private land covered by forest vegetation in accordance with the definition of forest or forest land in line with the Forest Law of 2012.

The Forest Law of 2012, provides (through Article 15) for the designation of suitable State Forest land to:

- a) **Nature Reserves**, when the forest, which preserves its naturalness, has not been affected by significant or permanent disturbance by human intervention and contains one or more rare species of flora or fauna or other element of nature with national, is managed for purposes of scientific research, monitoring and is considered an area for scientific reference while human presence and activity is minimized to ensure undisturbed functioning of natural processes
 - b) **National Forest Parks**, when the forest maintains its naturalness to a significant extent, and contains important features of biodiversity or genetic resources, landscapes or geomorphological elements, is managed for the protection and conservation of ecological functions and provides for spiritual, scientific, educational or recreational activities which are both environmentally and culturally compatible.
 - c) **Protective Forests**: when the forest, due to its location and / or soil and geological characteristics and / or land inclinations, acquires special importance for the protection of water resources or the soil or property and human settlements located underneath it, at sites with lower altitude.
 - d) **Forest Parks**: when the forest, due to its location in relation with urban environment, is of paramount importance for health, environmental education, aesthetics and recreation
-
- **Nature Micro-Reserves**, The Forest Law of 2012, provides (through Article 16) for the designation of suitable State Forest land to natural micro-reserves when the area contains one or more rare species of flora or fauna or other element of nature with national, regional or global interest, with the ultimate goal of protecting rare species and biodiversity.
 - **Forest Monuments**: The Forest Law of 2012, provides (through Article 16) for the designation of suitable State Forest land to forest monuments when the area contains specific natural, cultural or geomorphological features of exceptional or unique value due to their monumental character or their exceptional aesthetics and / or cultural features.
 - **Communal Forests**: The Forest Law provides (through Article 26) for the authority of the Council of Ministers to declare any state forest into Communal Forest for forest management and protection of the forested area for the benefit of the residents of the area, provided that there will be an agreement between the local Community Council / Councils and the Department of Forests setting down the rights and obligations of each partner, and that there will be a management plan for the particular forest.

Table 1. Forest area occupied by the main forest communities within the State forests (Department of Forests Database)

Major Forest Communities	Area in hectares
<i>Pinus brutia</i> community	88.790
<i>Pinus nigra</i> community	2.640
Mixed <i>Pinus brutia – nigra</i> community	2.330
<i>Cedrus brevifolia</i> community	230
<i>Cupressus sempervirens</i> community	6
Mixed <i>Cupressus sempervirens – Pinus brutia</i> community	177
Mixed <i>Cupressus sempervirens- Quercus alnifolia</i> community	2
Mixed <i>Cedrus brevifolia – Pinus brutia</i> community	167
Mixed <i>Pinus brutia – Quercus alnifolia</i>	5.870
<i>Quercus infectoria</i> community	0,1
<i>Eucalyptus</i> community	137
Riparian community (<i>Platanus</i> and <i>Alnus</i>)	1459,6
<i>Salix alba</i> community	45

The State forests of Cyprus are covered by the following plant communities; the *Pinus brutia*, the *Pinus nigra*, the mixed *Pinus brutia-nigra*, the *Cedrus brevifolia*, the mixed *Cedrus brevifolia-Pinus brutia*, the *Quercus alnifolia*, the mixed *Pinus brutia - Quercus alnifolia*, the *Eucalyptus* and the Riparian community. The area of the State forest that each one of the above communities occupies is stated in table 1.1.4 above.

The *Cedrus brevifolia* community covers an area of 230 ha, as shown above in Table 1. The natural stands cover 102,4 ha are natural stands while the rest are plantations. The *Eucalyptus* community is mainly concentrated around Fasouri 137 ha of eucalyptus trees are also grown in various sites around the island, mainly near streamlines.

Regarding the private forests, the areas occupied by the main forest communities are as follows:

Table 2 Forest area occupied by the main forest communities in the private forests (Department of Forests Database)

Major Forest Communities	Area in hectares
<i>Pinus brutia</i> community	48.954
<i>Cupressus sempervirens</i>	218
Mixed <i>Quercus infectoria-Q. alnifolia</i>	1368
<i>Eucalyptus</i> community (plantations)	260
Riparian community (<i>Platanus</i> and <i>Alnus</i>)	610
<i>Quercus infectoria</i>	77

3.2 Documentation of data sources as applied for estimating the forest reference level

3.2.1. Documentation of stratification of the managed forest land

Forest inventories are the tool for the rational design of forest management as well as monitoring the dynamic development of stands. As stated in paragraph 3.1 the managed forest land includes the *Pinus brutia*

community of the major state forest land which covers an area of 88790 ha. The nearest National Forest Inventory to the Reference period (2000 – 2009) of the Forest Reference Level was conducted during 2011 – 2012. Inventory covered only the area of *Pinus brutia* state forests which were stratified in three different strata: a) Exploitable Forests, b) Non Exploitable Forests and c) Reforestations.

Regarding the broadleaved forests, the attempt to estimate the forest reference level was based on archive data due to lack of real inventory data.

3.2.2. Estimation of Forest Reference Level based on specific criteria

The forest structure is defined as characterized by an uneven-aged forest. Although there is a forested land area represented by an even-aged structure (coniferous reforestations). Stratification of the high forest ecosystems in Cyprus was based on three main criteria according to the available data provided by the National Forest Inventory: a) Species composition, b) Function of the forest and c) Management practices. Further information about each stratum is given below:

- a) **Species composition:** The species composition criterion is mainly affected by the area covered by coniferous and broadleaved forests.
 - i) **Broadleaved Forests:** As stated above in 3.1 Paragraph (Tables 1 and 2), the broadleaved forests consist of rare and sensitive ecosystems like *Quercus infectoria*, *Eucalyptus* trees and Riparian communities. The Eucalyptus community is an artificial community and it was not considered as managed forest land during the Reference period 2000 – 2009. The Riparian communities cover areas along river lines and consist of *Platanus*, *Alnus* and *Salix* species. The Riparian communities are protected habitats under the Habitat's Directive (Annex I) and are included in the Natura 2000 network for Cyprus by the codes 92CO, 92AO and 92COx92AO. The FRL for the broadleaved forests, covering an area of 3958 ha in total was calculated following the same methodology used for the NGHG Inventory which is based on expert judgement and past estimations on the net increment while the harvest ratio is based on data from the Annual Reports of the Department of Forests.
 - ii) **Coniferous Forests:** The coniferous forests consist of pine, cypress and cedar forests and cover the majority of the managed forest land in Cyprus. The *Cedrus brevifolia* community is a protected habitat (9590*) included in the Natura 2000 Network. It covers a small area and is characterized as a nature reserve. The *Cupressus sempervirens* community consists mainly of communal forests scattered all over the island which are according to the Forest law they are to be enjoyed communally for the purpose of amenity and recreation by the inhabitants of each community. The remaining forest area is covered by pine forests consisted by pure stands of *Pinus brutia*, mixed stands of *Pinus brutia* and *Pinus nigra* and pure *Pinus nigra* stands. The *Pinus nigra* forest land is scattered at the higher range of elevation of Troodos Mountain, covering the area above 1400 m. there is a transitional zone where the mixed stands of *Pinus brutia* and *Pinus nigra* grow between 1300 -1700 m of altitude. Starting from sea level up to 1400 m of altitude lays the zone of *Pinus brutia*. The *Pinus brutia* forests cover the vast majority of the managed forest land of Cyprus which covers an area of 88790 ha. The data for the National Forest Inventory are derived from permanent plots which are scattered throughout the *Pinus brutia* forests. Consequently, the data available for estimating the forest reference level are those derived from the National Forest Inventory and cover an area of 81.575,42 ha of *Pinus brutia* community within the state forest area. An area of 6024 ha is

covered by other coniferous species like *Cedrus*, *Cupressus* and *Juniperus*. For the estimation of the FRL the net increment as well as the harvest ratio and deadwood ratio derived from the National Forest Inventory of *Pinus brutia* were taken into account due to lack of actual inventory data of the other coniferous species. This was assumed by the fact that they belong in the coniferous family so the increment could not differ significantly. The FRL was estimated for an area of 143.768 ha in total consisted of coniferous forests around the island.

b) Function of the forest: Exploitable, non-exploitable and reforestations

Following the main stratification of species composition, the next level of stratification of the managed forest land in Cyprus, was based on the functions assigned to the forests. Cyprus' forests consist of (i) Exploitable forests and ii) Reforestations, where active management practices take place (i.e. particularly for wood production) and (iii) Non-exploitable forests, which are managed via "close to nature" silviculture, covering the forest areas characterized as nature reserves, national forest parks, multiple-use permanent forest reserves, and forests with other non-specified functions.

c) Management Practices:

Considering the functions of the forests of the previous strata, the MFL was further stratified in accordance of the silvicultural practices that take place at each stratum. At exploitable forests and reforestations targeted thinnings are applied following the principles of sustainable forest management providing wood harvested products. As for the stratum of non – exploitable forests a "close to nature" silviculture is applied which mainly aims to a sustainable conservation of the forest stands. The main management practice applied is a conservative single selection system.

3.2.3. Documentation of sustainable forest management practices as applied in the estimation of the forest reference level

The National Forest Inventory, the Forest Management Plans, the Natura 2000 Management Plans and the Annual Reports are the documents that describe in detail the common forest management practices while providing the data used to estimate the forest reference level.

3.3 Detailed description of the modeling framework as applied in the estimation of the forest reference level

The data provided from the National Forest Inventory were the inputs for calculating a ratio of harvest and deadwood to standing biomass in relation to different diameter classes. Statistical data of the National Forest Inventory held at 2001 and 2011 were processed for each stratum. For the purpose of modeling, the strata of exploitable forests and reforestations were considered one stratum due to the same forest managed practices that are applied. The non – exploitable forests consisted a different stratum.

The model was based on the increments for the different strata which were differentiated according to the evolution of maturity (diameter) classes in each stratum. The net increment and its feedback from management (changes in structure) were used to provide the gains of biomass. Fixed ratios of harvest and of

the deadwood to standing biomass were applied to the diameter classes and that led to the calculation of the net gains. Afterwards the gains were calibrated to the Greenhouse Gas Inventory (GHGI) and were used to project the FRL.

4. Forest reference level

4.1 Forest reference level and detailed description of the development of the carbon pools

The forest area was first determined utilizing the previous detailed mapping that was conducted by the Department of Forests as follows (Table 3):

Table 3. State and Private Forest and Other Wooded Land by species classification (area in hectares)

Main Forestry Species	Year of mapping	State Forests	Haliland Forests	Private Forests	Total
<i>Pinus brutia</i> community	1997	88790		48954	137744
<i>Pinus nigra</i> community	1997	2640			2640
Mixed <i>brutia – nigra</i> community	1997	2330			2330
Mixed <i>Olea europaea - ceratonia siliqua</i>	1997			5720	5720
<i>Eucalyptus</i> community (Plantations)	1997	137		260	397
Mixed <i>Pinus brutia – Quercus alnifolia</i>	1997	5870			5870
<i>Cedrus brevifolia</i> community	2012	102			102
Mixed <i>Cedrus brevifolia – Pinus brutia</i> community	2012	167			167
<i>Cedrus brevifolia</i> community plantations	2012	119			119
<i>Cupressus sempervirens</i> community	2012	6	218		223
Mixed <i>Cupressus sempervirens - Pinus brutia</i> community	2012	177	14		191
Mixed <i>Cupressus sempervirens - Quercus alnifolia</i> community	2012	2	5		7
Mixed <i>Cupressus sempervirens - Juniperus phoeniceae</i>	2012	3	4		7
Mixed <i>Cupressus sempervirens - Platanus orientalis</i>	2012		6		6
Mixed <i>Cupressus sempervirens - Olea europaea - ceratonia siliqua</i>	2012		1		1
Mixed <i>Juniperus oxycedrus - Pinus brutia</i>	2012	1			1
Mixed <i>Quercus alnifolia - Juniperus foetidissima</i>	2013	19			19
<i>Juniperus foetidissima</i> community	2013	211			211
Mixed stands <i>Juniperus (J. foetidissima) - Pinus nigra</i>	2013	31			31
Shrublands of <i>Juniperus excelsa</i>	2013	0	25		26
Mixed shrublands <i>Quercus alnifolia - Juniperus excelsa</i>	2013		2		2
Shrublands of <i>Juniperus foetidissima</i>	2013	5			5
Mixed shrublands of <i>Juniperus oxycedrus - Pinus brutia</i>	2013	2			2
Shrublands <i>Juniperus phoenicea</i>	2013	4354	506		4860
Mixed scrublands of <i>Juniperus phoenicea</i> - Φρύγανα ή Λεμώνες	2013	754	750		1505
Mixed scrublands of <i>Juniperus phoenicea - Pinus brutia</i>	2013	0	11		11
Mixed shrublands of <i>Juniperus phoenicea - Olea europaea - ceratonia siliqua</i>	2013		214		214
<i>Quercus infectoria</i> community	2013	0	77		78
Mixed <i>Quercus infectoria - Quercus alnifolia</i>	2013		1368		1368
Riparian community (<i>Platanus and Alnus</i>)	2013	1460	610		2070
<i>Salix alba</i> community	2013		45		45
		107181	3854	54934	165969

From this, the area of conifers and broadleaves was determined and kept constant for the calculations. The total area for the reference period was 147.726,3 ha as follows:

	Area for FRL (ha)
Coniferous	143767,9
Broadleaves	3958,4
Total	147726,3

The average increment per hectare per year for the conifers was determined from calculation derived from inventories taken in 2001 and 2011 for Pinus brutia plots in the state forest and was found to be 0,903 m³/ha/year. Even though, there is some data available for the diameter classes of the trees, the increment per diameter class was not determined at this stage. Harvesting was assumed to be constant.

Emissions were calculated for conifers as follows:

<u>Coniferous Forest</u>	
$\Delta CG = A * Gw * (1+R) * CF$	
A - Coniferous Forest land (ha)	143767,875
Iv/A	129768,795
Gw=Iv*BCEFI	
Iv= m ³ /ha/yr	0,903
BCEFI= t dm/m ³	0,450
Gw (tdm/ha/y)	0,406
R	0,280
CF (tC)* wood	0,470
ΔC Biomass (tC/yr)	35.131,008
Emissions (ktCO ₂)	-128,814

For broadleaves the default value used in the NIR was used as well as the average harvest volume for the reference period used in the calculations for the NIR.

Emissions for broadleaves were calculated as follows:

<u>Broadleaved Forest</u>	
$\Delta CG = A * Gw * (1+R) * CF$	
B - Broadleaved Forest land (ha)	3958,4
Iv/A	
Gw=Iv*BCEFI	
Iv= m ³ /ha/yr	2,000
BCEFI= t dm/m ³	0,550
Gw (tdm/ha/y)	1,100
R	0,280
CF (tC)* wood	0,470

Broadleaved Forest	
Δ CG (tC/yr)	2.619,511
H (m ³ /yr)*{average 2001-2011}	1.116,964
BCEFR (t biomass/m ³ wood volume)	0,890
R	0,280
CF (tC/t biomass) wood	0,470
Δ CL(wood-removals) (tC/yr)	598,049
Δ CBiomass (tC/yr)= Δ CG- Δ CL	2.021,461
Emissions (ktCO ₂)	-7,412

Since a constant harvesting rate and a constant increment was applied, removals for the period 2010-2025 from living biomass were constant as follows:

	Year	Conifers	Broadleaves	Estimated total removals from living biomass in ktCO₂
1	2010	-128,8	-7,4	-136,2
2	2011	-128,8	-7,4	-136,2
3	2012	-128,8	-7,4	-136,2
4	2013	-128,8	-7,4	-136,2
5	2014	-128,8	-7,4	-136,2
6	2015	-128,8	-7,4	-136,2
7	2016	-128,8	-7,4	-136,2
8	2017	-128,8	-7,4	-136,2
9	2018	-128,8	-7,4	-136,2
10	2019	-128,8	-7,4	-136,2
11	2020	-128,8	-7,4	-136,2
12	2021	-128,8	-7,4	-136,2
13	2022	-128,8	-7,4	-136,2
14	2023	-128,8	-7,4	-136,2
15	2024	-128,8	-7,4	-136,2
16	2025	-128,8	-7,4	-136,2

The Harvested Wood Products were calculated as in the NIR using the average values for the period 2000-2009 and extrapolated to 2025. Below is the actual data as reported from FAOSTAT for the NIR.

Year	Code 1861			Code 1872			Code 1873			Code 1876		
	Roundwood			Sawnwood			Wood-Based Panels			Paper+Paperboard		
	Production	Imports	Exports	Production	Imports	Exports	Production	Imports	Exports	Production	Imports	Exports
1990	62800	4050	10	22000	72400	0	13800	78100	900	0	34800	0
1991	53800	4149	0	16430	64000	0	11400	63700	200	0	43300	0
1992	45100	2968	1622	14160	108932	1518	12100	60025	2009	0	62716	741
1993	53100	2618	216	17160	90218	1197	22000	61481	267	0	48480	1853
1994	46500	4600	0	14900	98000	200	22000	61400	0	0	49200	200
1995	48000	3500	0	14900	121900	150	21000	59700	0	0	50200	300

1996	45100	2900	0	15600	76900	3900	21000	51200	1500	0	49100	1400
1997	41000	13500	0	13600	90900	5500	20100	69900	2800	0	50600	1400
1998	35342	0	0	11290	95000	5500	19300	51600	2800	0	53500	2500
1999	36451	0	0	11750	95050	8175	20500	48250	4200	0	55200	2550
2000	20580	2110	4	8740	66800	1350	12200	79280	152	0	54610	1026
2001	18310	3100	60	8600	77280	160	4200	107240	80	0	55540	230
2002	15430	2280	0	7460	84480	240	2600	132020	80	0	57710	340
2003	11990	781	0	5645	183085	397	2340	112761	94	0	60216	2656
2004	10058	777	0	4953	120907	188	1900	118613	190	0	67516	402
2005	9656	493	0	4255	134780	210	1718	165368	166	0	63614	21
2006	7437	787	0	3850	120312	159	2500	125590	124	0	105003	48
2007	19672	698	1	8717	157497	0	2534	139268	349	0	71408	118
2008	19831	520	0	9657	115605	572	2312	141249	268	0	74925	37
2009	9878	944	0	4571	63263	0	1396	94224	154	0	67360	61
2010	8958	594	0	3971	73642	0	1067	102958	167	0	75795	291
2011	8495	611	0	2909	56045	0	480	90017	16	0	74063	145
2012	10990	2252	0	2628	35129	0	12	60351	14	0	59100	73
2013	9399	1668	0	2241	28982	5	8	50388	27	0	55192	232
2014	8810	1560	0	2390	33160	0	5	53860	1	0	55660	4
2015	10595	2444	0	1865	33380	0	10	46996	0	0	52052	35
2016	15738	2473	0	1718	39762	0	6	66089	7	0	53433	48
2017	15529	2838	0	1146	41142	0	7	81872	0	0	52642	82
Average 2000-2009	14284	1249	7	6645	112401	328	3370	121561	166	0	67790	494

The results of Harvested Wood Products for the FRL were as follows:

Inventory Year	Gg CO ₂ /yr Stock Change	Gg CO ₂ /yr Atmospheric Flow	Gg CO ₂ /yr Production	Gg CO ₂ /yr Annual harvest	Gg CO ₂ /yr Annual CO ₂ release	Gg CO ₂ /yr Total Contribution
1990	-143	74	-6,56	-67	60	-7
1991	-127	82	1,39	-57	59	1
1992	-186	90	5,10	-48	53	5
1993	-155	84	-9,58	-57	47	-10
1994	-165	86	-4,86	-50	45	-5
1995	-186	88	-4,10	-51	47	-4
1996	-125	88	-7,12	-48	41	-7
1997	-155	103	4,24	-44	48	4
1998	-137	103	-2,38	-38	35	-2
1999	-132	103	-5,50	-39	33	-5
2000	-138	127	12,98	-22	35	13
2001	-173	136	22,07	-20	42	22
2002	-204	165	24,06	-16	41	24
2003	-271	118	25,41	-13	38	25
2004	-227	124	25,58	-11	36	26
2005	-277	135	25,95	-10	36	26
2006	-276	147	25,58	-8	34	26
2007	-258	149	18,59	-21	40	19
2008	-225	148	16,72	-21	38	17

2009	-106	150	23,98	-11	35	24
2010	-183	172	19,15	-15	34	19
2011	-182	173	18,67	-15	34	19
2012	-181	175	18,19	-15	33	18
2013	-179	176	17,73	-15	33	18
2014	-178	178	17,27	-15	33	17
2015	-176	180	16,83	-15	32	17
2016	-174	182	16,54	-15	32	17
2017	-172	184	16,12	-15	31	16
2018	-170	186	15,71	-15	31	16
2019	-168	188	15,31	-15	31	15
2020	-166	190	14,91	-15	30	15
2021	-164	192	14,53	-15	30	15
2022	-162	194	14,15	-15	29	14
2023	-160	196	13,78	-15	29	14
2024	-158	197	13,42	-15	29	13
2025	-156	199	13,07	-15	28	13

4.1 Consistency between the forest reference level and the latest national inventory report

Comparison of FRL and NIR

Forest Area

	Area used for calculations for FRL (ha)	Average Area for 2001-2011 from NIR (ha)
Coniferous	143767,9	157423,0
Broadleaves	3958,4	642,9
Total	147726,3	158065,9

Emissions calculated for NIR2019 and FRL (2011-2017)

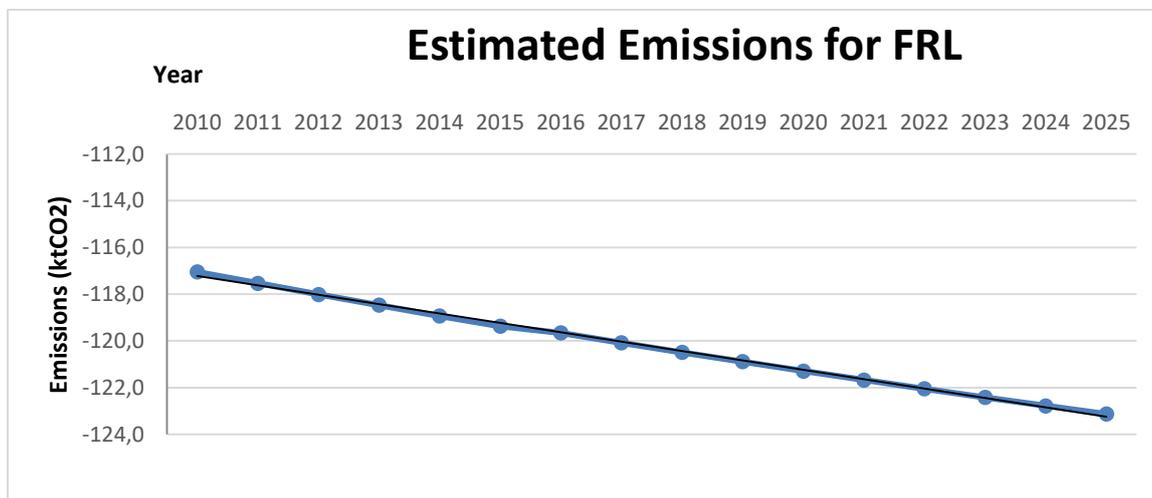
	NIR2019			FRL		
	F -> F	HWP	Total	Living biomass	HWP	Total
2010	-90,5	24,7	-115,2	-136,2	19,15	-117,1
2011	-130,4	24,6	-105,8	-136,2	18,67	-117,5
2012	-123,5	23,7	-99,7	-136,2	18,19	-118,0
2013	-140,1	24,0	-116,1	-136,2	17,73	-118,5
2014	-141,5	23,2	-118,2	-136,2	17,27	-118,9
2015	-140,7	23,3	-117,4	-136,2	16,83	-119,4
2016	116,6	23,6	140,2	-136,2	16,54	-119,7
2017	-130,1	23,6	-106,4	-136,2	16,12	-120,1

Except for year 2016 the rest of the removals/ emissions are quite comparable. In 2016 due to forest fires Cyprus reported net emissions from Forest Land.

4.2 Calculated carbon pools and greenhouse gases for the forest reference level

The final emissions were calculated by adding emissions from the production method for Harvested Wood Products to the estimated emissions from living biomass (+ signs=emissions, - signs=removals). The final results are shown below:

	Year	Estimated total removals from living biomass in ktCO ₂	HWP	Total Emissions (ktCO ₂)
1	2010	-136,2	19,15	-117,1
2	2011	-136,2	18,67	-117,5
3	2012	-136,2	18,19	-118,0
4	2013	-136,2	17,73	-118,5
5	2014	-136,2	17,27	-118,9
6	2015	-136,2	16,83	-119,4
7	2016	-136,2	16,54	-119,7
8	2017	-136,2	16,12	-120,1
9	2018	-136,2	15,71	-120,5
10	2019	-136,2	15,31	-120,9
11	2020	-136,2	14,91	-121,3
12	2021	-136,2	14,53	-121,7
13	2022	-136,2	14,15	-122,1
14	2023	-136,2	13,78	-122,4
15	2024	-136,2	13,42	-122,8
16	2025	-136,2	13,07	-123,1



Overall removals show an increasing trend due to decreasing emissions from the Harvested Wood Products pool.

Year	Conifers	Broadleaves	Estimated Removals from living biomass in ktCO ₂	HWP	Total Emissions (ktCO ₂)
2021	-128,8	-7,4	-136,2	14,53	-121,7
2022	-128,8	-7,4	-136,2	14,15	-122,1
2023	-128,8	-7,4	-136,2	13,78	-122,4
2024	-128,8	-7,4	-136,2	13,42	-122,8
2025	-128,8	-7,4	-136,2	13,07	-123,1
AVERAGE Emissions for the period 2021 – 2025 (FRL)					-122,4

Conclusively, the Forest Reference Level for Cyprus for the period 2021-2025, taking into account emissions/removals from Living Biomass and Harvested Wood Products pools, has been estimated to be **-122,4 ktCO₂** per year, thus overall, these pools are considered to be net removals.

5. References

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