RMK's CARBON REPORT 2021

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Introduction

The Climate Change Department of the Estonian State Forest Management Centre (RMK) has compiled this Carbon Report, which provides an overview of the quantities of carbon removed and emitted by RMK in 2021. The **fluxes of three greenhouse gases (CO_2, CH_4 and N_2O)** have been taken into account and expressed as CO_2 equivalent values based on the global warming potential of these gases[1].

In compiling the Carbon Report, greenhouse gas fluxes from RMK-managed lands and emissions from RMK's activities were considered. In addition, the carbon stock of all forests and land managed by RMK, i.e., the quantity of carbon stored in soil and woody biomass, was calculated.

Given that climate change is associated with increasing concentrations of carbon dioxide (CO_2) in the atmosphere, the Carbon Report helps to assess RMK's carbon footprint and make decisions on how to reduce it.

When reading the following pages, it is important to keep in mind that **while trees sequester carbon dioxide (CO_2), biomass and soil store carbon (C)**. In terms of molecular weight, one tonne of carbon is equivalent to about 3.7 tonnes of carbon dioxide.

In the calculations made for the purpose of this Carbon Report, carbon sequestration values are presented with a plus sign, while the quantities of carbon emitted to the atmosphere, i.e., carbon emissions, are presented with a minus sign. All inbound and outbound carbon fluxes were assessed for the purpose of determining the carbon balance. The quantities of carbon removed from forests as a result of regeneration cutting and taken into active use are also included in the carbon balance.

[1] https://unfccc.int/process/transparency-and-reporting/greenhouse-gas-data/greenhouse-gas-data-unfccc/global-warming-potentials

Calculations

As a result of state forest inventory, the forest growing stock and increment have been estimated. In addition, descriptions of growing stock on non-forest land were compiled based on remote sensing.

Carbon stock and sequestration are calculated on the basis of forest inventory data. In order to determine the carbon stock, the quantities of carbon stored in woody biomass (separately for each tree species) and carbon stock in the soil are calculated. Carbon sequestration is calculated on the basis of the current annual increment estimated separately for each tree species growing in a particular sub-compartment. To this is added other plant production: branches, roots, leaves, needles, and underbrush and ground vegetation. Soil respiration, or emission from the soil, has been calculated for both mineral and peat soils on the basis of the results previously estimated in scientific studies.

Carbon sequestration has been estimated using the NEP [1] (net ecosystem production) method, which assesses whether an ecosystem acts as a sink or source of carbon. Based on that method, the total plant production that sequesters carbon through photosynthesis was calculated, and quantities emitted from the soil through soil respiration were deducted from it. The difference between plant production and soil respiration indicates whether an ecosystem is a carbon sequestering or a carbon emitting ecosystem.

In order to calculate the carbon stock stored in wood and the carbon sequestration through forest increment, the stem volume must be converted to **stem mass**. Carbon calculations are always made on a dry mass basis, and wood density [2, 3] at absolutely dry (oven-dry) mass must be used to convert volume units to mass units. Different tree species have different wood densities. In the calculation of the carbon stock and sequestration in RMK-managed forest land, all tree species growing there were taken into account. Since forest management has a significant impact on the carbon stock of forest land, the quantity of carbon removed from forests through regeneration cutting was also taken into account in determining the balance.

In addition to stem mass, biomass also includes branches, roots, leaves and needles. Based on previous research and biomass models developed for Estonia, the proportions of different biomass components and the proportions of the production of the different biomass fractions were calculated. Generally speaking, **80% of all woody biomass is located above ground and 20% is located below-ground.**

Depending on the tree species, stems account for 80–90% of the total above-ground biomass. The proportion of carbon varies in the different parts of the tree. For example, carbon tends to account for 48–52% in the crown and stem. In the calculations of the carbon balance, it was assumed that **50% of the dry mass of wood is carbon.**

The stocks of soil carbon in forest land and other land categories have been estimated on the basis of soil maps and the quantities of carbon in different soils as reported in published research [29–34]. For other land categories, the volume of wood was estimated by way of remote sensing and, on this basis, carbon stocks in the wood were calculated.

The calculations and inputs for carbon stocks and balances for forests and other land categories have been reviewed by Prof. Veiko Uri (Academician, Estonian University of Life Sciences). The inputs for the calculation of the carbon balance have been taken from published research [1, 3–28]. Staff of the Environment Agency tasked with the preparation of LULUCF[2] reports for the European Union [28], were also consulted on the calculation of the carbon balance.

For the estimation of emissions arising from RMK's activities, the source data were taken from RMK's accounting and property reports. The Estonian Environmental Research Centre was consulted for the calculation of the carbon balance and the specification of inputs. The specific carbon emissions and calorific values published in the State Gazette were also used as inputs [35, 36]. The same emission factors were used for the calculation as for the Estonian GHG inventory [37, 38]. The list of sources is given at the end of the report. A calculation example based on one forest sub-compartment is also given at the end of the report.

[2] LULUCF stands for land-use, land-use change and forestry.

Carbon stock

The carbon stock shows how much carbon is stored in a given place at a given point in time. When calculating the carbon stock, the carbon contained in the soil and the carbon stored in the above-ground (stem, crown) and below-ground parts (roots) of trees are taken into account.

The tables below show the distribution of carbon in wood and soil on both forest land and non-forest land. The carbon stocks in protected and managed forests are indicated separately.

Distribution of RMK's forest land:

- protected forests – 0.41 million ha
- managed forests – 0.64 million ha
- total forest land – 1.05 million ha

In 2021, the carbon stock of lands placed under the administration of RMK amounted to 258.9 million tonnes.

- 2/3 of the carbon was stored in soil and 1/3 in trees.
- Forest land stores 219.5 million tonnes of carbon (85% of the stock).
- Non-forest land stores 39.5 million tonnes of carbon (15% of the stock).

Table 1. Distribution of carbon in RMK's forest land (1.05 million ha)

	In wood			In soil	**Total in wood and soil**
	Protected forests	Managed forests	Total forests		
Growing stock (million m³)	90.7	106.1	196.8	–	**196.8**
Carbon stock (million t)	32.7	38.6	71.3	148.2	**219.5**
Carbon stock per hectare (t/ha)	79.8	60.4	68.0	141.4	**209.4**

Table 2. Distribution of carbon in RMK's non-forest land (0.38 million ha)

	In wood	In soil	**Total**
Carbon stock (million t)	1.97	37.5	**39.5**
Carbon stock per hectare (t/ha)	5.2	98.6	**103.8**

Carbon sequestration

In 2021, RMK's forests, forest land and non-forest land sequestered 5.67 million tonnes of CO_2 from the atmosphere.

- Growing forests sequestered the largest share of CO_2 (5.48 million tonnes), while 0.19 million tonnes of CO_2 were sequestered on other types of land.
- Through regeneration cutting, -2.89 million tonnes of CO_2 were removed from forests in timber.
- The quantity of carbon sequestered in RMK's forests, forest land and non-forest land, adjusted for regeneration cutting, was 2.78 million tonnes of CO_2.
- Managed forests are more productive than protected forests, sequestering 0.5 tonnes CO_2 more per hectare each year.

Table 3. shows carbon sequestration in the first and second layers of the stand and in the underbrush, net of emissions from the soil and the quantity of carbon sequestered through regeneration cutting.

Carbon accounting is based on timber harvested through regeneration cutting, as it has the largest impact on carbon accounting. Tending involves logging the wood that has already fallen out of the stand naturally or would fall out in the near future due to competition in the stand. However, fallen trees are no longer carbon sinks, but instead emit carbon as their organic matter decomposes. Tending enhances the positive climate impact of forest management, as the remaining trees will grow faster and will also produce higher-quality wood that can be used in long-life products. This, in turn, also allows us to mitigate climate change through the substitution effect – we use less non-renewable materials.

In 2021, RMK took 3.13 million m^3 of timber out of forests through regeneration cutting. The average oven-dry density of the wood taken out through regeneration cutting was assumed to be 500 kg/m^3, which is the average oven-dry density of the three main tree species, and the proportion of carbon was assumed to be 50%. The result was multiplied by 3.7 to convert carbon to carbon dioxide. Thus, -2.89 million tonnes of CO_2 were removed through regeneration cutting.

For the other land categories, total sequestration was obtained by adding up the carbon sequestration values for different types of land. Wetland communities are the main sink, locking carbon in peat. The remote sensing method can be used to estimate the volume of wood in other categories of land, but not the increment. Therefore, carbon sequestration in other categories of land is probably underestimated, as the carbon sequestered in woody biomass is missing.

Table 3. Carbon sequestration on RMK's forest land and other categories of land

2021	Protected	Managed	Total
Area of forest land (ha)	409,752	638,577	1,048,329
CO_2 sequestration: layer I, stems, branches and roots (t)	3,583,373	6,469,404	10,052,777
CO_2 sequestration: layer II (t)	156,542	306,613	463,155
CO_2 sequestration: underbrush/ground vegetation (t)	3,790,205	5,906,836	9,697,041
CO_2 emissions from soil (t)	-5,520,219	-9,207,734	-14,727,953
CO_{2e} sequestration on forest land	**2,009,901**	**3,475,119**	**5,485,020**
CO_2 sequestration, tonne per hectare (t/ha/year)	**4.91**	**5.44**	**5.23**

Area of other categories of land (ha)	380,315
CO_2 sequestration in other categories of land (t)	**188,598**

Volume of regeneration cutting in 2021 (m^3)	3,130,000
Carbon removed through regeneration cutting (CO_2 t)	**-2,895,250**

Area of land under the administration of RMK (ha)	1,428,644
CO_2 sequestration on land under the administration of RMK (t)	**2,778,368**

Carbon emissions

Total emissions from RMK's activities in 2021 amounted to -65,041 tonnes of CO_2, which is 1% of the quantity of carbon sequestered on RMK's land during the year.

The main source of carbon emissions from RMK's activities is forestry operations, where CO_2 emissions mainly result from the use of motor fuels.

Carbon emissions from RMK's activities	CO_2 t
Forestry operations	-47,442
Forest improvement	-8,206
Forest planting	-668
Nature conservation-related operations	-1,152
Staff transport	-1,908
Offices	-1,779
Nurseries	-1,342
Other real estate	-2,294
Põlula Fish Farm	-250
Total	**-65,041**

Carbon emissions for the most important types of operations are detailed below.

FORESTRY OPERATIONS

Forestry operations emitted -47,442 tonnes of CO_2 in 2021. The table below shows how this figure was determined.

Table 4. CO_2 emissions from different types of forestry operations

Type of work (unit)	Quantity	Fuel consumption per unit	Fuel consumption, l	CO_2 emission, t
Clear cutting, shelterwood cutting, deforestation: cutting operations and transportation (m^3)	2,900,585	1.2 l/m^3	6,961,400	-18,167
Thinning, salvage cutting, design cutting: cutting operations and transportation (m^3)	612,454	2 l/m^3	2,449,800	-6,392
Energy timber harvesting (m^3)	229,126	2.1 l/m^3	481,200	-1,255
Energy timber chipping (m^3)	276,972	1.39 l/m^3	385,000	-1,003
Roundwood transportation (m^3)	3,591,574	48 l/100 km		
Average load volume (m^3)	33.2			
Average distance of roundwood transportation (km)	69			
Roundwood loads (number)	108,180		7,165,800	-18,700
Wood chip transportation (m^3)	276,403	38 l/100 km		
Average load volume (m^3)	32.4			
Average distance of wood chip transportation (km)	51			
Wood chip loads (number)	8,531		330,700	-863
Brush cleaning (ha)	40,703	10 l/ha	407,000	-1,062
Total				**-47,442**

FOREST IMPROVEMENT

The carbon footprint of forest improvement operations in 2021 amounted to -8,206 tonnes of CO_2, estimated on the basis of the quantity of fuel consumed for the operations. The largest contribution came from the construction of roads and the reconstruction of ditches.

Table 5. CO_2 emissions from forest improvement operations

Type of work (unit)	Area	Fuel consumption (l)	CO_2 emissions (t)
Reconstruction of ditches (ha)	16,987	662,153	-1,728
Maintenance of ditches (ha)	22,917	266,991	-697
Construction of roads (km)	319	1,537,430	-4,012
Maintenance of roads (km)	35,814	677,878	-1,769
Total		3,144,452	**-8,206**

FOREST PLANTING OPERATIONS

In 2021, the carbon footprint of operations that precede forest planting amounted to -668 tonnes of CO_2, estimated on the basis of the quantity of fuel consumed for the operations.

Table 6. CO_2 emissions from forest planting operations

Type of work (unit)	Area	Fuel consumption (l)	CO_2 emissions (t)
Preparation of land: plough (ha)	8,105	64,330	-381
Preparation of land: stub flipper (ha)	919	145,890	-168
Planting machine (ha)	423	42,300	-110
Pine sowing, plough (ha)	200	3,600	-9
Total		256,120	**-668**

NATURE CONSERVATION-RELATED OPERATIONS

In 2021, the carbon footprint of nature conservation-related operations amounted to -1,152 tonnes of CO_2, estimated on the basis of the quantity of fuel consumed for the operations. The largest CO_2 emissions were generated by ditch closure operations, as well as logging and transportation during nature conservation-related operations.

Table 7. CO_2 emissions from nature conservation-related operations

Type of work (unit)	Area	Fuel consumption (l)	CO_2 emissions (t)
Chopping (ha)	227	24,970	-65
Shredding (ha)	413	61,950	-162
Closing ditches (km)	238	154,462	-403
Construction of dams (number)	2,311	92,440	-241
Nature conservation-related logging and transportation (m^3)	42,071	100,970	-264
Brush cutting (ha)	398	3,980	-10
Other operations (ha)	85	2,550	-7
Total		441,322	**-1,152**

STAFF TRANSPORT

The carbon footprint of RMK's staff transport amounted to -1908 tonnes of CO_2 in 2021. During the year, a total of 7.8 million km was driven by company and private cars. For company cars, the actual fuel consumption was used to estimate CO_2 emissions, while the average fuel consumption for private cars was assumed to be 7 litres per 100 kilometres.

Table 8. CO_2 emissions from the transport of RMK's staff

Work-related trips	Km covered	Fuel consump-tion (l)	CO_2 emissions (t)
Company cars	5,915,466	598,224	-1,561
Private cars	1,900,000	133,000	-347
Total	**7,815,466**	**731,224**	**-1,908**

RMK'S REAL ESTATE

The total carbon footprint of the use of all RMK's real estate amounted to -5665 tonnes of CO_2 in 2021. The carbon footprint of RMK's offices was -1779 tonnes of CO_2 in 2021. On average, this translates into an annual footprint of -3.8 tonnes of CO_2 per office employee. RMK's real estate includes visitor centres as well as auxiliary buildings, with the Sagadi manor complex having the largest footprint (-1,211 tonnes of CO_2). All types of energy used and factors that generate carbon emissions were taken into account in the calculation of the footprint.

Table 9. CO_2 emissions from the use of RMK's real estate

	CO_2 emissions (t/y)
RMK's offices	-1,779
RMK's nurseries	-1,342
Põlula Fish Farm	-250
Other real estate	-2,294
Total	**-5,665**

The footprints of RMK's offices can be compared in Table 10.

Table 10. CO_2 footprint of RMK's offices

	CO_2 emissions (t/y)	
Office	Per office	Per person
Ahtme office	-27.2	-1.9
Antsla office	-37.5	-7.5
Avinurme office	-4.6	-0.8
Erastvere office	-29.1	-3.2
Iisaku office	-29.7	-2.0
Kihelkonna office	-35.7	-3.2
Kärdla office	-58.4	-3.9
Käru office	-22.8	-3.3
Laiksaare office	-97.8	-9.8
Laiuse office	-45.0	-3.5
Loobu office	-68.9	-4.6
Märjamaa office	-12.2	-2.0
Paikuse office	-124.7	-11.3
Piirsalu office	-26.6	-2.4
Pikknurme office	-23.5	-2.6
Rapla office	-22.6	-1.7
Rava office	-27.0	-2.1
Ristipalo office	-88.5	-3.4
Sagadi office	-11.5	-1.1
Sonda office	-19.8	-2.0
Surju office	-65.5	-4.7
Taali office	-63.9	-6.4
Tallinn office	-376.0	-5.9
Tartu office	-219.6	-3.9
Triigi office	-58.7	-5.9
Ussimäe office	-53.2	-4.1
Valga office	-33.4	-2.8
Varbla office	-25.4	-3.6
Võru office	-39.6	-2.6
Õisu office	-30.1	-1.7
Total	**-1,779**	**-3.8**

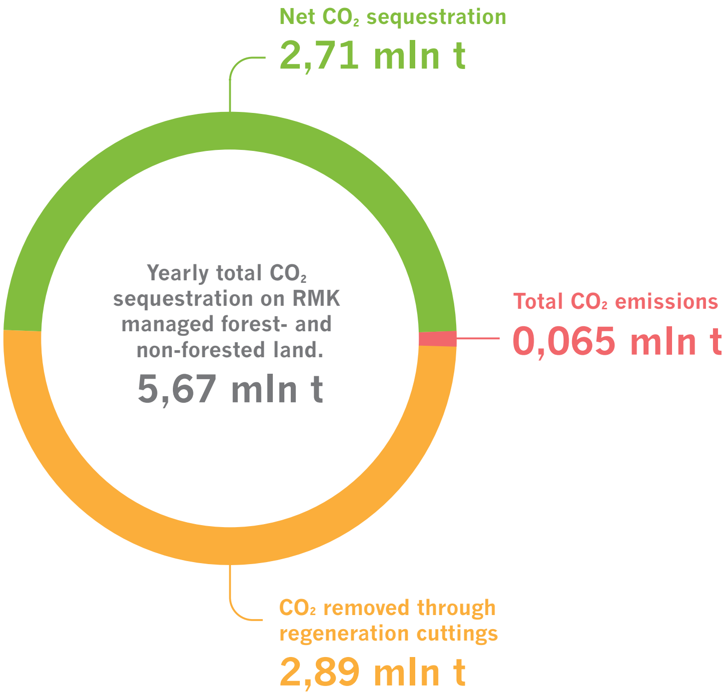
Carbon Report in summary

If we subtract from the carbon sequestered in RMK's forests and other types of land (5.67 million tonnes of CO_2) the carbon removed from forests through regeneration cutting (-2.89 million tonnes of CO_2) and the carbon emissions related to RMK's activities (-0.065 million tonnes of CO_2), the result is a positive carbon footprint, with 2.71 million tonnes of CO_2 sequestered in RMK's forests and other types of land in 2021.

The Ministry of the Environment has released preliminary GHG inventory data for Estonia for 2020; the final report will be available in April 2022. According to the preliminary data, Estonia emitted -11.58 million tonnes of CO_{2e} in 2020, most of which (-8.29 million tonnes) was emitted by the energy and transport sectors. A comparison of these figures shows that the **carbon sequestered in RMK's forests and land covers a quarter of Estonia's annual carbon emissions.**

RMK manages half of Estonia's forest land. Sustainable forest management is one of the ways – if not the only way – to sequester large quantities of carbon from the atmosphere. Through smart forest management, by channelling timber into long-term products and by renewing forests quickly and with high quality, RMK can make a significant contribution to climate change mitigation.

Knowing RMK's carbon balance makes it possible to estimate and reduce CO_2 emissions from different activities. For example, holding meetings virtually, not printing unnecessary materials, and sorting and reducing waste is a good start. Thanks to carbon accounting, we can measure and direct the processes which enable more carbon to be sequestered in forests and greenhouse gas emissions from forest management to be reduced.



Calculation example

Please find below a calculation example that illustrates how the figures were determined for the Carbon Report. A middle-aged pine stand in Pärnu County, growing in a myrtillus site type, has been chosen for this purpose. It is a fertile forest with spruce growing in the first layer in addition to pine. The available data for this forest are as follows.

Compartment No. VD254, sub-compartment 3					Reserve in the sub-compartment (m^3)			Annual increment in the sub-compartment (m^3)	
Site type	Area (ha)	h100 (m) (predicted height at 100 years)	Composition	Age (y)	Pine	Spruce	Dead wood	Pine	Spruce
Myrtillus	2.13	29.4	85MA15KU (85% pine, 15% spruce)	58	492.59	86.93	10.65	14.23	2.51

CARBON STOCK

In order to find the carbon (C) stock stored in this forest sub-compartment, it is first necessary to **switch from cubic metres to mass units**. Oven-dry wood density is 470 kg/m^3 for pine and 420 kg/m^3 for spruce. Therefore, we multiply the cubic metres by the oven-dry wood density and convert the result to tonnes. Thus, we obtain a **stem mass** of 231.5 t for pine and 36.5 t for spruce.

Calculation of stem mass
Pine: 492.59 m3 = 492.59 x 470 = 231,517 kg = 231.5 t
Spruce: 86.93 m3 = 86.93 x 420 = 36,510 kg = 36.5 t

Since, in addition to stem mass, other above-ground biomass and below-ground biomass are also important, we use the biomass ratios between the different fractions derived from scientific studies to determine them. For pine and spruce, stem mass represents 90.2% and 80%, respectively, of the total above-ground biomass. **Above-ground biomass** is therefore 256.7 t for pine and 45.6 t for spruce.

Calculation of above-ground biomass
Pine: 231.5 x 100 / 90.2 = 256.7 t
Spruce: 36.5 x 100 / 80 = 45.6 t

Below-ground biomass accounts for 20% of the total biomass for pine and 21% for spruce. **Below-ground biomass** is therefore 64.2 t for pine and 12.1 t for spruce.

Calculation of below-ground biomass
Pine: 256.7 x 20 / 80 = 64.2 t
Spruce: 45.6 x 21 / 79 = 12.1 t

Adding up the above-ground and below-ground biomass figures, we obtain the **total biomass** of 320.9 t for pine and 57.7 t for spruce.

Calculation of total biomass
Pine: 256.7 + 64.2 = 320.9 t
Spruce: 45.6 + 12.1 = 57.7 t

Dead wood was estimated at 10.65 m^3 in this stand. To calculate **the biomass of dead wood**, we use a density of 300 kg/ m^3. This gives a biomass of 3.2 t for the dead wood.

Calculation of the biomass of dead wood
10.65 x 300 = 3,195 kg = 3.2 t

Carbon accounts for 50% of the dry mass of wood. Thus, to determine the quantity of carbon in the wood of the sub-compartment under consideration, the above-ground and below-ground biomass of pines and spruces and the biomass of dead wood must be added up and then divided by two. **The total carbon stock in the wood of this sub-compartment** amounts to 190.9 t.

Calculation of carbon in wood
(320.9 + 57.7 + 3.2) / 2 = 190.9 t

A large part of the carbon is locked up in the soil. For soils in myrtillus site types, studies have estimated a carbon stock of 125.2 t/ha. In order to determine the **total soil carbon stock in the sub-compartment**, we multiply this estimate by the area of the sub-compartment (2.13 ha). The multiplication result is a soil carbon stock of 266.7 t.

Calculation of carbon in soil
2.13 x 125.2 = 266.7 t

The total carbon stock in the sub-compartment is determined by adding up the carbon in wood and soil. The result is 457.6 t.

Calculation of the total carbon stock in the sub-compartment
190.9 t + 266.7 t = 457.6 t

CARBON SEQUESTRATION

In order to assess whether a particular forest ecosystem is a carbon sink or source, it is necessary to estimate all inbound and outbound carbon fluxes.

Let us start with the increment. In the description of the sub-compartment, the stem increment is given as 14.23 m^3 per year for pine and 2.51 m^3 per year for spruce. These figures must first be converted to biomass in a similar way to the calculations of the forest reserve. The **annual increment of biomass** is 6.7 t for the stem mass of pine and 1.1 t for the stem mass of spruce.

Calculation of the annual increment of biomass in stems
Pine: 14.23 x 470 = 6,688 kg = 6.7 t
Spruce: 2.51 x 420 = 1,054 kg = 1.1 t

In the case of pine and spruce, a significant proportion of the biomass is also made up of needles, branches and roots. Forest ecosystem carbon studies conducted in Estonia indicate that only 37.7% of the total biomass bound in pine and 34.9% in spruce is produced in stems, the remainder being deposited in roots, branches and needles. In order to find the **total biomass added during the year**, these parts must also be included, resulting in 17.8 t for pine and 3.1 t for spruce.

Calculation of the annual increment of biomass in the sub-compartment
Pine: 6.7 x 100 / 37.7 = 17.8 t
Spruce: 1.1 x 100 / 34.9 = 3.1 t

Again, as the proportion of carbon is 50%, the figures obtained must be divided by two to find out **how much carbon is sequestered in the forest biomass during a year**.

Calculation of the mass of carbon sequestered in the sub-compartment during a year
Pine: 17.8 / 2 = 8.9 t
Spruce: 3.1 / 2 = 1.55 t

It should be remembered that the forest biomass stores carbon but sequesters carbon dioxide from the atmosphere, with 1 t of C equalling 3.7 t of CO_2. In this sub-compartment, **trees remove 38.7 t of CO_2 from the atmosphere during a year**.

Calculation of the quantity of CO_2 removed from the atmosphere by trees
(8.9 + 1.55) x 3.7 = 38.7 t

In order to assess whether this forest sub-compartment is a carbon sink or emitter, the quantity of **CO_2 sequestered by underbrush and ground vegetation** must also be taken into account. Scientists have estimated that, in similar forests, above-ground and below-ground parts of underbrush and ground vegetation sequester a total of 9.25 tonnes of CO_2 per hectare. In this sub-compartment, therefore, underbrush and ground vegetation remove 19.7 tonnes of CO_2 from the atmosphere per year.

Calculation of the quantity of CO_2 removed from the atmosphere by underbrush and ground vegetation
2.13 x 9.25 = 19.7 t

It is also important to determine the **emissions from the decomposition of organic matter in the soil**. Studies have estimated these to be 14.06 tonnes of CO_2 per hectare per year for the type of soil in question. The forest in question therefore emits 30 tonnes of CO_2 per year through soil respiration.

Calculation of CO_2 emissions from soil due to organic matter decomposition
2.13 x 14.06 = 30.0 t

Adding up the quantity of CO_2 sequestered by trees and the quantity of CO_2 sequestered by underbrush and ground vegetation and subtracting the quantity of CO_2 emitted through soil respiration gives the result of an **annual CO_2 sequestration of 28.4 tonnes in this stand**. Such a forest **sequesters 13.3 tonnes of CO_2 per hectare per year**.

Carbon sequestration in the sub-compartment (CO_2)
38.7 + 19.7 – 30.0 = 28.4 t

Carbon sequestration in the sub-compartment per hectare (CO_2)
28.4 / 2.13 = 13.3 t

P.S. In international climate reporting, carbon sequestration is usually indicated with a minus sign to show the decrease in carbon dioxide and other greenhouse gases in the atmosphere as a result of forest growth. In our calculations, we expressed carbon sequestration with a positive sign, because carbon sequestration is nothing but positive!

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