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Determining of Carbon Storage in Anatolian Black Pine Stands

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Abstract: One of the most important problems of today is global warming that occurs due to climate change that affects human life. Especially with the industrial revolution, the destruction of forests, the increase in the use of fossil fuel, the increase in the world's population, the increase in energy consumption and the increasing levels of greenhouse gas released into the atmosphere because of human activities such as distorted urbanization has increased more than normal. As a result of this increase, local, regional, international conferences and efforts to raise awareness have been initiated to prevent global warming threatening the future of the world. As a result, it was decided to limit the release of carbon dioxide, which is one of the most important measures that can be taken against global warming, has a high rate of presence between greenhouse gases and has a high rate of presence between greenhouse gases. In this context, the United Nations Framework Convention on Climate Change (UNFCCC), countries that are parties to the various sectors of greenhouse gas emissions, National Greenhouse Gas Inventory Report (NIR) has entered the obligation to report. In the NIR reports that need to be arranged every year, the amount of carbon stored by forests with an important carbon pool should be determined. Carbon in the forest areas, trees; it is stored in lifeless biomass consisting of litter, dead wood, soil organic matter and other substances with live biomass consisting of branches, foliage, stem and roots. In this study, the amount of carbon storage in the black pine stands of Balıkesir Forestry Regional Directorate, Dursunbey Forest Enterprise, Çamlık Forest Planning Unit was calculated based on ecosystem.

Keywords: Global warming, Carbon storage, Forest, Black pine.

1. INTRODUCTION

Forest ecosystems have an important potential in preventing global warming due to the excess of the carbon they connect in the unit area and their ability to keep this carbon within many years. Carbon pools in forest ecosystems are divided into 5 categories according to the 2006 guide of the International Climate Change Panel (IPCC, 2006). These are above-ground biomass, below-ground biomass, deadwood, Litter and soil organic matter. Countries on the Kyoto Protocol are obliged to inform the United Nations Climate Change on Framework (UNIDCS) by preparing a national greenhouse gas inventory report in various sectors. In this context, it is necessary to determine the amount of carbon stored by forests with an important amount of carbon. Within the scope of the National Greenhouse Gas Inventory Report, the carbon storage amounts of forests are determined while the agricultural, forestry and other land use (AFOLU) guide prepared by International Climate Change Panel (IPCC) is used. In this guide, 3 methods are recommended for calculating carbon emissions or carbon storage amounts caused by various sectors. These methods require calculation according to the data source; It is called tier1, tier2 and tier3. The simplest and basic method that requires minimum data is the tier1 method. In this method, carbon emissions are found by multiplying the amount of consumption with the emission factor calculated on a global scale. In the tier2, which is a high -level calculation method, carbon emissions are calculated by the approach in the tier1. The difference of the tier2 method from the tier1 method is to obtain the emission factor from the calculated values specific to the country. The most complex and precise predictions method is the tier3 method. In this method, emission factor is determined by inventory data or using previously developed models (Ravindranath & Ostwald, 2007). As the level used in these calculation methods recommended by IPCC, the reliability and accuracy of the estimation made increases. In this context, tier3 methods were used in this study. In this study, the amount of carbon storage of the Anatolian black pine, which naturally spread in the area corresponding to 18.3 % of the Turkish forested area, was calculated based on ecosystem.

2. MATERIALS AND METHODS

2.1. Study Area

In this study, Çamlık Planning Unit was selected as the research area within the boundaries of Dursunbey Forest Management Directorate of Balıkesir Forestry Regional Directorate in the west of Türkiye. There are Akdağ to the north of this planning unit, Gediktepe to the west, Kınık in the south, Musalar planning units to the east (Figure 1).

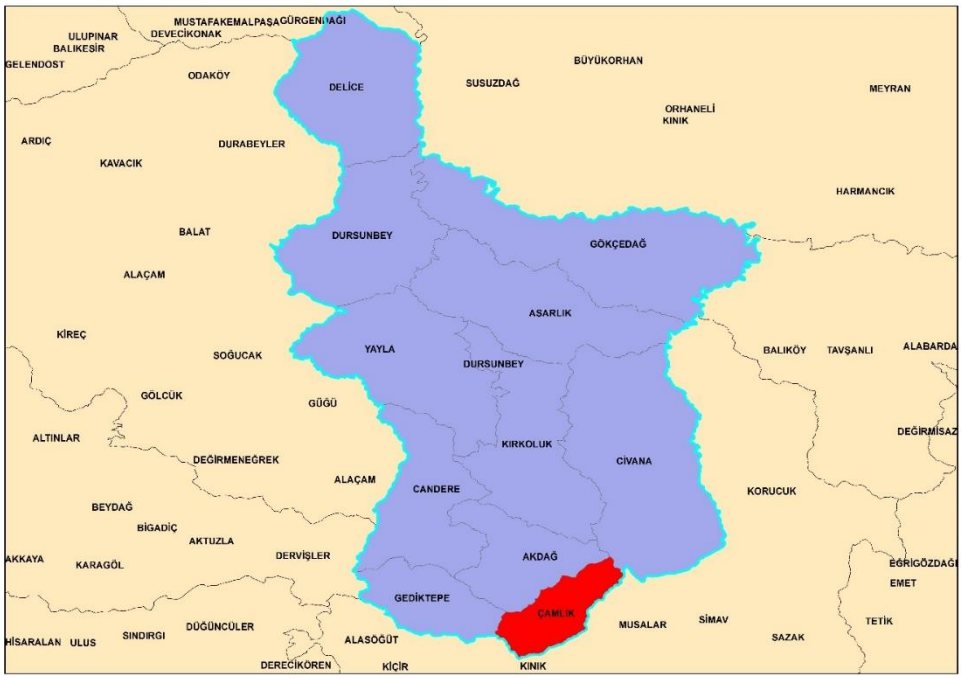

Figure 1. Study area.

Although the study area is located in the Aegean Climate Zone, the summers are cooler and the winters are harder. Vegetation time is quite short. Forest vegetation is typical and the dominant tree species include Anatolian black pine (*Pinus nigra* subsp.), Oak (*Quercus* sp.), Oriental beech (*Fagus orientalis* Lipsky.) and Lebanon cedar (*Cedrus libani* A. Rich.).

2.2. Determination of the Carbon Stored in the Tree

In the sample plots selected, a tree that can represent a sample plot is selected as a sample tree. The sample tree is cut from a height of 0.3 m and divided into sections and diameter measurement is made every two meters. The age and height of the sample tree are determined. All branches are separated from the body to measure diameter and height. A branch representing all branches is selected as an example branch and separated from the foliage. All sample foliage and branch weights are determined. 5-7 cm thick cross-section is taken from a portion of the sample tree. All samples taken are transported to the laboratory (Mısır et al., 2012).

2.3. Determining the Amount of Litter, Living Cover and Dead Wood Carbon

In the sample plots, there are trees as well as different herbaceous and woody species. To determine the carbon stored by these herbaceous and woody species; In each sample plot, 2 pieces of sampling plots are formed at the points determined by random method. The covering degrees of the living cover entering the area are determined and the living covers in the area are cut from the soil surface and weighed. To determine the amount of litter accumulated on the soil surface, the litter is collected in the sampling areas of 25 x 25 cm at 4 points determined by random method. In addition, for the sample deed wood sampling in the sample plots, 1x1 m samples are collected from 2 points where it is randomly determined (Mısır et al., 2011).

2.4. Determination of Carbon Stored Below-Ground

To determine the amount of below-ground carbon storage; The root sample is determined, and the root pit is opened around 80x120 cm. A corner of the root pit is close to the tree and the corners of the root pit are determined and removed by digging litter on it. The soil pit is started to be opened by paying attention not to overflow beyond the specified boundaries. Excavation depth is up to the depth of the roots. Roots removed from the root pit are classified as fine (0-2 mm), small (2–5 mm) and coarse root (5–10 mm) (Yavuz et al., 2010).

2.5. Determining the Amount of Carbon Stored in Soil

Soil samples are taken by using the pit excavated for the root. 0-10, 10-30, 30-50, 50-80 and more than 80 cm, including different depth levels, using the soil cylinder.

2.6. Laboratory Work

The samples taken during the field studies are transported to the laboratory for the necessary measurements and analysis. The stem and branch wood samples brought to the laboratory are measured. With the aid of sections made in sample trees, each sample tree has a total stem volume. Then, to determine the dry weights of the stem, branches, foliage and bark, to reach the unchanging weight of 105 ± 3 ºC in the drying oven, the stem and branch samples are dried by waiting for 72 hours and the samples of the samples are dried by waiting for 24 hours and the dry weight values of the samples are recorded by weighing. The shell weight of the stem sections, which have become oven dried, is measured and volume is made, then the shell is peeled, and the shell is measured again, and the dry weight is measured. Litter, living cover and dead wood samples are also made of oven and their weights are measured. After the root samples are kept in water for 24 hours, they are washed and removed from the soil and litter, the washed roots are divided into three classes as fine (0–2 mm), small (2–5 mm) and coarse root (5–10 mm), 65 ºC in the drying oven. It dries for 24 hours. After the necessary measurements are completed, the body, branch, shell, exile, alive cover, dead cover, dead wood and root samples are broken down and grinded. Following the completion of the grinding process, the process of determining the amount of carbon amounts found in the tree, litter, living cover and dead wood and root components that form the ecosystem biomass is started. Carbon quantities of all samples are determined using the elemental analysis machine.

3. RESULTS

The amount of carbon stored in the stem of the Anatolian black pine trees in the study area is 13.07 tons/ha and 54.29 tons/ha, the amount of carbon stored in its branches is 3.3 tons/ha and 10.72 tons/ha, the amount of carbon stored in its foliage is 1.74 tons/ha and 7.04 tons/ha. The total amount of carbon stored in the trees varies between 20.26 tons/ha and 72.18 tons/ha. In some sample plots, there is no living cover, while the maximum amount of carbon was determined as 0.8 tons/ha. Likewise, dead wood was not found in some sample plots, while the amount of 2.7 tons/ha dead cover carbon was determined. The amount of dead wood carbon varies between 2.76 tons/ha and 4.22 tons/ha. Forest ecosystems are in the soil with the highest carbon accumulation in carbon pools. In this study, it was observed that the amount of carbon stored by the soil to a depth of 1 meter varies between 104,18 tons/ha and 139.06 tons/ha. The amount of carbon stored in under soil biomass was evaluated in 3 classes and was found to be between 56 kg/ha and 61 kg/ha in the fine root, 10 kg/ha in small root and 80 kg/ha in coarse root and 10 kg/ha to 100 kg/ha. Descriptive statistics regarding the amounts of carbon stored by carbon pools in forest ecosystems are given in Table 1.

Table 1. Descriptive statistics on carbon amounts in carbon pools.

Carbon pool	Components		Carbon Stock (ton/ha)			
			min	**max**	**mean**	**std. Deviation**
Above-ground biomass	Living trees	Stem	13,07	54,29	33,55	20,61
		Branch	3,30	10,72	7,65	3,87
		Foliage	1,74	7,04	4,15	2,68
		Bark	1,84	7,96	5,19	3,10
		Tree	20,26	72,18	50,89	27,19
	Living cover		0	0,80	0,42	0,54
Below-ground biomass	Roots	Fine	0,056	0,061	0,059	0,004
		Small	0,01	0,08	0,05	0,04
		Coarse	0,01	0,10	0,05	0,06
Deadwood			0	2,70	1,69	0,95
Litter			2,76	4,22	3,32	0,79
Soil organic matter			104,18	139,06	121,62	24,66

4. DISCUSSION AND CONCLUSION

In this study, it was determined that the total amount of carbon stored in the pure Anatolian black pine stands within the boundaries of Balıkesir Forestry Regional Directorate, Dursunbey Forest Management Chief, Çamlık Forest Management Directorate was 137.8 tons/ha. Forests, which constitute the majority of the amount of carbon stored in terrestrial ecosystems, have undertaken important tasks against climate change. One of the most important of these tasks is to store carbon dioxide (CO_2) by connecting. The studies show that the increase in global warming and the change in the climate will affect the whole world and our country with the increase in CO_2 density released into the atmosphere. For this reason, the studies carried out to determine carbon storage amounts on tree species are very important. In particular, the carbon storage capacity of the forests should be determined according to the Tier 3 method, which is one of the methods specified in the IPCC guides. By using the coefficients obtained from studies in different countries, the determination of the carbon storage capacity of forests will lead to some deficiencies. Türkiye is one of the countries that will be most affected by a climate change that can be seen, especially in the complex climatic structure, especially due to global warming. Naturally, it is surrounded by seas on the three side, it has a defective topography and its orographic characteristics, due to its orographic characteristics, different regions of Türkiye will be affected differently and in different sizes from climate change (Öztürk, 2002; Erkut, 2013). For these reasons, determining the carbon storage capacity of our forests, how the changes in carbon storage capacity over time, how carbon storage capacity changes according to planning units, and how the interventions affect the carbon storage capacity in the fastest and practical way to determine.

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