- **Short communication**
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CARBON STORAGE IN ARBOR FORESTS UNDER THE BACKGROUND OF CARBON NEUTRALITY

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Abstract

Arbor are the main body of forest plants and have the role and status of "skeleton" of carbon storage. In the present study a large number of arbor forest carbon storage literature and the research progress of arbor forest carbon storage were reviewed. Results showed that the carbon storage of pine trees in arbor forest was relatively high; the areas with large carbon storage in arbor forest were Tibet, Yunnan, Heilongjiang, Sichuan, Inner Mongolia and Jilin.The carbon storage of arbor forests of different age groups increases with stand age and arbor forests of different origins have higher carbon stocks than planted forests in natural forests.

In the context of current climate change mitigation, forest plants have attracted much attention due to their huge carbon sequestration (Fao *et al.* 2015). Forests are the largest carbon pools in terrestrial ecosystems and play an important role in maintaining global carbon balance and mitigating climate change effect. Relevant studies have shown that the global carbon storage of forest plants accounts for about 80% of the total carbon storage of terrestrial vegetation, and fixed carbon annually accounts for about two-thirds of the entire terrestrial ecosystem (Fang *et al*. 2001, Pan *et al.* 2011, Fang *et al*. 2014). There are various forest types and tree species in China, and there are more than 2,000 species of arbor trees. Trees are the main body of forest plants and have the function and the status of "skeleton". According to the statistics, the number of arbor forests in China is 189.243 billion, with an accumulation of 17.0581959 million m3. Accurate estimation of carbon storage in forest vegetation has been the focus of attention in recent years (Haywood and Stone 2017).

To study the carbon storage of forest vegetation, monitor the size and spatial distribution of forest carbon storage and carbon density, and master the change law of forest vegetation carbon sink, which is useful for understanding the terrestrial carbon cycle process, the carbon sink characteristics of different vegetation, and is of great significance. This is because to fully understand the carbon sink potential of forest vegetation in China and to support decision-making in international climate change negotiations. As an important part of forest vegetation, the estimation of its carbon storage is of great significance for grasping the carbon sink potential of dominant tree species and exploring their dominant tree species. Therefore, on the basis of characterizing the main arbor species, the present uses the literature to analyze the carbon storage of domestic arbor vegetation, and summarizes the carbon storage of arbor vegetation in different regions and different climates (Qi *et al*. 2018). The influencing factors are analyzed, in order to supplement the theory and method for the carbon storage analysis of main arbor vegetation, and provide reference and reference for the selection of artificial arbor species based on the double carbon perspective (Keith *et al.* 2014).

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Woody plants with an upright trunk and usually six to tens of meters in height are called trees. They tend to be tall trees with a distinctly tall trunk. According to its height, it can be divided into four grades, such as Weiqiao (over 31 meters), Big Joe (21-30 meters), Middle Joe (11-20 meters), and Xiaoqiao (6-10 meters). Trees correspond to low shrubs, and tall trees are usually seen, such as kapok, pine, magnolia, birch, etc. Trees are divided into deciduous trees and evergreen trees according to whether they are deciduous in winter or dry season.

The variation trend of carbon storage in different tree species/groups is quite different (Liu *et al*. 2012). The carbon storage of natural arbor forests in Fujian Province is dominated by broad-leaved tree species (including mixed coniferous and broad-leaved forests. Liu *et al.* (2012) pointed out that the carbon sequestration capacity of the dominant tree species in descending order is Poplar, *Pinus tabulaeformis*, North China Larch, *Robinia pseudoacacia*, Conifer, other conifers, and other soft broad-leaved species. Yan (2019) pointed out that the contribution of broad-leaved forest and mixed coniferous and broad-leaved forest to carbon storage has gradually increased in recent years, but the coniferous forest dominated by masson pine is still the main contributor to the city's carbon storage. Zhang measured and analyzed the carbon content of 8 main tree species in Guangdong, and pointed out that the carbon content of different tree species is in the order of slash pine > fir > masson pine > fast-growing acacia > hard broad class > eucalyptus > soft broad class > Capsule, and the carbon content of conifers larger than broadleaf trees (Zhang 2018). It was pointed out that the relationship between the carbon content of different organs was leaf > branch > bark > trunk > root. Zhou *et al.* (2012) analyzed the resources of the Haikou Forest Farm in Kunming City, the study area, and pointed out that the arbor forest with the largest carbon storage was Huashan pine forest. According to the previous research results, it is known that the carbon storage of pine trees is relatively high in the tree species of arbor forest.

According to the previous research results, it can be seen that the arbor forest resources in different regions of China have obvious differences in the size of the carbon storage and the carbon density of the arbor forest due to the differences in the area size, climatic conditions, geographical distribution, forestry policies and social development status (Zhang *et al*. 2012). There are obvious spatial differences in the distribution of forest and arbor forest carbon storage in each province. On the whole, the area of arbor forest and the accumulation per unit area are the determinants of the size of regional forest carbon storage, and the regional carbon storage with larger arbor forest area is also larger. According to the analysis by Qi *et al.* (2018), several regions with large arbor forest carbon storage are Tibet, Yunnan, Heilongjiang, Sichuan, Inner Mongolia and Jilin, all of which account for more than 5% of the national total, and the six regions together account for the national arbor forest carbon storage 65% of reserves (Qi *et al*. 2018). The provinces with relatively small arbor forest carbon storage are Shanghai, Tianjin, Ningxia, Beijing, Qinghai and Jiangsu, whose arbor forest carbon storage is less than 1% of the national total. The areas with high carbon densities of arbor forests are Tibet, Xinjiang, Jilin, Sichuan, Yunnan and Qinghai, and their carbon densities are all >39 Mg/hm^2, which is higher than the national average (Liu and Wu 2017). Among them, Tibet is the province with the largest arbor forest carbon density in China, which is 104.66 Mg/hm^2, which is 2.81 times the national average and much higher than other provinces (Li *et al*. 2012). The areas with low arbor forest carbon density are Hebei, Beijing, Hunan, Jiangsu, Ningxia, and Tianjin. The average arbor forest carbon density is less than 20 Mg/hm^2, which is lower than the national average of 37.28 Mg/hm^2.

Qi *et al.* (2018) divided the dominant tree species (groups) by natural forest, plantation forest and age group structure (young-aged forest, middle-aged forest, near-mature forest, mature forest and over-mature forest in each province (excluding Hong Kong, Macao and Taiwan) Data on the area and volume of arbor forests were obtained from the results of the seventh (2004-2008) and eighth (2009-2013) forest resource inventories in China (State Forestry Administration 2009) (The

Eighth National Forest Resources Inventory Report 2013). The forest carbon storage was analyzed, and it was concluded that the order of carbon storage of arbor forests in different forest age groups was: middle-aged forest > mature forest > near-mature forest > over-mature forest > young forest. The area of young and middle-aged forests accounts for 64.66% of the total area of arbor forests in China and 40.80% of the total carbon storage of arbor forests. The area of mature forest and over-mature forest accounted for 19.65% of the total area, but the carbon storage accounted for 38.58% of the total carbon storage. So it can be predicted that the carbon storage of arbor forests in China has a great potential to increase. There is a big difference in the carbon density of arbor forests in different forest age groups, which is also an important factor in determining its carbon storage. The order of carbon density of arbor forests in China is: over-mature forest > mature forest > near-mature forest > middle-aged forest > young forest, the older the forest age, the higher the carbon density. Zhou *et al.* (2012) used the regression relationship between biomass and stock volume established by Fang *et al.* (1996) to calculate the 8 species of arbor forests of different ages, including Huashan pine, Yunnan pine, and cypress, based on the relevant data of Haikou forest farm resources in Kunming City. Area and carbon storage, it was concluded that middle-aged forest > near-mature forest > young forest > mature forest. Based on the forest resources inventory data in Fujian Province, Xiao (2022) used the biomass conversion factor continuous function method to calculate the carbon storage of different tree species such as hemlock, Huangshan pine, black pine, oil fir, cedar, and Metasequoia, and obtained the natural arbor forest carbon storage (Xiao 2022). The density showed an obvious upward trend with the increase of forest age. Similarly, Yan (2019) used the data of the sixth (2002), seventh (2007), eighth (2012), and ninth (2017) forest resources continuous inventory in Chongqing, using continuous biomass expansion (Yan. 2019). The factor method was used to estimate the carbon storage of arbor forests in four consecutive forest resource inventory cycles. Wu and Xu (2021) used the data of four consecutive forest resource inventories in Sichuan Province, and applied the systematic comparison of the single-tree model method and the expansion factor method to estimate the carbon storage. It was concluded that the carbon sequestration potential of leaf mixed forest and spruce forest was relatively large in mature stages, and the annual growth and average growth of carbon density increase with the increase of stand age. Based on the survey data of arbor forest sample plots in the Tianshan Mountains of Xinjiang from 2001 to 2016, Zhang *et al.* (2021) used statistical methods to analyze the changes in the carbon density of arbor forests in this area, and concluded that the average carbon density increased with the increase of forest age. Therefore, it can be seen that the carbon density of arbor forests of different stand age groups increases with the increase of stand age, which also indicates that young and middle-aged arbor forests are the carbon sequestration potential of the future forest system.

Qi *et al.* (2018) pointed out that among the carbon storage of arbor forests of different origins, natural arbor forests are the main part of the carbon storage of arbor forests in China, accounting for 85.50% of the total carbon storage. The carbon density of each age class of natural forest is obviously greater than that of plantation forest, especially in near-mature forest and over-mature forest. Sharma *et al.* (2013) showed that even though the age class of natural forest is much smaller than that of plantation forest, its carbon density and carbon sequestration capacity are higher than those of plantation forest, which may be due to the fact that the age class structure and material of natural forest are better than that of plantation forest (Stinson *et al*. 2011). Yan (2019) analyzed the arbor forests in Chongqing and also concluded that the carbon storage capacity of natural forests is much greater than that of artificial forests. The proportion of young and middle-aged forests in China's artificial arbor forests is relatively large. With reasonable forest management, it can be predicted that the proportion of artificial arbor forests in the total carbon storage will continue to increase in the future. When its carbon density is close to that of natural

forests when the density is increased, the carbon storage will increase to a large extent. Zhou *et al.* (2012) pointed out in an article "Research on the carbon sink function of several arbor forests" that the carbon storage of artificial forests is smaller than that of natural forests. Therefore, from the previous results, one can see that the carbon storage of natural forests is higher than that of artificial forests in arbor forests of different origins.

Arbor forest is an important carbon pool of forest ecosystem, and accurate estimation of its carbon storage is of great significance to the evaluation and protection of forest ecosystem service functions. The present study summarizes the previous results. Observing that the carbon storage of pine trees in the arbor forest is relatively high; the areas with large carbon storage in arbor forests are Tibet, Yunnan, Heilongjiang, Sichuan, Inner Mongolia and Jilin; the carbon storage of arbor forests in different age Density increase with stand age; arbor forests of different origins have higher carbon stocks than planted forests in natural forests. Thus the present study has important strategic value for forests to mitigate global climate change. As countries continue to pay attention to global climate change and greenhouse gas emission reduction, accurately and completely estimating the carbon storage of forest ecosystems, revealing its carbon cycle process and changing laws, and exploring sustainable sink enhancement channels will still be one of the future research priorities.

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