EXTENSION

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Introduction to forest carbon

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How carbon capture by trees can benefit landowners

Oklahomans with unproductive timberland that still supports some tree growth may not have many income-generating possibilities. Some landowners use their property for hunting or sell the right to hunt on their land through a hunting lease. Many landowners own land they may not even consider to be forest but enjoy the recreational benefits the trees provide on their land. Depending on the tree species, landowners may benefit from selling alternative forest products like fruits, nuts or firewood. Depending on circumstances and markets, another option may be selling carbon accumulating as tree growth on their property. Although trees take a long time to grow, it may be possible to capitalize on tree growth which provides landowners additional income. Landowners can change their management strategy in a way that sequesters and stores more carbon than would have been sequestered and stored given status quo. By doing so, landowners can make a commitment to sell carbon credits to "offset" carbon dioxide (CO_2) emissions elsewhere. Carbon credits are generally sold to a "broker" and have value because they offset emissions from carbon dioxide-producing sources, such as manufacturing or transportation.

The importance of carbon sequestration and storage

The sequestration and storage of carbon dioxide is important because it decreases the concentration of greenhouse gases linked to climate change and global warming. The global carbon cycle (Figure 1), like any other naturally-occurring process, involves continuous recycling, storage and utilization of carbon. The quantity of carbon sequestered and stored in forests is referred to as the carbon stock. Carbon stocks are reservoirs or pools, including living biomass (such as trees and branches), dead organic matter (including shed leaves) and organic soil (resulting from the decomposition of debris and shed leaves). Preserving or increasing carbon stocks is essential for mitigating climate change, since increasing carbon stocks diminishes atmospheric carbon dioxide levels by sequestering and storing carbon. Through the physiological processes of photosynthesis and respiration, trees convert atmospheric carbon dioxide, water and sunlight into energy and biomass. The faster a tree is able to do this, the faster it sequesters atmospheric carbon dioxide and turns it into solid biomass. This is called carbon sequestration rate, and it may differ from the total amount of carbon a tree is able to store. To reiterate, sequestration refers to the rate, whereas storage refers to the amount. Generally, younger trees may have faster carbon sequestration rates due to a high foliage to stem ratio, but older trees may have more carbon storage capacity due to much larger stems and root systems. This is because younger trees have tremendous amounts of energy invested in aboveground parts focused on photosynthesis, like foliage. Older trees have more investment in belowground parts like roots, which increase carbon storage capacity. Another way to think of this is that tree physiological processes take carbon dioxide as a greenhouse gas, store it in solid forms like roots or stem wood, and that wood can be used to build solid wood products. For example, the solid wood products in your home - such as the house's frame or furniture - are roughly 50% carbon. This carbon has been stored indefinitely until it decomposes or combusts.

Forest landowners can monetize carbon on their property

As a landowner, carbon accumulation can offset carbon dioxide emissions from elsewhere, which can create extra income (Figure 2) called carbon credit. Depending on the tree species, productivity and land management, carbon credits can be generated. In Oklahoma, carbon projects generally involve planting trees where there were previously no trees. One acre of land with trees can absorb several tons of carbon per year. The price of carbon may vary widely, from a few U.S. dollars to over $100 per metric ton of carbon dioxide equivalent. To determine the quantity of carbon stored by trees per acre, carbon accounting uses information on tree species, density and age. The process of calculating, verifying and monetizing forest carbon into credits begins with determining the amount of carbon sequestered per tree. First, the dominant tree species is identified, and tree size is assessed. This plays a key role in carbon estimation. Diameter at breast height (DBH) is measured to assess the tree's diameter at a height of 4.5 feet above ground level. Following this, tree biomass is estimated by using species-specific allometric equations. Since approximately 50% of a tree's biomass consists of carbon, the carbon content is calculated by multiplying the biomass (in kg) by 0.5. Finally, the estimated carbon is converted to carbon dioxide equivalent (CO_2e). Once the CO_2e) is measured per tree, it is multiplied by the TPA (stem density in trees per acre) to determine the amount of carbon per unit area. Finally, carbon credits are calculated by multiplying CO_2e) per acre in metric tons by carbon credit/metric tons (Figure 3).

Summary

Trees take a long time to grow, so carbon-based forest management is a long-term contractual system in which carbon credits are generated through forest management practices and sold to industries, providing landowners with a source of income. This approach is particularly beneficial for land unsuitable for agricultural production but still able to generate revenue through tree planting. Here, additional carbon can be generated where it would not have otherwise been. Fast growing species like loblolly pine are well-suited for such lands and can help landowners earn carbon credits. The decision to participate in these projects is influenced by various motivational factors, including environmental attitudes, social norms, personal values and perceived capability.

Both animal and plant biodiversity contribute to the carbon cycle. Through the process of photosynthesis, trees use sunlight, water, and atmospheric carbon dioxide gas to grow. Much of the carbon component of atmospheric carbon dioxide is stored in tree trunks, leaves, roots and soil. Carbon dioxide is also a byproduct of plant respiration. Therefore, trees both store carbon when building vegetation and release carbon dioxide during respiration. Shed tree parts, or forest litter, decompose. Through decomposition and fire, carbon dioxide from forest litter is released back into Earth's atmosphere, where Carbon dioxide gas is one component.

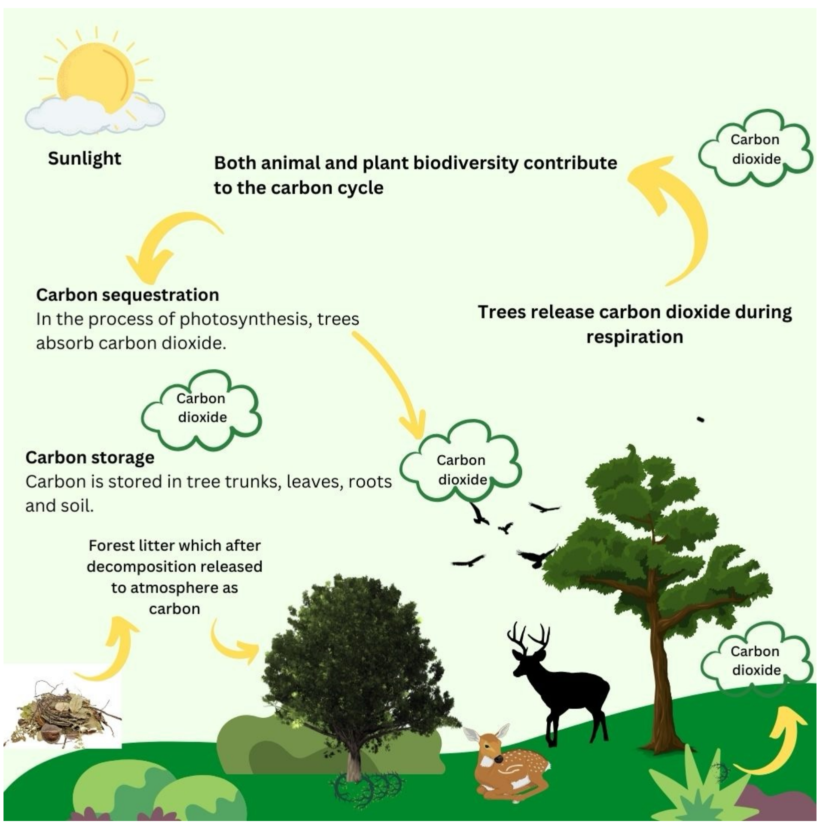

Figure 1. Influence of forest in global carbon cycle.

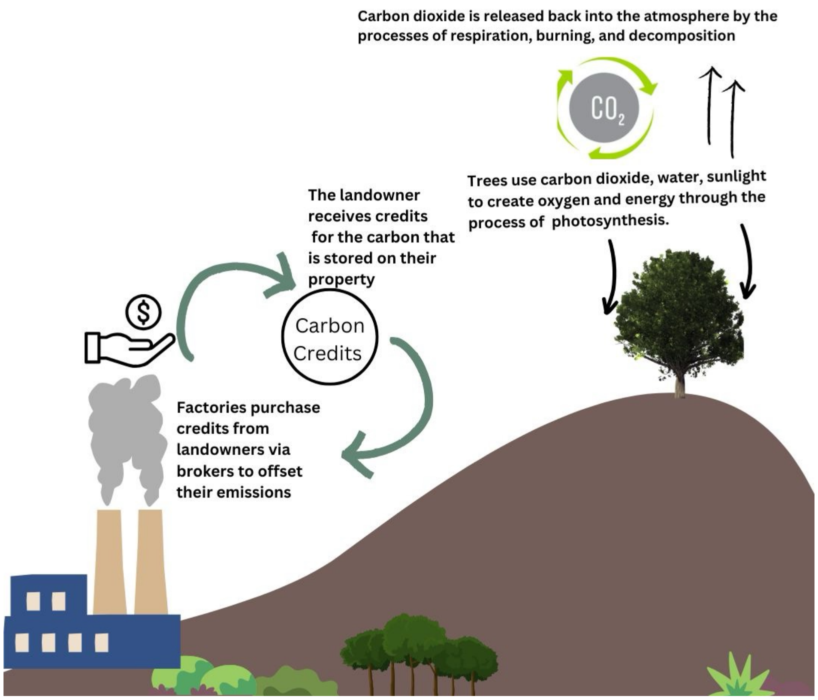

Figure 2. Carbon credit illustration.

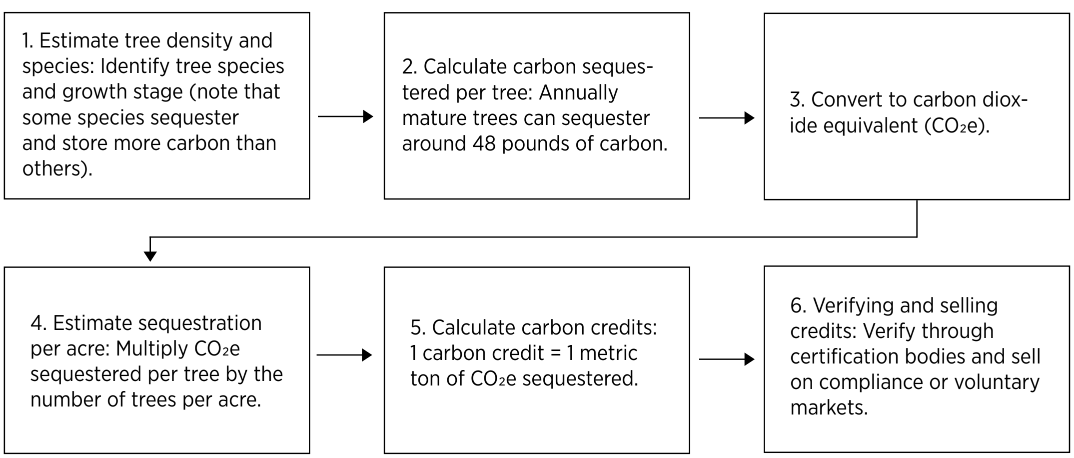

Figure 3. Estimating and monetizing carbon sequestration and storage from trees.

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