NRCS Natural Resources Conservation Service

# Alaska Forestry Technical Note 1

## Carbon Sequestration and Forest Land Thinning

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**Does Thinning Increase Carbon Sequestration in Forest Stands?**
Current literature and research indicates that the use of thinning to increase the amount of total carbon sequestered does not always achieve the desire results. This is due to the management regime that must be developed to maximize carbon sequestration. Most forestland management is industrial based where getting a product to useful size in the shortest amount of time is one of the major objectives for the landowner. This is often in conflict with the management scenarios for carbon sequestration, which often involve long term forest harvest cycles. Alaska has some unique forests that grow very slowly compared to many other forested areas in North America. These vast expanses of forest being managed for long harvest rotations may fit into the carbon sequestration model, but may not fit most industrial models.

In Alaska one of the factors in determining EQIP eligibility and ranking is the ability to mitigate the effects of atmospheric emissions; the following should assist in determining if the project being proposed does actually meet the intent of the EQIP program. Factors that determine the carbon sequestration effect of the planned treatment requires information that goes beyond the basic inventory data needed for practice needs, eligibility determination, and design. Landowners' long term goals and objectives are needed to evaluate the use of this practice for carbon sequestration.

**The Basics of Carbon Sequestration:**
Trees sequester carbon by using photosynthesis to converting $CO_2$ into woody and non woody plant material. Wood material is stored in the trees as wood fiber. Other materials such as leaves, needles, bark and branches are shed periodically and decay producing carbon that is released to the atmosphere or becomes part of the organic horizon of the soil. When a tree dies it stops sequestering carbon and becomes a carbon producer. When forest soils become exposed to the sun and warmer temperatures they increase carbon and nutrient production as a result of an increased decomposition rate.

An important consideration in the carbon sequestration abilities of forest is that forests composed of larger older trees sequester more carbon than younger forests composed of smaller trees, in healthy fully stocked forest stand conditions.

**Effects of Thinning**:
Thinning is the removal of some trees in a stand to allow the remaining trees to continue growing in order to meet a future need.  This is not only a process of harvesting but it is also naturally occurring. Thinning stops the removed trees from growing and storing carbon and they become carbon producers. Within a few years, the residual trees respond to the added growing space, soil nutrients, and increased moisture and increasing their growth rates which eventually compensate for the carbon producing slash and residue left on site.  Pre-commercial thinning of forested stands at young ages initially produces no net increase in carbon sequestration, but later exceeds the carbon sequestration rates that would have occurred if the thinning had not been applied. This typically occurs five to 10 years after thinning. After this point, the balance begins to favor carbon sequestration over carbon production. When the forests get to approximately 30 years after treatment, the forest will now have sequestered more carbon in comparison to the un-thinned condition when you include total carbon production from the site. The forest is now in the plus side of the total carbon equation.  Commercial thinning (partial harvest), removing trees of a commercial size, typically shows no increase in total carbon sequestration. This is due to many factors including, length of time to final harvest, amount of slash typically left to decay from harvesting a larger tree and the carbon associated with the processing and end use of the crop.

**Effects of Harvesting:**
Once a tree is harvested it ceases to add growth and stops sequestering carbon and the decomposition process will begin.  Once a new tree establishes itself, either naturally or through planting, it begins to sequester carbon but when compared to an older mature tree it does not sequester as much carbon, even if there are thousands more younger trees than larger trees. Young trees will be thinned or will be self-thinned resulting in carbon production thus producing carbon. Using thinned or harvested trees for energy would displace a nonrenewable carbon source such as oil. This is termed carbon offset and does produce a favorable condition in the atmospheric carbon equation since a ton of carbon from wood fiber used for energy is then recaptured by wood fiber producing forest.  If wood products are converted into non-consumable products like furniture or homes this could be considered long term carbon storage, but the carbon equation does not balance very well in this scenario due to the cost of conversion or production.  Building materials production produces waste, which decomposes or is used for fuel, but the entire process usually results in a net carbon output due to the energy needed in conversion.  Eventually homes are

burned, torn down, and remodeled this process all leads to one form or another of atmospheric carbon production.

**Highest Carbon Sequestration Potential**
The highest amount of carbon sequestration potential for forested stands occur when stands are managed for the fastest growth rate through early thinning, are protected from insect, disease and fire; and are allowed to grow continually for very long periods. The white and Sitka spruce common to most of Alaska can live in up to 300 years if properly managed and cared for. Management associated with the reduction of risk associated with fire, insects and disease can all lead to greater carbon sequestration by making possible 100+ year harvest cycles. The difficulty in this management regime is that it does not fit into most forest landowner management plans. It also requires financial inputs with no immediate return on investments.

**Can Forest Stand Treatments Sequester Atmospheric Carbon and fit into Alaska NRCS EQIP Resource Concern Evaluation?**
The answer is yes if the following conditions are met:

1. Thinning needs to be done early when the stand has very high stocking rate and is still in the sapling and small pole size. ( 1 to 5 inches dbh)

2. Thinning needs to remove understory, intermediate and co-dominate trees leaving the dominate trees in place.

3. Stands need to be managed for large diameter commercial products over a long time periods. (Trees need to be managed for medium to large saw log sizes, 16 plus inches in diameter over at least a 60 year period)

4. Forests need to be managed for the reduction of fire, insect, and disease risks.

**How much carbon can be sequestered?**
The research suggests a wide range of carbon sequestration rates for a properly thinned forest. Ranges fall in the 0.2 to 0.3 tons of carbon per acre per year if the forest is maintained for a long rotation. These are the most favorable numbers that could be applied to Alaska's forest based on research from forest found in Sweden and New Brunswick. Sequestration rates reported for the United States are in the 0.9 to 4.6 tons on forest land, but keep in mind that these values are based on various management actions on lands more productive than what we have in most of Alaska.

**Carbon Credits Payments for Treatments?**

At the current value of carbon credits a typical Alaskan forest can expect to produce 1.2 to 1.8 dollars a year worth of carbon credits per acre from thinning. When compared to treatments cost of $400 per acre, the analysis of a profitable economic return from thinning for carbon credits does not pencil out, even with a cost share component. If this is coupled with the economic return from the thinning which can results in a high valued forest product in a reasonable time frame there maybe an incentive in pursuing payments through carbon credits? The deciding factor is the amount of time the investor is willing to wait for a return on his/her investment and also have enough time for a positive net gain in carbon.

**What Other Forestry Practices Have a Carbon Sequestration Potential: (*Potential Alaska Applications*)**

1. Afforestation of agriculture lands *(Native grasslands e.g. Kodiak and Ag. Lands e.g. Delta Junction Area)*
2. Reforestation of harvested or burned timberland *(Interior Alaska burns and insect impacted areas in South Central AK)*
3. Modification of forest management practices to emphasize carbon storage *(Thinning of overstock areas in Southeast)*
4. Adoption of low impact harvesting methods to decrease carbon releases
5. Lengthening forest harvest rotations *(Southeast Alaska, Kodiak)*
6. Preservation of forestland from conversion *(Areas of high urban gr*owth)
7. Adoption of agroforestry practices *(Silvopasture grassland areas)*
8. Establishment of short-rotation woody biomass plantations *(Native Villages willows)*
9. Urban forestry practices *(Urban green belt areas)*

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