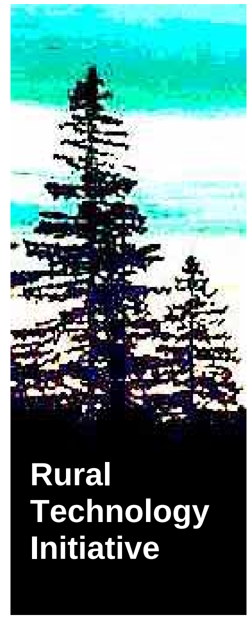
RTI FACT SHEET #17

Rural forest community issues *Updated May, 2004*

The Role of Northwest Forests and Forest Management on Carbon Storage



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Some suggest that longer rotations store more carbon while also being complementary to biodiversity and endangered species. Others suggest that more intensive management can store more carbon at lower cost. Some say the carbon stored in products is not important since it deteriorates over time releasing carbon emissions. Others say the buildup of wood products is a major source of increasing carbon pools. Some say that preserving old growth stores more carbon than manufacturing products. Others say that the carbon in the forests would neither increase nor decrease over the long term if we avoided deforestation and land use conversion. In spite of differences in approach, reducing carbon emissions has become an international commitment and carbon trading or carbon credit markets are developing. So what do we know about the role of northwestern forests on carbon?

On the question of the forests role in storing carbon and the impact of forest management on carbon storage, a consortium of 14 research institutions across the US (mostly universities) have been looking at this question for several years. The Consortium for Research on Renewable Industrial Materials (CORRIM), a not for profit university lead research group, developed a research plan in 1998 to study the complete environmental performance of wood by developing a life cycle inventory (LCI) data base of all inputs and outputs from forest regeneration, through harvest, processing, construction, building use and final disposal. They completed a review draft of their final report on forests in the PNW and SE in January of 2004. This revised Fact Sheet summarizes the impacts of forests and forest products on carbon under several management strategies as reported in the CORRIM Phase I Final Report (draft).

The simplest example often cited is that you can store more carbon in the forest on longer rotations or with no harvest at all. It is true that extending the rotation age from 50 to 100 years in the PNW will more than double the inventory of wood and carbon stored in the forest. Extending the age even further will increase the carbon stored somewhat more but eventually, due to natural the natural aging process and disturbances such as windstorms, fire, and disease the volume of timber and carbon stored will decrease, followed by new growth and renewal. Looked out over the long term across these disturbances and with no harvesting, the long term average of carbon stored on a fixed acreage of forestland will not likely change very much although the increase in fossil fuel emissions and global warming may alter that stability.

However, this is just the beginning of the carbon storage accounting if any products are removed from the forest. While short-lived products such as paper may enter the waste stream quickly and decompose, long lived products including housing construction continue to grow over time as more houses are built and the carbon stored in houses lasts longer than the rotation age, thereby accumulating carbon storage from rotation to rotation. The housing stock continues to increase and therefore the carbon stored in housing is increasing. The carbon stored in forests (stem, root, crown, litter, and dead or dieing carbon pools) under rotations intervals of 45 years, 80 (with two thinnings), and 120 (with three thinnings), and no harvest or disturbance are shown in figure 1. Simulations show that longer rotations do store more carbon in the forest with the no harvest (or disturbance) scenario producing the most. Empirical data shows little if any increase in carbon stored in NW forests beyond 120 years.

The carbon in short-lived product pools removed from the forest decomposes rapidly resulting in carbon emissions while those in long-lived products decompose slowly with some residual build-up in storage from rotation to rotation. The carbon stored in products is illustrated in Figure 2 under an 80 year rotation showing successively more product in the first two thinnings prior to the harvest. The chart also displays the emissions from the logging and manufacturing as negative pools, the rapid decomposition of short lived products such as chips, and the carbon in lumber products lasting 80 years, the expected life of a house.

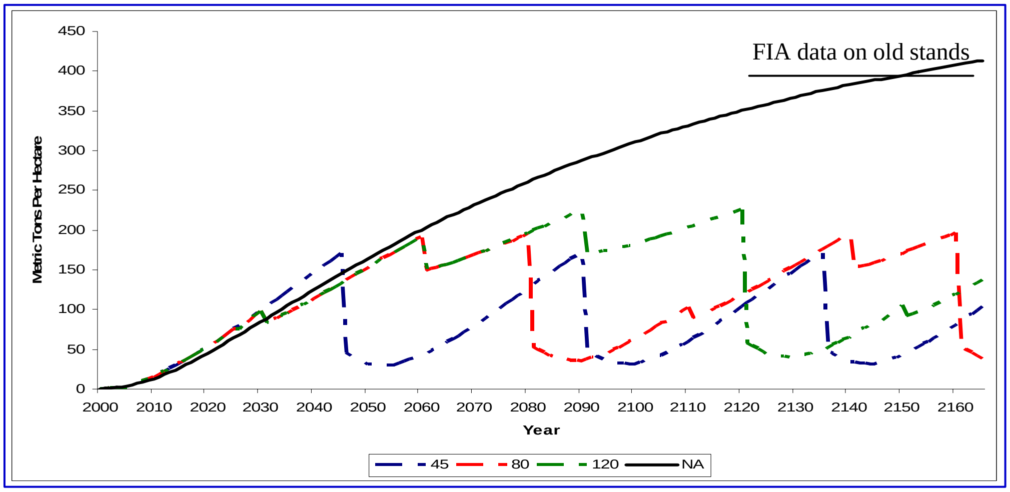

Figure 1. Carbon in forest pools for different rotations

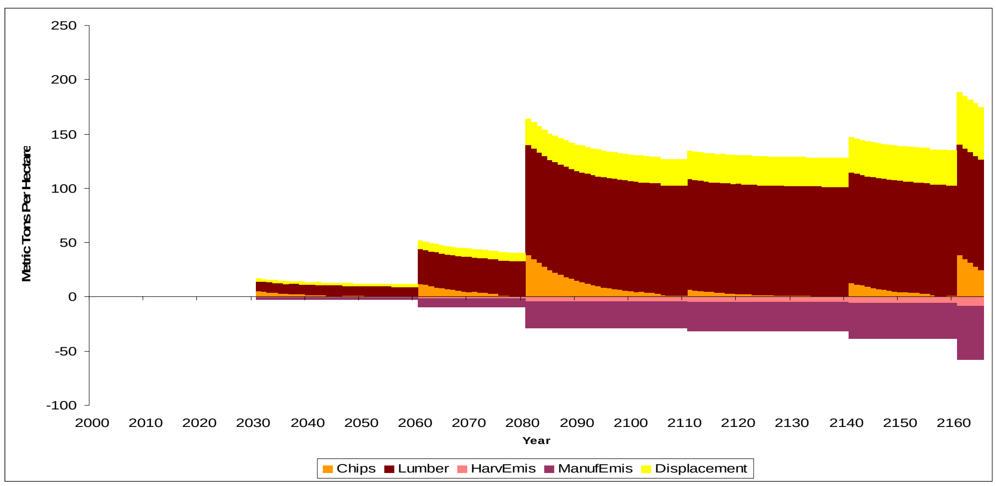

Figure 2. Carbon in products, energy displacement and processing emissions

When the short lived products are used as a biomass source for producing energy (co-generation), net electrical energy is added to the electrical grid. While a low valued use of wood and probably not the best way to increase carbon storage, using the wood as a fuel (thereby substituting for fossil fuels), will increase carbon storage over time without the decomposition associated with short lived products. The figure illustrates displacement of fossil fuels when low valued co-products other than chips for paper are used as a biofuel.

Figure 3 shows the carbon stored in the forest and both short and long lived product pools along with the displacement of fossil fuels as a positive pool and the energy for processing as a negative pool for an 80 year rotation. It also shows a positive carbon pool for substitution as the long lived products are substituted for concrete framed buildings. Note that the carbon in the forest is stable across rotations, and by adding the carbon in products there is a modest increase in carbon stored but by including the substitution for more energy intensive products such as steel or concrete there is a much more positive trend in stored carbon.

Long rotations or no harvest have a very counterproductive impact on the product and substitution pools since the contribution from products occurs so much later in time. Figure 4 summarizes the carbon account averages for intervals of 0-45, 0-80, 0-120 and 0-165 for each of the rotation scenarios and the no action scenario. In the first 45 year, since there is no harvest, there is little difference between the alternative scenarios. For the 0-80 year interval, the 45 year rotation harvest results in substantial product substitution resulting in more carbon stored than the other scenarios. For the 120 year interval, a harvest has also occurred on the 80 year rotation and a heavy thin on the 120 year rotation.

Finally by 165 years all scenarios have included a harvest. The total carbon stored is for each interval decreasing with rotation age even though the carbon in the forest and even in the forest and products is increasing with rotation age.

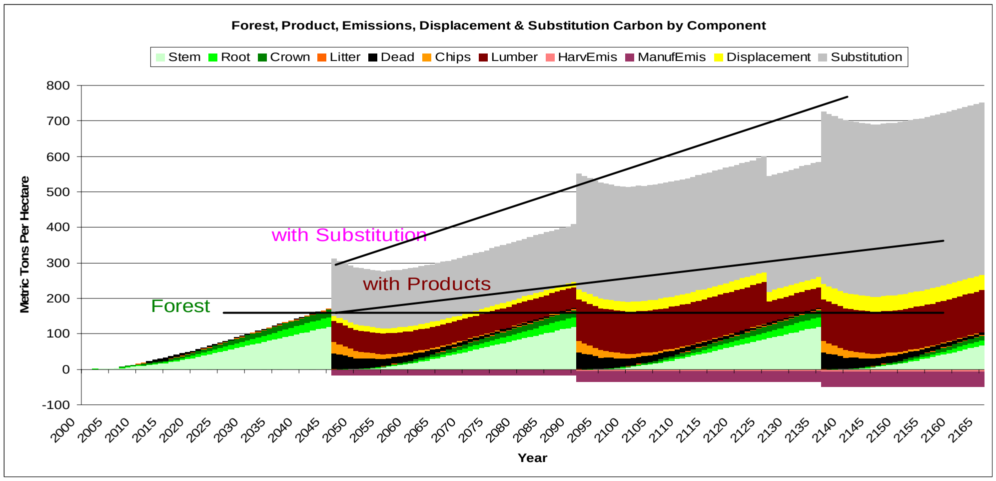

Figure 3. Carbon in the forest and product pools with concrete substitution for the 45 year rotation

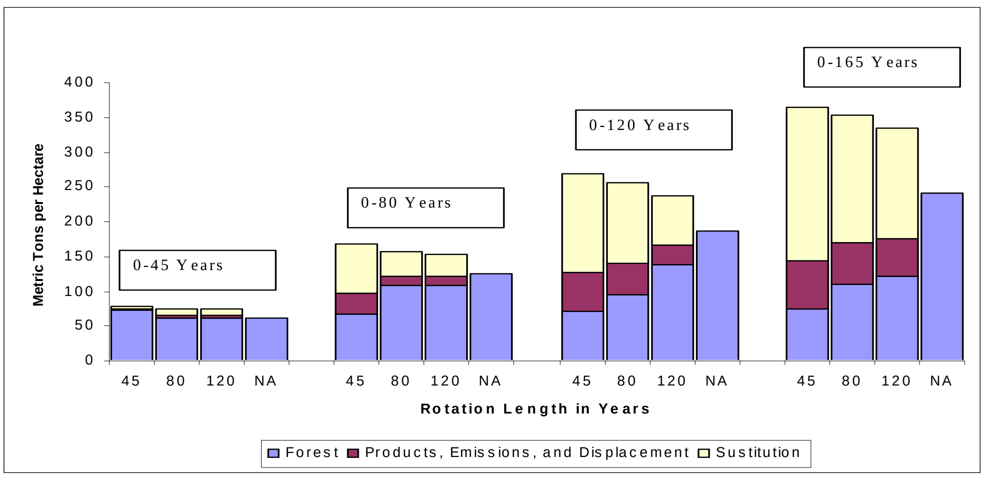

Figure 4. Average annual carbon in forest, product and concrete substitution pools for different rotations.

Since the greatest carbon storage occurs with the shortest rotation it should be obvious that more intensive management with a short rotation should be even better. Figure 5 shows the carbon stored in the base case with a 45 year rotation and a more intensive management case including fertilization and a commercial thinning on the same rotation. As a second case, the rotation was extended 10 years to see if the response time after the thinning would produce increased storage. There is a significant increase in carbon stored from the intensive management but very little gain by also increasing the rotation age another ten years.

Drawing the boundary conditions for the analysis around a forest is only correct if there is no harvest, in which case over the long term the forest stores a substantial amount of carbon but it is neither increasing nor decreasing when looking across disturbance cycles. In that sense, it plays no role in the equation for mitigation in global warming and how to reduce carbon emissions. Changes in management which includes conversion to forestry but especially producing more products as soon as possible to replace energy intensive substitutes has the largest impact. The economic returns do not change this finding. Figure 6 displays the Soil Expectation Value (SEV) with a 5% (real) interest rate. SEV is the return to the land from perpetual rotations. While there is a small increase in carbon for the intensive management 55 year rotation over the shorter rotation, the cost penalty from the longer rotation is already substantial. The economic returns to intensive management are not large and might even be negative with low prices for small logs. Nevertheless, any small incentive related to the increased carbon stored would logically support a significant increase in management intensity as it reduces the risk of making such an investment. The 80 and 120 year rotations have fallen below the 5% discount target with no increased carbon storage as a consequence, unless substitution is ignored

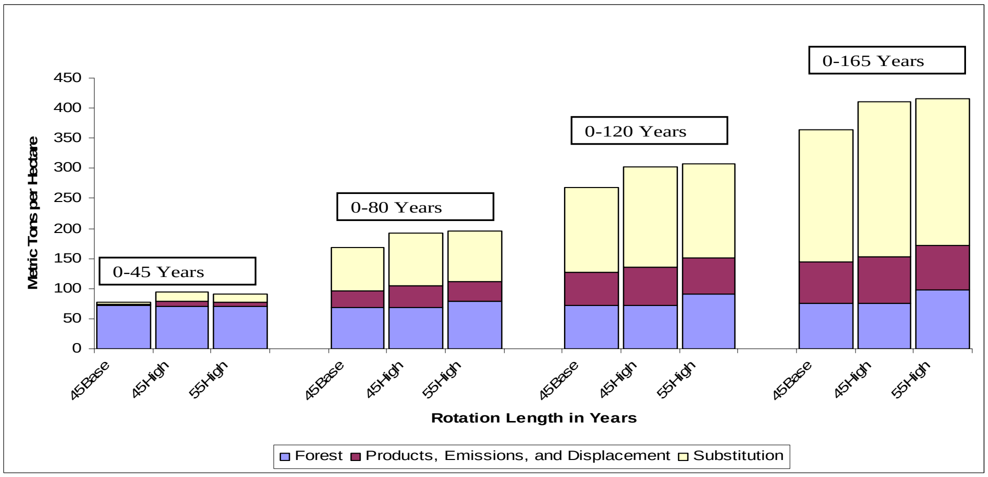

Figure 5. Average carbon in forest, product and concrete substitution for different management intensities.

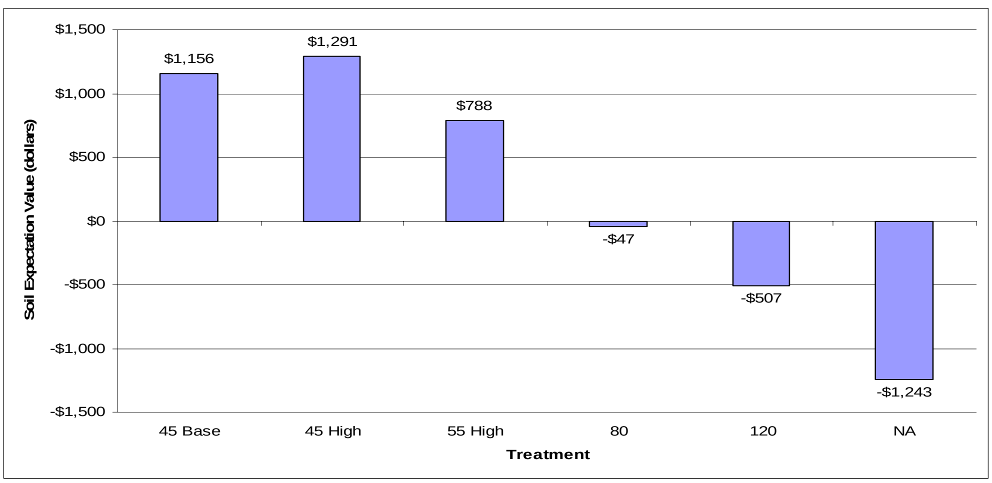

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Figure 6. Soil Expectation Value for different rotations and management intensities

The carbon in the forest is only useful for increasing carbon storage if land not in forestry is converted to forestry (afforestation), a one time increase in storage, or if periodic harvests convert the trees to long lived products producing an increasing pool of product storage in buildings. More intensive management that increases volume growth producing more long-lived products also increases carbon storage. In the PNW, that means intensive management on 45-50 year rotations for average site productivity is probably optimal. When carbon credits include the effects of substitution, a higher price for carbon in the short term would likely reduce rather than increase the rotation age. If substitution is ignored carbon credits would be likely to motivate longer rotations which may well be counter productive to the objectives of reduced carbon emissions.

References: (1) Manriquez, C. 2002. Carbon sequestration in the Pacific Northwest: a model. Master's thesis. University of Washington, Seattle, Washington, USA.

(2) Bowyer, J. et al. 2004. Life Cycle Environmental Performance of Renewable Industrial Materials: CORRIM Phase I Research Report. CORRIM Inc. (in care of College of Forest Resources, University of Washington)

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