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Research Station

Science
FINDINGS

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"Science affects the way we think together."
Lewis Thomas

LAND USE PLANNING: A TIME-TESTED APPROACH FOR ADDRESSING CLIMATE CHANGE

Jeff Kline

Land use planning in western Oregon has helped maintain the landscape's ability to store carbon.

"What good is a house, if you haven't got a decent planet to put it on?"
—Henry David Thoreau

Land use planning—it's not just about subdivisions and strip mall placement. It can be an integral part of broader environmental policy for addressing climate change. Since its inception in 1973, Oregon's land use planning program has concentrated development within urban growth boundaries. It has also encouraged efficient transportation corridors that include mass transit, bicycling, and other options for getting where we need to go. This pioneering approach to protecting agricultural and forest land has kept an estimated 1.2 million acres of these resource lands from further development. Along with reducing suburban sprawl, keeping forests as forests and farmland in crops has another unexpected benefit—land use planning in western Oregon has helped maintain the landscape's ability to store carbon.

Jim Cathcart, forest resource trust manager with the Oregon Department of Forestry, and Jeff Kline, a research forester with Pacific Northwest (PNW) Research Station in Corvallis, Oregon, quantified these contributions in a study that was incorporated into Oregon's strategy for greenhouse gas reductions.

The increase in atmospheric carbon dioxide (CO_2) is a leading contributor to global climate change. As policymakers grapple with mitigating climate change, two basic methods present themselves: reduce the amount of CO_2 (and other greenhouse

IN SUMMARY

Oregon's land use planning program has protected an estimated 1.2 million acres of forest and agricultural land from development since its inception in 1973. As a result, these resource lands continue to provide forest products and food as well as another unexpected benefit: carbon storage. By keeping forests as forests, land use planning capitalizes on the natural landscape's ability to sequester atmospheric carbon, a key contributor to climate change. Nationwide, however, forest land is the land type most frequently converted to more developed uses. When this happens, carbon storage opportunities are lost, and the new use, such as a housing development, often becomes a net carbon producer.

Scientists from the Pacific Northwest Research Station and Oregon Department of Forestry quantified the carbon storage maintained by the land use planning program in western Oregon. They found these gains were equivalent to avoiding 1.7 million metric tons of carbon dioxide emissions annually—the amount of carbon that would have been emitted by 395,000 cars in a year. Had the 1.7 million metric tons of stored carbon been released through development, Oregon's annual increase in CO_2 emissions between 1990 and 2000 would have been three times what it actually was. As policymakers look for ways to mitigate climate change, land use planning is a proven tool with measurable results.

gasses) emitted in the first place, or find ways to pull some of the excess carbon back out of the air. The study by Cathcart, Kline, and their collaborators suggests that an effective land use planning program can contribute to both these methods.

"The ability of forests to store, or sequester, carbon means they have a key role to play as we try to mitigate the effects of climate change," says Kline. Forests naturally sequester atmospheric CO_2 through photosynthesis and store it as carbon in trees, vegetation, roots, woody debris, and soil. When forests are cleared for more developed uses, much of the sequestered carbon is released back into the atmosphere, and the landscape's ability to sequester more carbon is severely reduced. To further exacerbate the problem, the new land use, such as a housing development, usually becomes a net carbon contributor, especially if it is accompanied by longer commuting times.

Forest land has been the largest source of development nationwide. Between 1992 and 1997, 1 million acres of forest were lost annually in the United States, and by 2030, another 26 million acres could be lost, including 2 million acres in the Pacific Northwest, Kline explains.

Oregon's climate strategy calls for reducing greenhouse gas emissions to 10 percent below 1990 levels by 2020. To find ways to meet this goal, the governor appointed an advisory group in 2004. Working under the Oregon Department of Energy technical team for this group, Cathcart was chair of the biological sequestration subcommittee. "We wanted to know what opportunities existed for storing terrestrial carbon. I knew that maintaining forests was important, but I wasn't sure how to quantify it. Then I met Jeff," recalls Cathcart.

The two scientists met by happenstance at a science fair sponsored by the PNW Research Station in 2004. Kline was presenting a poster describing a land use model developed for a different study. The model could be used to project future land use for western Oregon with and without Oregon's land use program in effect. After talking a bit, the two scientists realized that by using Kline's model and Cathcart's carbon numbers, "We'd be able to figure out how much carbon storage would have been lost without land use planning," Cathcart says. It also enabled the scientists to consider how extensive a role land use planning could play in future carbon sequestration strategies.

KEY FINDINGS

- Oregon's land use planning program yields significant gains in carbon storage through avoided forest land loss. Estimates indicate this storage has been equivalent to avoiding 1.7 million metric tons of carbon dioxide (CO_2) per year. This is in addition to the primary benefits attributed to land use planning such as protection of forest and agricultural land, improved transportation, and more orderly growth.
- Had the 1.7 million metric tons of stored carbon been released though development, Oregon's annual increase in CO_2 emissions between 1990 and 2000 would have been three times what it actually was.
- Oregon's land use planning program will continue to yield carbon storage benefits based on its conservation of productive forest land. By 2024, avoided development on an additional 205,000 acres of forest and agricultural land will yield an additional 3.5 million metric tons of avoided carbon loss, equivalent to roughly a reduction of 12.8 million metric tons of CO_2 emissions.

Jeff Kline

Forest land stores more carbon than other land uses, but is the land type most likely to be developed nationwide.

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UNPLANNED BENEFITS

Much of the impetus for Oregon's land use planning program 36 years ago was to protect commercial forest and farm land from development. Transportation planning was integrated soon after, as policymakers realized the two components could work hand in hand—by clustering development, transportation routes could become more efficient and influence the location and type of future development. Most people weren't thinking about carbon storage and reducing emissions back then, but as Kline and Cathcarts' study found, these benefits were quietly accumulating below the radar.

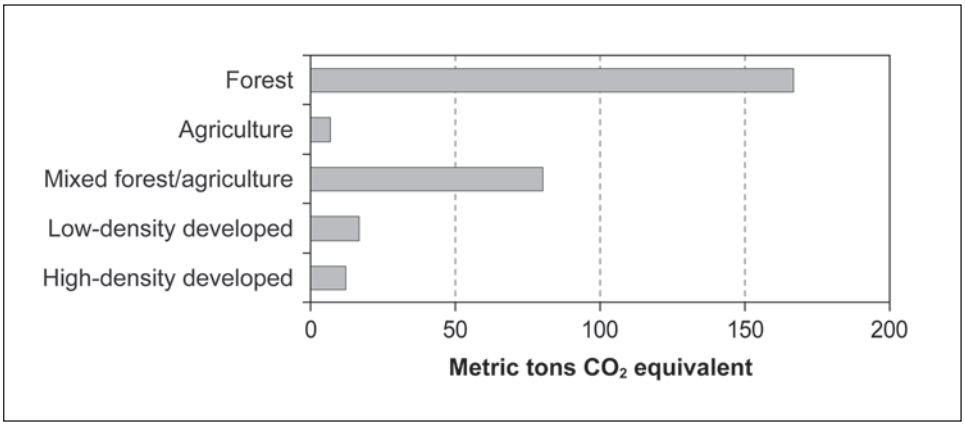
"We estimated carbon benefits for two scenarios: one assuming Oregon's land use planning program as enacted in 1973, and another assuming Oregon's land use planning program was not enacted in 1973," says Kline.

The scientists estimated that 1,221,000 acres of forest and agricultural land in western Oregon would have been converted to more developed uses without the land use planning program. By maintaining these lands, the gains in carbon storage are equivalent to avoiding 1.7 million metric tons of carbon dioxide emissions per year. That's the amount of carbon that would have been emitted by 395,000 cars in a year (assuming each car gets 25 mpg and is driven 12,000 miles annually), explains Kline.

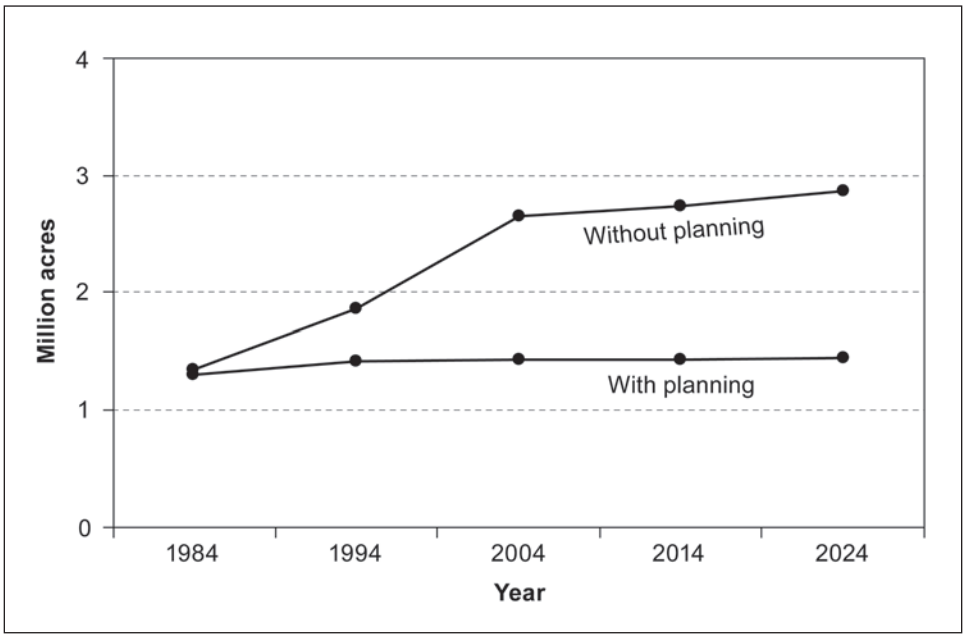
Had the additional 1.7 million metric tons of stored carbon been released through development, Oregon's annual increase in CO_2 emissions between 1990 and 2000 would have been three times what it actually was.

"Had we not had the land use policy, we would have had sizeable more emissions, and that's before we were even concerned about carbon storage," says Cathcart. "Now that it's something we're aware of, we can shore this up, but it has to be a conscious policy decision to keep a land use policy in place to do this."

Their projections suggest that if maintained, Oregon's land use planning program will continue to yield carbon storage benefits based on its conservation of productive forest land. By 2024, avoided development on an additional 205,000 acres of forest and agricultural land will yield an additional 3.5 million metric tons of avoided carbon losses, equivalent to roughly a 12.8 million metric ton reduction in CO_2 emissions, or 0.64 million metric tons CO_2 per year.



Estimated average amount of CO_2 stored per acre by different land uses in western Oregon.



The estimated cumulative loss of forest and agricultural land to low-density or greater development in western Oregon with and without the state's land use planning program.

CONSERVATIVE ESTIMATES

"Our findings are pretty conservative because we didn't consider the carbon stored in soil and dead wood," says Kline. "The forest land-use class will have more of this than other land-use classes, so carbon savings are actually greater. We were just looking at avoided forest loss. If you factor in other benefits like more compact development, people driving less, using public transportation, then it would be even higher," he explains.

Cathcart agrees, adding, "In our land cover assumptions, we assumed that the forest being lost to development was 25-year-old Douglas-fir, when in actuality, the trees are probably older than that and so would have stored more carbon."

Because this analysis simply looked at aboveground carbon stocks, the model indicated that moderately developed land stores more carbon than agricultural lands. "We don't want this to be misinterpreted," says Cathcart. "The increase in carbon storage on moderately developed lands comes from landscaping, shade trees, and grass, for example. In this analysis we assumed that agricultural land was cultivated in annual crops, not something like orchards or Christmas trees, which store more. We only accounted for changes in carbon stock arising from development. We didn't account for the higher carbon footprint of average domestic use over agriculture."

RECOGNIZE WHAT WORKS

Long-lasting wood products, such as 2 by 4s, continue to store carbon even after the tree has been cut. Forest land that is actively managed for timber is replanted after each harvest, and thus over time, stores more carbon than land that is harvested once before development. "It may simply be the act of maintaining or increasing the amount of land area in forest cover that is the most important action to take," explains Cathcart.

"All you hear about is developing a cap and trade program or carbon market—a policy approach that has not been used that much," says Kline. A cap and trade program, as generally envisioned, would include carbon offset opportunities where an entity, such as an electrical power plant, could buy carbon credits from a landowner whose property provides an increased level of carbon storage. A key part, though, requires a cap, presumably set by the federal government, limiting the amount of carbon that can be emitted before the entity would be required to buy or trade carbon credits for the rights to emit more carbon. Some people think that a carbon cap and trade program can work in a similar fashion and with similar success as the sulfur dioxide (SO_2) market established in the 1990s by the Environmental Protection Agency.

"There's potential for markets to work," says Kline, "but a carbon market will be more complex than the SO_2 market. With SO_2 there were a lot fewer producers involved—SO_2 pollution generally came from a known number of coal-fired electrical plants." Carbon dioxide, on the other hand is emitted by every breathing being on Earth. Sulfur dioxide emissions also led to an immediate and visible problem: acid rain. This created a greater sense of urgency in the general public than climate change has, a problem commonly perceived as occurring in the nebulous future.

When the SO_2 market was created, explains Kline, "People were reacting to the acid rain that had been damaging and killing trees in the Northeastern United States. People could see the effects of SO_2 pollution and they pressured politicians to change things. The immediate effects of CO_2 and climate change are not as visible or certain in the collective mind of the public, so the public may not be as motivated to act as quickly."

"While we wait for stronger climate change policies to be implemented, we don't want to forget about what we're already doing," says Kline. "Existing forest land conservation policies and programs can make significant contributions to addressing climate change until the issues involved with carbon trading and offset programs are resolved, or society becomes more amendable to taxing carbon emissions."

Jeff Kline

By maintaining forest and farm land, Oregon avoided an estimated 1.7 million metric tons of carbon emissions annually between 1974 and 2004.

Jeff Kline

Oregon's land use planning program has encouraged high-density development within urban growth boundaries.

Land use planning has its own uncertainties, however. In the last 10 years, there have been several challenges to Oregon's land use planning program, and voters have approved some changes to it. Relative to other approaches

WRITER'S PROFILE

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to forest land conservation, land use regulations and zoning can be implemented and administered at relatively low cost to governments. There is, however, "a persistent tension between society's desire to both conserve land and uphold certain private property rights," explains Kline.

Ballot Measure 37, which weakened the land use planning program, passed in 2004 but then was overturned and modified in 2007 by Measure 49. "Given the passing of Measures 37 and 49, it creates some uncertainties about the future of land use planning in Oregon. Pointing out these broader environmental benefits becomes an important factor to add to the debate. It has to be a conscious policy decision to use land use planning as a way to mitigate climate change," says Kline.

LAND MANAGEMENT IMPLICATIONS

- Land use planning is typically implemented to facilitate more orderly and efficient use of land, conserve forest and farm lands, and facilitate transportation planning. These results suggest that land use planning also can be an important part of larger strategies focused on lowering greenhouse gas emissions and mitigating climate change.
- Traditional approaches such as land use planning and conservation easements and others that retain land in forest cover remain relevant methods for storing carbon and offsetting CO_2 emissions even as policymakers focus on newer and perhaps less tested policy alternatives.
- Informing the public about the carbon sequestration benefits of land use planning is important, particularly in Oregon where voters are periodically asked to reassess the value and appropriate extent of land use planning.

COMPLEMENTARY APPROACHES

"Mitigating the effects of climate change will likely take a variety of approaches," says Kline. Lifestyle choices play a big part in the amount of carbon that is emitted, but policies and programs can create the opportunity to make choices that leave a smaller carbon footprint. For example, a gas tax or road toll can raise the cost of commuting so that commuters want to drive less and live closer to where they work. A land use program that provides clustered development around alternative transit options makes driving less a more feasible option.

"At a minimum, you don't want policies to work against each other, and ideally you want them to work together," says Kline. "If people want to live closer in because commuting costs are going up, and land use planning is helping them live closer to work, then that's a good example of complementary policy."

"We can have smart development to minimize loss of forest value," says Cathcart. Conservation easements and private land trusts are some of the other ways to protect forest and agricultural land from further development. Another possibility is developing ecosystem service compensation programs. For example, landowners could receive a credit for avoided development. And if and when carbon trading and offset programs or markets more fully develop, they will offer another approach.

In the meantime, says Kline, "existing forest land conservation policies and programs can make significant contributions to addressing global climate change."

Jeff Kline

Landscaping can help increase the carbon storage capacity of developed land.

"No matter how complex global problems may seem, it is we ourselves who have given rise to them. They cannot be beyond our power to resolve."

—Daisaku Ikeda

FURTHER READING

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