It All Starts in the ~~Dirt~~ Soil

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Chris Edwards: Welcome to Forestry Smart Policy, a podcast produced by the Oregon Forest Industries Council for policymakers and other thought leaders influencing decisions in Oregon. I'm Chris Edwards, your host and president of OFIC. In this episode, I sit down with Dr. Tom DeLuca, who has been Dean of the Oregon State University College of Forestry for just over three years. As an expert in forest soils, Tom holds a doctorate from Iowa State University, a master's degree from Montana State University, and a bachelor's degree from University of Wisconsin-Madison, all in soil science. We discuss all things related to forest soils and carbon, including forestry's role in the carbon cycle, how long carbon is stored in wood products, the benefits of mass timber, and forest management's impact on carbon stored in the soil. Along the way, we also talk about our human connection with trees and wood products, the natural relationship between trees and soil, and the impact of land use decisions on carbon stored in soils. Without further delay, here's my discussion with Dr. Tom DeLuca.

All right, today on the Forestry Smart Policy Podcast, I'm super excited to be interviewing Dr. Tom DeLuca, Dean of the OSU College of Forestry. Tom, welcome to the podcast. Before we jump in to the conversation, how about you give us a little bit about your background? What brought you to Oregon?

Tom DeLuca: Yeah, it sounds great. So prior to coming to OSU, I was the Dean of the College of Forestry and Conservation at the University of Montana. And before that, I was at the University of Washington as the Director of the School of Environmental and Forest Sciences. My background is in forest soils. I have a PhD in soil science from Iowa State University, and I have worked in forest soils my whole career.

Chris Edwards: All right. Forest soils. I'm already making notes of some things I want to ask you about later. And I know that you and I both share a love for the sector for many of the same or similar reasons. And we both see a need for humanity to flourish and thrive. And we understand that just inherently everything ultimately rests on natural resource utilization. I mean, everything that we use in our lives comes from the ocean or the dirt or a

hole in the ground. I've always been impressed by just how renewable active management forestry is and the important role that it plays in meeting the needs of modern society. And one of the things that I've noticed is that a lot of the folks, really important stakeholders in these conversations, might not have the same grounding of knowledge about forestry. They're being pushed or pulled in different directions by concerns of the moment, whereas our members, and certainly the College of Forestry, is really looking at the long term, the long view, if you will. And so maybe to kick the conversation off, we could start talking about the long view, maybe a little bit of the history of forest management in Oregon or the Pacific Northwest.

Tom DeLuca: Yeah, that would be great. Thank you, Chris. I'll first just mention that, of course, we'll want to refer to soil as soil, not as dirt. But that's just a minor correction. No, all joking aside, it's interesting. Forestry under US governance doesn't make an appearance on the landscape until the beginning of the last century. And forestry was introduced as the first large scale conservation practice to be conducted on a landscape level under US governance in response to what had been a sort of cut out, get out, logging mentality of Europeans as they arrived in the United States from the East Coast through the Northwoods and into the West Coast. And that is what resulted in the creation of the National Forest System and the establishment of forestry programs at universities all across the US., including Oregon State University. The first forestry degrees started being granted in 1907, and that was similar at universities like Washington, Montana, Yale. And the intent was to train that cadre of foresters that was going to populate this National Forest System and manage these forests all across the West with the intent of doing so in very much a conservation-oriented mentality of meeting human resource needs but minimizing impact on the environment. Those are forestry's roots. And through the 1950s and 60s, the US. Forest Service practiced maximal allowable yield forestry and began to and provided those resources that basically built the growing infrastructure of the United States. All the housing that was going up in eastern United States across the Great Plains, these resources were being used for this purpose. The extent of forest management on federal land hit a rough point with the American public and with the writing of the Monongahela Report and the Bolley Report. Really, things began to change. And forest management on federal land in the Pacific Northwest really came to a screeching halt with the Northwest Forest Plan in 1994. That really changed the shape of the landscape in the West with what had been intensively managed forests on federal lands that were scheduled for entry for pre-commercial thinning and first thinning and then for a rotation were just set aside. And that has resulted in a very significant change in the structure and function of those forests and the condition that we see them in today. Nonetheless, humans' demand for these resources just continued to grow. Roundwood demand is

growing lockstep with population growth globally, and we're in a location that is very well suited to sustainably producing timber for this growing population. And as you said, Chris, forestry, unlike most other land uses, is really a sustainable land use. It is grown on long rotations compared to any other agricultural use, and with native species, a native understory, it really is a different beast altogether, but it tends to get a very critical eye because of the visibility of it in particular, given where it sits in the landscape, predominantly in upland settings.

Chris Edwards: Yeah, that's a really good point. It is a very visible activity, and what's less visible are the market's ability to find other solutions. So if we don't responsibly utilize our resources from here, whether that's meeting our own demand or demand elsewhere, predominantly inside the United States in this case, those materials are going to come from elsewhere, and they may come from ecosystems that do not have the same types of resources. Markets are very powerful engines for finding solutions. And I think that something that's lost on a lot of folks is that if we are not producing here in the Pacific Northwest, as you said, it gets produced elsewhere. The markets will make up for it. That demand will be met somewhere. And our biggest concern is if it's met in a place where species are imperiled in a big way and environmental laws are such that those species are not protected.

Tom DeLuca: I think we can do a great job here in the Pacific Northwest of producing timber resources sustainably and in a way that meets these human resource demands while minimizing our impact on the environment. And that will continue to be one of those drivers for us as a forestry college of how do we do the very best job possible. And of course, we're talking about markets in a global sense, but we also have some global challenges like climate change.

Chris Edwards: And of course, that has really focused much of society. Certainly, it's been a focal point of the environmental movement. And forestry has a really strong role to play in addressing climate change. But perhaps you could talk a little bit about the carbon cycle and start grounding this conversation with sort of the big picture forestry within the carbon cycle.

Tom DeLuca: Yeah, well, we all know by this point that climate change is a result of anthropogenic loading of the atmosphere with CO2 or other greenhouse gases that are produced through a number of channels. But by far and away, the number one leading cause of greenhouse gas loading of the atmosphere comes from the burning of fossil fuels. 4.5 billion metric tons of carbon dioxide are put into the atmosphere annually here in the United States as a result of fossil fuel burning. If you look down the list of the other sources, primary sources of greenhouse gas emissions, they will be orders of magnitude less than

the fossil fuel consumption source, but it will be production of a host, a range of industrial products, including concrete and steel, as well as a number of industrial products. And then the agricultural sector with the fertilization and annual tillage is a significant contributor. And forestry, as you'll note, as a sector, is a net sink of carbon. It does not show up as a contributor to greenhouse gas, net greenhouse gas loading of the atmosphere in the United States or globally. And that's important because we have areas where that is not the case, such as where there is deforestation occurring, and people inaccurately conflate deforestation with forestry, and they're two very different things. Forestry is growing of successive crops of timber with intention and a specific intention to harvest and replant and grow another future stands of timber. Deforestation is the clearing of land for urban settings, for agricultural production, or industrial production, and it is very different from forestry. So forestry as a sector is a net sink for carbon, and that's something that we're really proud of and something that we want to build upon and recognize that the timber sector can generate structural building materials that can displace some of the carbon-emitting building materials on a global scale. Yeah, you asked me to talk about the carbon cycle, and now I realize I didn't get back to the cycle because it is a cycle. Carbon is constantly, globally, naturally, carbon is constantly being emitted as CO2 and absorbed by biological plant life and converted back into what we call reduced carbon, into sugars and cellulose and lignin and into proteins and you name it. It goes into biological carbon, and both in the ocean as well as in the terrestrial landmass. And CO2 is also absorbed into the ocean and precipitated out as carbonates into deep sea sediments. And so the earth is literally breathing. It's releasing carbon dioxide and it's absorbing carbon dioxide. And it's that net emission of carbon dioxide that's adding an excess amount of carbon dioxide to the atmosphere. And greenhouse gases writ large, I should say, CO2 as well as other greenhouse gases. And in the case of burning fossil fuels, those are buried in geologic deposits that would not interact with the atmosphere if we didn't drill them, refine them and burn them. And it's only at the end of that process of burning that we have that net addition to the atmosphere. So when I refer to forestry as a net sink for carbon, what I mean is that it is in the short term, geologically speaking, it is storing more carbon than it is emitting. So if the forest, as it's growing, takes CO2 and water and sunlight and creates sugars, and those sugars go into the function of that tree, either into the biomass or into the processes that keep the tree alive, that results ultimately when that is converted into wood, that it's stored for a relatively long period of time. In a Douglas fir, that might be anywhere from 50 to 800 years, or in a blade of grass, it might be six months or eight months that it's stored in that biological form. The vast majority of carbon in the terrestrial landmass actually exists below ground in soil. So as trees fall to the earth and decompose, a certain percentage of that goes into what we call the soil organic matter, and it's both stored in surface soils as well as down deep in the soil. And an enormous amount of carbon is stored

below ground. So it's stored both in the standing live timber of those time frames that I talked about, you know, 50 to 800 years, or it's stored in the soil organic matter or short term in animals and herbaceous vegetation. It's not...

Chris Edwards: You've already corrected me in calling it soil instead of dirt. I kind of feel like dirt has a little bit... It's a little more folksy, so I may continue to call it dirt. I'll try to be a little bit smarter about this. So we're talking about carbon stored in soils, or if it was carbon that was grown into that tree, then that's carbon stored until it either A, decays, or B, is burned. I'm not sure if there's anything else that could happen to it that would release carbon.

Tom DeLuca: No, those are the two routes for it to be converted to carbon. So in our homes that we live in, most of us in the Pacific Northwest live in wood-framed housing. The frame that creates the structure of that house, that is storing carbon. So there was no emission when that house was built or when that log, when that tree was felled in the woods, and then that didn't become an emission. The felling of the tree itself is not an emission. The use of diesel to power vehicles that are felling timber, of course, is a source of emission. When you de-limb the tree and burn the slash, that's an emission. And when you burn mill residues at the mill, that's another source of emission. So you might come out with anywhere between, let's say, because a significant amount is left in the root mass in the ground, which also decomposes and releases, you might have, say, in the wood that's actually milled, 35% of the total tree mass is going into a wood product, and that has different lengths of time until it decays based on what it's turned into, what you're producing, and how it's used. So when you put that wood product into use, into a home, it's up for a long time. We hope to see those homes, like the home that I'm living in was only built in the 1990s, but the house we lived in in Helena, Montana, for example, was built in 1901. And it's still standing today. I just saw it not that long ago when I was interviewing for a job in Britain. At one time, we went out to a pub that was built in 1400s, and the timbers that are still there after 700 years are sitting there intact. So depending on the use, it can be a very long-term storage of carbon as a standing structure, or even when that material goes into the landfill, it may last for a long time in the landfill. A landfill is intentionally sealed as a tomb. You basically try to keep the water out so you don't get leaching of toxins through the landfill, and you try to minimize the amount of air because air isn't good in the landfill. You want to maximize the mass that fits in there, not a bunch of air. So you compact and compact and compact, and you put layers of seals, you know, and cells, clay caps to try to minimize the water moving through. One time I used to take my soils class in Montana out to the landfill every year just as a part of a tour of what happens to our waste because we as consumers generate a lot of waste. And they were digging gas extraction wells, and this was in the mid-90s, and he pulled up a newspaper from 1972 with Richard Nixon's picture

on the front page, and it looked like brand new. It looked absolutely like it was just printed yesterday. Now, that's not true of every landfill and not true, but it was just incredibly instructive to those students that a landfill isn't a good place for decomposition. It's a good place for things to last a long time, and that has to be factored into that length of time that those wood products that go into the landfill last. Ideally, we keep reusing wood products, such as with mass timber, which we may talk about later, that have the potential to be repurposed at the end of their building lifespan.

Chris Edwards: You just said a bunch there, and I have three things that I want to return to before we move on. First, even if those wood products were to decompose, they started out as a part of the natural carbon cycle, as opposed to carbon that came from embedded deep below, deep in the crust of the earth. That type of decomposition is not a net contributor to the amount of carbon in the atmosphere. Is that a correct statement?

Tom DeLuca: That is absolutely correct, and thank you for clarifying that point, because it's a really important one. All that carbon that's going to be released by that tree being burned or being used in one way or another is carbon that was fixed within the lifespan of that tree. When we see the needles being burned in a slash pile, for example, along with stems, the needles are the most recently fixed carbon in the tree, basically, and that might have just been fixed within the last year. So yes, you're absolutely right.

Chris Edwards: That's a really good point and one that needs to be considered. Another item that I wanted to return to was when you were speaking of how old houses are. So just as it, because I've heard folks talk about, well, you can't assume that a built structure is going to last that long. It may only last 30 years. So I just did a very informal poll on my Facebook page. And I just said, hey, everybody, when was the house built that you're living in? Whether you own it, you're renting it, it's an apartment. And people were posting, oh, when it was built in the 90s, when it was built in the 70s. My parents, the house that they still live in, that was built in the 60s, got a lot of answers that were sort of built in that post-World War II era, which of course is much more than 20 or 30 years ago. And then people were chiming in and saying, oh, well, we built in, the house that we live in was built in the early 1900s or the 1920s or the 1910s. And so we're talking about structures that are 80, 90, 100 years old, over 100 years old. And that is a very different picture. I also in that same survey asked if anybody was living in a home or on a lot that had been redeveloped. And I didn't have any answers now. Of course that does exist, but just in my little world, nobody said, oh, yeah, we live in a redeveloped lot or we bulldozed a lot and we rebuilt a new structure. You know, this notion of how long wood lasts in a standing, non-decomposing state after it comes out of the forest, I think is something important for folks to wrap their heads around.

Tom DeLuca: Yeah, absolutely. And, you know, one can calculate half lives or, you know, resonance times for different uses of wood products, whether it's paper or structural building materials or furniture. You can come up with a pretty good estimate of that. But it's all based on a certain set of assumptions, which may or may not be correct. But I think that with housing, and, you know, our hope is that when we build a house, it's going to be there for a long time, ideally. With large buildings, they tend to build with a specific design life. And, for example, the dormitories that they were tearing down when I was at University of Washington, were built with a design life of 60 years, and they went and tore them down at 60 years and rebuilt. And they tore down steel and concrete structures that were net emitters when they went up, and they rebuilt with another set of steel and concrete based structures with wood trim and wood windows and that type of thing. But it's interesting, the vast majority of mass in our landfills is construction materials. That's, yeah, that is interesting. That's mass. That's because concrete weighs a lot, you know, it has a high density, and we generate a lot of construction waste.

Chris Edwards: So one of the other items I wanted to return to is you made the statement that I knew what you were talking about when you talked about the waste that might be burned at the mill, and maybe that's, you know, the bar, the stuff that doesn't become a sheet of veneer or a piece of plywood or a shaving or a sawdust, which of course have other uses in composite materials, but there is a certain amount of material that gets burned at the mill, but it's burned to produce energy. Right? So it itself is substituting for other carbon-intensive forms of energy. I mean, if you have a natural gas peature plant or some other form, you know, coal, natural gas, a fossil fuel-intensive energy source, versus burning the residual waste, say the bark, off a tree to produce energy, one is clearly more carbon preferable and actually carbon neutral.

Tom DeLuca: Yes, absolutely. That's a really good point. And that is absolutely true of mill residues that get burned as hog fuel at a minimum or sometimes in really advanced boilers that are generating electricity. And so they offset or substitute for fossil fuel-based uses of energy, which is a direct offset that needs to be considered when looking at the total emission of carbon dioxide associated with the wood product.

Chris Edwards: One other thing I wanted to return to was the statement you made that only 35% of the total tree mass actually makes it into a finished building product. And I believe that statement was grounded on the fact that you were also talking about wood mass that exists below the soil or in the soil.

Tom DeLuca: Yes, absolutely. All the root mass above ground would be a much higher percentage than 35%. It's just the limbs and the tops that don't go to the mill end up being burned in place. But the root mass accounts for about 20-25% of the tree as a whole. A lot

of people think it's 50% of the tree's mass is below ground, but it's more like, I should have said 20-35%, I think, that ends up being below ground. It depends on the type of tree. Of course, we can take that same acre that we just removed trees from, and now we're storing... That has all the sidle benefits that we've already referred to as the carbon storage benefits that we've already referred to. And we can now take that acre and replant it, continuing that cycle.

Tom DeLuca: Yes, yeah, absolutely.

Chris Edwards: So let's talk a little bit then about what it is that we're able to build out of wood products, because there's a lot of advances in that world and what we can do with wood products, and a lot of that's being driven at the OSU College of Forestry. So tell us more about that.

Tom DeLuca: Yeah, mass timber. It's part of a revolution in tall building in the United States and abroad. Basically, we have these materials that are mass plywood panels, cross laminated timber, glulam beams. These aren't necessarily new things that have just recently been developed, but have been developed over years, both in overseas as well as here at home. So OSU plays a significant role in that, having a really solid wood science and engineering program that has lasted through the decades. A lot of universities around the nation folded their wood science programs. There's a few standouts around OSU, University of Maine, Virginia Tech, North Carolina State, but they're few and far between. Mississippi State, I believe. Anyhow, so that's something we're really proud of, having that really strong wood science and engineering program here in the college. They're working on a whole range of mass timber products that can be used in structural building. Well, basically, over the last 80 years, there have been restrictions on how tall you can build with wood because of fire concerns. The reason for that is that each individual stud is surrounded by oxygen, basically, and so in a fire, that stud can burn fairly quickly. With these mass timber products, such as cross-laminated timber, while the outside layers might char during a fire, they retain their structural integrity far longer than steel would under that same condition. So OSU has been directly involved in the development of some of these materials, but also the structural testing, and with the new Tallwood Design Institute that's at OSU, which is a joint effort between University of Oregon's architecture program, OSU's College of Forestry and OSU's College of Engineering, we work with industry to provide this outlet for innovation and testing in mass timber and mass timber construction. And so we just had a three-story building built indoors inside of the Emerson Advanced Wood Products Building, which is where Tallwood Design Institute is located. And we were able to test it with a strong wall and strong floor, doing seismic testing on these structures. So it's very exciting. We're helping move the needle on mass timber

construction. I think it's one of the most exciting things for architects that they've had in decades. And so architects are looking at mass timber as a way to A, displace some amount of steel and concrete in tall wood design and to bring down the net carbon intensity of that structure, as well as the versatility associated with it. It's lightweight. You can have all sorts of detail done at the mill site and then have it shipped out to the build site for a very quick assembly relative to how long it would take to build the same structure and steel and concrete, and it's also exceptionally quiet on the build site, which is kind of an interesting additional fact associated with mass timber construction. I just visited the new Hartwood building that went up in Seattle. We were just up there last week visiting with the architect and the builders, and Susan Jones of Jones Atelier and Swinerton, the company responsible for the construction, was just, first of all, it's a beautiful building. It was for low to mid-income residential living, and it was infill. So in a very small space, they put up this eight-story building with very little disturbance of the area surrounding, and it was constructed quickly. It's still under construction. There's still more work to be done, but it was a great example of a way that mass timber can help densify urban living, minimize sprawl and consumption of rural landscapes into urban development, and build with a low-carbon, totally renewable building material.

Chris Edwards: Yeah, that's super exciting because now you're taking wood structures from the suburbs, if you will, small towns in the suburbs to really city cores, and helping densify. Everybody knows that we need more housing, not just here in the Pacific Northwest. This is a national issue. It's a global issue. It's a global issue, and the housing is going to come from somewhere, and it is going to be built with something, and we have a choice. Yeah, and wood is beautiful. It's warm. In terms of, as in our value, associated with wood as opposed to other material. And it's simply relaxing to be in a wood structure as opposed to a concrete structure. It just really is. Yeah, there is something about our connection with wood as a material. I was at a meeting last week. They opened the meeting with an icebreaker question, and the icebreaker question was what do you have in your life that is made of wood that you value the most? And as we went around the room, there was so much emotional connection between the trinket that had been handed down or the dining room hutch or the century-old dining room table or the rocking chair or the house that Granddad had built. I mean, there were all these things that people felt a real connection to. And I remember when I left that meeting thinking, I don't feel like the answers would have been as heartfelt if the question had been, what object do you own made of steel or plastic that you care about most?

Tom DeLuca: Yeah, yeah, so it's really true. Anyway, it's just a little side thing. No, that's really great. And I could add to that, certainly, in terms of what things are valuable in our house that are made out of wood, so many things that have traveled with us overseas and

back again. One thing I wanted to just finish up with the mass timber construction, which I think is really exciting and really important, and I kind of alluded to it earlier, is that architects are now drawing up blueprints for construction and blueprints for deconstruction of mass timber buildings. Because you can. When you can deconstruct a steel and concrete building, you generally demolish it, you try to recycle the steel, so you have to ship it off and recycle the steel, and then the concrete can be ground and reused, but it's energy intensive, and oftentimes goes to the landfill as capping material as a recycled use. Whereas with these mass timber panels, you can actually repurpose them, pull them out of the building, so they have the instructions, the blueprints for deconstructing the building, pulling the panels out, and then you can CNC cut the building, the panels for a new building, and reconstruct with this material. That takes an 80 or 100 year design life of a building and just extends that lifespan of that material that much further. These products are really special, and we're really excited about the future that they hold for the people that will be using them, as well as the carbon neutrality of the material as well.

Chris Edwards: That's super cool. One of the things that I've noticed as mass timber picks up steam as an exciting new building material is that where there's always been concern about forest practices and the sustainability. And certainly one of the things that we do here at OFIC and elsewhere in the sector is try to educate people about the sustainability. That's part of why we're having this conversation today. But there have been architects that have been saying, well, how do we know that it's sustainable? How do we know that it's sustainably sourced? And of course, we had the Private Forest Accord, which is a huge rewrite of regulatory practices here in the state of Oregon and the state of Washington as their regulatory framework for forest and fish. And the bottom line, as far as I can see, is that here in the Pacific Northwest, we're the most regulated, the most modern regulatory practices in the nation. For whatever reason, mass timber seems to be bringing a new focus onto the regulatory framework. And I just wondered if you guys are thinking about that at the college or if you have any thoughts about just sustainability generally here in the Northwest.

Tom DeLuca: Yeah, absolutely. I have a lot of opinions. The sustainability of forest and forestry as a practice, I think there's a lot of misinformation about forestry as a practice. I think that there tends to be a lot of concern that's raised out of aesthetic concerns that are translated from when a forest is clear cut, for example, as opposed to the actual numbers that would be associated with, well, how does that function over the long term in terms of net carbon storage or ecosystem function? Humans have a unique connection to trees. People love trees; that's all there is to it. And so the tendency is to, because a tree also outlives us in terms of lifespan, we sort of revere a tree as really special in that regard. And

so we tend to perhaps inadvertently overestimate the value of that system from a biodiversity perspective. Those forests are exceptionally important from a biodiversity perspective. No question about it. But so were the low-elevation riparian areas that are now urban centers, which we all live. We made a gigantic clear cut, and we chose to live in it and plant back a few exotic species, as well as some native species. But the vast majority of what would have been exceptionally high biodiversity landscapes, the places where most animals want to live, we want to live. And we think, though, when we look up at the mountains, because that's where the vast majority of biodiversity is retained today, that that's where it always was. But it's a bit of a misconception about biodiversity on a landscape scale and our role in disturbance of it. We are consumers, and we demand resources at an exceptional rate, especially as our population grows. And so we tend to ignore the fact that our consumption is driving those decisions and those practices. People do have a really unique connection to trees and to forests, and we tend to think of them in a special way because they have such a long lifespan. We don't have nearly that affinity for young trees. Of course, with animals, though, puppies, humans, babies, the babies are the most revered part of a household. We don't have that sense when it comes to trees.

Chris Edwards: I'm not going to lie, seedlings are not as cute as puppies.

Tom DeLuca: No, they're not. Wrong agreement. Yeah. I guess I was just trying to explain the strange disconnect that people have when they think about forests versus other parts of the landscape. I talk with people all the time that want private landowners to grow their trees longer, to grow them older. And then once they're older, they say, whoa, now you can't cut them because they're old. They're more revered as they get older. And so, well, what do you want us to do? And it's inconvenient. It's inconvenient for people to really sit down and think about, like, well, where are we going to get the resources to provide for our society? Well, and it's complicated. It is. And it's completely understandable that people that aren't in the sector might not understand it very well. And going back to that point, I think that the tendency is to think of a managed forest as being a biodiversity bankruptcy, but it's not. It is actually a managed forest that's grown with native species and has a native understory, has a surprisingly high native biodiversity associated with it. That's something to build off of and to recognize and expand upon. And the SAF Code of Ethics... SAF is... As a Society of American Foresters has a Code of Ethics. And I think it's number three is we will always strive to do better. And that has to be our mantra, that we will always strive to do better. And I think the next one is that our work will be based on the best available science. And that's where we as a college come in. Our job is to pursue an understanding of what does that look like, to produce timber efficiently and economically while having the minimal impact on the environment. And that's what sustainability is, and that's what we are indeed pursuing as a college.

Chris Edwards: No, you did, and let's tee off of that concept. One other thing I wanted to ask you about sustainability is... I've talked with folks that have said, well, yeah, Chris, you can harvest and replant, and you can harvest and replant, but you're ruining the soil when you do that. Now, when I hear people talk about the impacts to the soil and their concerns about us being able to do that indefinitely and continuing those rotations on that land base, but then that to me doesn't quite square with what you said earlier about the percentage of woody biomass that is actually in the soil and left in the soil after harvest. So maybe you could talk a little bit about sustainability from a soils perspective, because it all starts in the soil. I'm not giving up on the term dirt yet.

Tom DeLuca: It all starts in the soil. We'll agree to disagree there. So yes, I totally agree that the importance of maintaining productive, healthy soil for a functioning ecosystem is so important. There is a sense that as you harvest timber, take off a rotation and start another plant and start another, that over time that system will degrade. The fact is that the soil is surprisingly resilient. And if you look at the effect of multiple rotations on soil organic matter, total soil carbon storage, the effects of timber harvest on soil carbon storage are fairly minimal. The organic horizon that sits on the soil surface, the forest floor as it's called, or the litter layer and the surface decomposing material, as well as what we used to call the humus layer, those can be lost as they're disturbed and moved into the soil surface, and some of that lost, but the vast majority of the carbon is stored in the mineral soil, and that is surprisingly very solid over time with any disturbance. Now, getting back to the heart of the question, if we contrast forest management with even here in the Pacific Northwest, the shortest rotations are about 35 years, 35 to 40 years. In parts of the state that grow trees extraordinarily fast. That's right, on the west coast, yeah, and in the west side of the Cascades. That would be the shortest rotation that is used. If we contrast that with any other land use, it's exceptionally long. Very few people plant a crop and think, well, I'll come back in 35 or 40 years and check on it. Well, the whole time that the forest is growing, the soil is in rest, so to say. In agricultural practice, you tend to till every year and replant, because we plant annuals predominantly on the landscape. Even in no-till agriculture, where we are not tilling so much, you know, you've got equipment on the soil surface on an annual basis. In timber production, the soil is in rest for at least that 30, 35 to 40 years. And in longer rotation forestry, it's 80 years or 100 years. And in uneven age stand management, there may be entries for thinning or variable retention harvest, or but the disturbance is just the surface equipment is not tillage. So the soil organic matter content is very stable over time with forest management compared to any other land management practice. The soil biodiversity is also surprisingly resilient to the effects of management, and especially in these systems with native species and native understories, such as here in the Pacific

Northwest, where we're growing doug fir, and as well as Western Red Cedar, hemlock. We end up with an amazingly sustainable system, is the truth of the matter.

Chris Edwards: Yeah, and there are a lot of variables and factors that are being considered by the land manager when they're making their decisions. And one of those decisions is weighing the risk of wildfire. So as wildfire prevalence and severity increases on the landscape, I know I've talked with members of our trade association, land managers, they're saying, look, we have to account for that increased risk. The longer we carry that stand on the landscape before harvest, the greater the chance that it is eventually going to get consumed by a wildfire. So that is something that really is weighing on this conversation about rotation age. I think some folks, why would they have an understanding of that risk? Because they haven't thought about it from that perspective. They're thinking more about it from maybe a carbon perspective, or they're thinking about it from a soils perspective. And that wildfire risk and heightened risk in recent decades is a finger on the scale, so to speak, for that decision making. Yeah, that's a really good point. So maybe you could expand a little bit on the notion of sustainability and the concept of sustainability as it pertains specifically to forest soils and soil health.

Tom DeLuca: Yeah, I'd love to do that. First of all, when we think about soils and we think about soil health, soils are teeming with life, like a single gram of soil, like a teaspoon of soil, has billions of bacterial cells, kilometers of fungal hyphae. It's unbelievable. It's micro life, but it is teeming with life, all the micro arthropods and the amoebas and the rotifers and all these incredible organisms. And they're all dependent on carbon, reduced carbon coming into their environment. In other words, sugars that are produced by plants. So soils live in symbiosis. This living life in the soil lives in direct symbiosis with the plant canopy that lives above it, whether it's grassland or a forest or mixed savanna. And the trees constantly pump carbon into the ground. You might think, why would they do that? Why would they just leak carbon into the soil? Because of that symbiosis, they're literally feeding this microbial community. Most people are familiar with mycorrhizae. They've heard a lot about it, and they've especially heard recently with The Mother Tree, the book by Susan Simard that describes the mycorrhizal relationships and connections between trees. And so they think about it from that perspective. But trees just leak carbon to the free soil microbes as well. And they feed this community, and in turn, the community turns over nutrients, degrades mineral nutrients, and releases those for the tree's uptake. So it's this beautiful symbiosis that lives between the plant community and the microbial community below ground. And it's dependent on that continual cover of vegetation on the soil. And every time we have just completely bare soil surface, we're starving the soil for what it needs. It needs the carbon from the atmosphere fixed by the plants and fed to the soil. There's also, in addition to the root exudates, there's all this sloughed off root tissue and

the turnover of the mycorrhizal tissue and you name it. Forestry, as a practice, leaves an intact plant community in place for decades. That is not true of most other land uses. And, you know, agriculture is wonderful. It's feeding the world, right? And we depend on agriculture for the foods that we eat. But people usually don't think much about the fact that you till that soil annually and you keep it clean till during the off season, the non-growing season. Well, that's not feeding that carbon into the system. And so people are devising alternative practices that maximize the cover of carbon, of plants on the landscape throughout the growing season. But in forestry, we always grow that way. We have the overstory and the understory intact for anywhere from 35 to, you know, 80 or 90 year rotation for a given operation. Or if it's uneven age stand management and continual cover forestry, we never have the soil fully exposed ever. And even in the case of an individual rotation where a harvest is conducted, today we're using equipment that minimizes the impact to the soil landscape, but much more so than equipment used 20, 40 years ago. The amount of disturbance is spatially, it's not continual across the landscape. In other words, there are areas where there's, you know, the wheel or tread turns up soil, but the soil is not tilled itself. There is a fair amount of disturbance. There is incorporation of the O horizon material down into the soil, and you do get a pulse of carbon dioxide to the atmosphere. But very soon thereafter, you have the replanting of trees, and within 10 years, you have almost complete coverage once again, and this thriving plant community putting carbon into the understory, and now you have your rotation length ahead of you now, 35 years ahead or without any soil disturbance, and that system being fed constantly. So forest soils are in amazingly good shape from a sustainability perspective compared to any other land use across the globe. It's surprisingly good from a soil health perspective compared to any other land use that's meeting those human resource needs. In other words, it's producing products that are necessary for our survival as a species, whether that's shelter as a roof over our heads or whether that's producing crops for consumption.

Chris Edwards: Yeah, I think there has been a lot of focus on within forestry, what's okay, what's not okay. And it seems like those conversations don't always take into account the bigger picture. And that is that particularly on parcels that are near urban centers or in those transition lands, although we do have a land use system in Oregon, the land use system does not say that nothing else can be done with that land. And in fact, we see land, even land that is currently in a UGB was not always in a UGB. And it can become housing, it can become a shopping center, it could become a road, it could become agriculture, it could become a winery. There are all sorts of things that could become the fate of that forest parcel, particularly in areas like where you live in Corvallis. I mean, Corvallis is a great example because it's nestled right up against the coast range. So you've got a lot of those, seems like those transition type lands.

Tom DeLuca: Yeah, absolutely. Right now, right near our house, there is a whole new development going in. When we moved in, I assumed that forest would still remain a forest, but working forest or a park, but it's not. There's a whole set of new buildings going in in that area from a carbon perspective and from a land use management perspective. Of course, it's sad to see those forests taken out of production, but it's interesting too that there's a lot more forest on the landscape around Corvallis than there was when Europeans arrived. Of course, indigenous people managed the land for millennia before Europeans arrived. The vast majority of the area around Corvallis was oak savanna. So a lot of open hill slopes, sort of like the Chip Ross area with grass and these big spreading oaks, and you'll find those big spreading oaks in those dug fir forests. We tend to see the landscape today and think, oh, that's how it's always been, and that's how it will be forever, but it's not that way. There's a constant change happening. It's also really important to acknowledge that humans were part of this landscape going back thousands and thousands of years, and they were using those resources and managing that land for, as I said, millennia, perhaps doing it with a different eye to demands and desires, but the fact of the matter is that these lands were being managed and continue to be managed today and just for different purposes.

Chris Edwards: Your explanation of what's going on below the surface of the soil leads me to concede that perhaps because it's so complicated, I should stop calling it dirt and referring to it as soil, because soil is much more complicated and complex. And soil is the word that is clearly more sophisticated. So any other thoughts that you have, Dean DeLuca, before you leave us today?

Tom DeLuca: Well, I'll just finish by saying that I appreciate the opportunity to share with you all today. And I think that there's a story to be told around forestry that isn't being told currently, that's being lost in the midst of confusion over what constitutes conservation and what constitutes protection of our landscapes in a way that will meet our human resource needs while at the same time protecting the broadest array of species and treasured resources, such as keeping carbon in the ground as much as possible and in our landscapes as much as possible. I think that forestry is one of the most sustainable land uses in practice today, but that we as foresters have to commit to doing better. We have got to always go back to that SAF commitment to always do better and to base it on the best available science, and it'll prove us out as a sector in the long run.

Chris Edwards: I love that. Always do better, best available science. If I could add one thing to the credo there, I would say work to depoliticize forestry or depoliticize science. And that's what we're trying to do through efforts like this. And it's not fun when you can see all the good that's happening and the potential and the real role that forestry has, but we get caught up in the political proplosh, if you will, at times. And that can certainly be

frustrating. But that's for a whole other podcast episode. So with that, I think we'll wrap this up. Thanks, Tom, for being with us.

Tom DeLuca: Yeah, great. Thank you, Chris.

Chris Edwards: I hope you enjoyed this episode on carbon and forest soils. Be sure to check back for new content coming your way soon on the Forestry Smart Policy Podcast. And as always, if you have a question about this episode or something else, drop us a note at podcastatofic.com.