Decode 6

DECODING CARBON AND ECOSYSTEM SERVICES

WHICH NEW TECHNOLOGIES COULD IMPACT CARBON & ECOSYSTEM MARKETS?

Featuring Dr. Nate Salpeter

General Partner at SNØCAP, Co-Founder of Sweet Farm

DJ May:

Welcome to the Decode 6 Podcast, where we take your questions about carbon and ecosystem services and match them to the experts with the answers. I'm your host DJ May.

And today we're tackling a fun exploratory question, which emerging technologies could play a role in carbon and ecosystem services markets?

Taking on this question is my guest, Nate Salpeter, general partner at SNØCAP and co-founder of Sweet Farm. Nate is a person of many talents. He holds a Doctorate in mechanical engineering with expertise in heat transfer, fluid flow and simulation, and he stays super up to date on new tech for his role as a consultant in the food biotech and agtech sectors. Welcome Nate.

Nate Salpeter:

Thanks for having me.

DJ May:

I'm excited you're here. We can jump right in, so give me the highlights on which emerging technologies could play a role in carbon and ecosystem services markets.

Nate Salpeter:

This is a big question, obviously and when I say big question, I mean there are a lot of different angles, which you can take this when it comes to carbon, are we talking about carbon markets? Are we talking about carbon trading? Are we talking about carbon sequestration? Pretty broad. I'll dive in just with a couple of examples of companies that we work with that hit on a couple of different points there. One is a topic that is probably not foreign to a lot of the listeners on this podcast, we're talking about biochars. There's a company called BioForceTech, actually, that is based originally in Italy and the San Francisco Bay area, they have a unique technology that is actually producing biochars from high moisture content feedstock. Why is this important?

While oftentimes biochars are produced using already relatively dry feedstocks, so we're talking about everything from hemp stocks to wood chips from forestry projects, but there is this need for being able to address high moisture content feedstocks. What is biochar for anyone who is not familiar with that? Well, biochar is essentially a carbon structure, not too dissimilar from charcoal, but is produced by burning this feedstock at high temperatures with low to no oxygen, so the resulting product, you can think of it almost as very porous carbon structure that can be used actually in agriculture for doing things like boosting water retention in soils or retention and release of nutrients, and also potentially as a surrogate for some other less sustainable options such as vermiculite or perlite vermicula, of course, you have to mine it, you then have to exfoliate it using a very high energy intensive process.

All of those things expand the carbon footprint, but you have this opportunity with biochars, if done in a certain way, you can actually do it in a carbonate negative process. BioForceTech in particular, they actually are taking high moisture content feedstock from the wastewater treatment facilities, so this has already been processed, think of it like a sludge that normally would get dried down, compacted, thrown into landfills, or, in some places, it could be used on certain types of crops, but what BioForceTech does is they actually take it and they use their BioDryers, so they utilize the process, heat that is generated from natural microbes as well as the process heat from their self-sustaining pyrolysis or burning process to continue drying it down. In that way, they can create this self-sustaining biochar production that the end result is this beneficial co-product. They get paid to take the material, they get paid on the backend to sell the biochar into different marketplaces, and agriculture is one of those.

There's obviously different considerations you have to think through when applying biochars, I'm not a biochar expert, I do have about four years of experience doing biochar field trials at very small scale out at Sweet Farm, but keeping an eye on these technologies on where do we have a mutual benefit on both ends, basically, cleaning up the environment, these technologies can remove forever chemicals, whether it's polyfloral alcohols and pharmaceuticals from the waste stream, but then create something that can help address real challenges in the agriculture space, such as we're dealing with drought across much of the country.

How can we increase that retention? How can we utilize these products to clean up edge of field, use them perhaps in edge of field approaches to basically reabsorb nutrients or if you're direct applying them into your field, maybe you're using it as a pre-filtration on your water system to absorb nutrients from your pond while reducing sediment as it's heading out to be watered out in different blocks and then you can directly apply it out in the field. These combined technologies are really unique because they solve a lot of problems simultaneously. They're not perfect, we're still learning. Biochars at large are not necessarily new on their own, of course, they've been tied to the terra preta soils in Brazil. These are very old and established utilizations, but applying it to more modern process, modern technologies is interesting as well. That's what I'm super excited about, obviously.

DJ May:

Well, you're making me think here, so there's something else wet and sludgy that I know we deal with a lot in agriculture, but could something like this drying technology be used for manure? Are there cross applicable? I know you don't necessarily bring it.

Nate Salpeter:

I think where it becomes really interesting is when you look at some of the other areas where there's a high moisture content feedstock, just one that immediately comes to mind is actually the wine industry. Of course, Sweet Farm was originally founded in California, big wine country there, and we've since moved to upstate New York in the Finger Lakes region where there's a lot of wine production there.

In wine, in the production process, there is a in product known as Wine Lees, so this is the sludge at the bottom of the fermentation tank, again, not a wine maker, but is my understanding that these are products that you have to actually pay people to take. It's not a beneficial co-produce,

it's not something you can sell to people in that form, and you can't just dump it, it has microbes and yeast and things that folks don't want just released into the environment, so you could link a process like this that can take these 80% moisture content feedstocks and actually turn them down into a co-product that could be reutilized out in the same field that produced the wine and grapes in the first place, so absolutely, this is not just necessarily applied to applied to wastewater treatment, it could be applied to a lot of different areas in agriculture and beyond.

DJ May:

Excellent. Well, that's really exciting.

Nate Salpeter:

It's super neat work that they've done and they've been expanding out considerably with different municipalities. Sweet Farm did four years of field trials with them, testing them out, there's a lot of considerations that goes into utilization of these things, and it's everything from not applying them directly without... You need to apply them with nutrients already impregnated into those biochars, you don't want to leach the nutrients from the soil back into those. You also don't want to apply biochars when they're dry, and that's because there's actually research in 2019, I think it was 2019, there was a study that came out talking about worms and biochars and how in order to reduce the adverse impacts on worm populations within fields, you should pre soak the biochars as well so little things like that. We're constantly learning, I think everyone is, so it's a fun space to be operating in, especially as it pertains to carbon, because if you have a self-sustaining process and you're putting that carbon back in the soil, it is one piece of the carbon cycle, if you will.

DJ May:

Well, it's always interesting, the thing too, just something as simple as hydrating it a little bit before you put it down makes a big difference for that whole ecosystem you have going on in the soil.

Nate Salpeter:

Absolutely. When you hear some of these things and you read a scientific article, oftentimes it can get read as, "Well, of course you need to do that," but we're super happy that there are amazing scientists and researchers out there in the world doing this work to confirm that these things are, in fact, these hunches are correct, or they're identifying things that people didn't think about before, so to everyone listening who falls in that category, a huge thank you for the work that you're doing.

DJ May:

Yes, definitely. Well, let's move on. I know you have a couple other topics you want to hit. What's next?

Nate Salpeter:

When we talk about a full cycle emissions and carbon on that front, it can take a couple of different forms. Another company that Sweet Farm did a couple of years of field trials with, we actually did their very first two years of field trials, is a company called Inner Plant, and they are doing something really unique. They're actually teaching plants how to talk to farmers. Of course, they don't have tiny little mouths or anything like that. Instead, they are essentially linking stress responses to protein generations that have a fluorescent signal. Of course, this is invisible to human eyes. It's a very distinct mission, and they can tie it to things like pest stress or water stress. They just recently did a field trial within a greenhouse, and they actually were testing out a drought response, so they would cut water from the crops within about three days.

They could actually see the signals from the plant saying, "Hey, we're water stressed," but you could not see it visibly with your own eyes. It took about three or four more days before you could actually notice there's real water stress for these plants, and you start to see visible wilting and things like that. By day nine, plants are dead, so how does this relate to carbon? Of course, it's everything from plant waste in the field to, if you're talking about stresses from things like nutrient stress or pest stress or fungal stress, we're talking about being able to knock out problems at their source, knocking them out efficiently and early as opposed to waiting up to two weeks to actually get visible signs of issues and by that time, it either might be too late, in which case, huge carbon footprint of that level of loss, or you're having to actually go out into the field and spray thousands of acres to try and contain and address what could have been done very early on.

Those technologies are super interesting for a number of reasons. One, it's moving the broader agriculture market forward, 95% of the world feeds themselves using really tried and true traditional agriculture practices, large scale farming agriculture practices. Anything we can do to help those large scale practices evolve forward in a positive way, reduce inputs that's less expensive for the individual farmer themselves, it's better for the communities, better for the environments, those are things that we are very excited to support, and of course, with that, we make those positive impacts when it comes to emissions and ecosystems at large, so Shelly Aronov, the founder of Inner Plant, incredibly talented, incredibly smart CEO of Inner Plant, has been just a pleasure to work with out at Sweet Farm, as have the entire team. She has very strong vision in terms of how something like their technology can improve the lives of individual farmers as well as the communities and people that they are feeding.

DJ May:

Well, I want to back it up just a little bit because I immediately pictured the images you see of what an insect sees when they go through a field where it's a different color spectrum, but how are you visualizing what's happening with the plant before you visibly see it?

Nate Salpeter:

Absolutely. A specific plant, everything has a back scatterer, a visible light spectrum. It's not just an individual wavelength of light, so a plant, for instance, it may look green, but there is actually a whole spectrum. It's a combination of greens and blues and magentas and yellows at all different intensities within them.

Those have a very distinct fingerprint to them. If you can actually tie a response to a slightly higher peak on one particular wavelength, for instance, then if there is that protein response, then all of a sudden you use a low pass filter, a band pass filter on a camera, and you can see that one little spike actually have a higher intensity, so all of a sudden, it becomes a canary in the coal mine situation where you can have a whole bunch of plants and then scattered throughout it, some of these indicator plants, and those ones will let you know this block has higher incidents of a particular type of pest, so let's knock it out before it spreads more broadly, so it is a combination of cameras as well as the plants themselves emitting them so it's not just visual hyper spectrum, it's a combination of this genetic engineering combined with that visual inspection.

DJ May:

Very neat. It's just like indicator plants scattered throughout a field, not necessarily the whole field?

Nate Salpeter:

There's probably many different ways that this technology can be taken, but being able to utilize them, if you think through the wine industry, I know that's the second time I'm using it as an example here, but for a long time, rose bushes were put at the front of different rows of grapes and they were done for the reason of being able to be indicator plants of certain types of diseases or fungus or pests, because they would react sooner than the grapes so it became indicator plants, so you could think through it in a similar way, using them as indicators to get a heads up before it attacks other things.

DJ May:

Very nice. Clever.

Nate Salpeter:

Super sharp. Again, we recognize that even though Sweet Farm, for instance, we grow food at a very small scale. In California, we ran a small scale CSA for tens of families level, growing on an acre and a half scale. In New York, we're scaling up. We do have a vineyard that we will be bringing back with our wine partner, but we are growing food at small scale, and we recognize that that is not going to feed the world in mass. We need to do things that really can help fundamentally move the needle on that as well.

DJ May:

You have to start somewhere. If you can make it work at the small scale, you can probably scale it up.

Nate Salpeter:

Totally. We're very intentional about our approach of getting our hands in the soil and soil under our fingernails, as opposed to just being purely on the research side or purely on the investment side. It's incredibly important to get that experience and respect just how difficult these

challenges are. If you don't have that experience, you miss a lot of the nuance and maybe don't necessarily know how to start asking some of the important questions. I won't say all the questions because I don't think anyone knows all the questions we need to be asking, but at least gives us a starting place, so it's humbling, I think everyone who listens to this podcast knows just how incredibly complicated these systems are. My background is in engineering, specifically in nuclear engineering so doing systems level design for a large scale plants, what I'll say is the food system is many orders of magnitude more complicated than a nuclear reactor.

It's incredibly challenging to know at all these different scales how they work together. What I'll say is when it comes to emerging technologies that play a role in these ecosystem markets and carbon markets and such, especially if there's any investors out there listening on the call, what I like to encourage folks to do is really expand the control volume on which they assess what is a climate technology, what is a technology that's worth investing in for the sake of improving these processes.

For instance, you could draw a control volume around a single plant and look at it at just the root level or the soil level around that plant, or you could draw that control volume around a whole field, or you could draw it around a region or the world, and as you increase it, what happens is you get increased complexity of interactions, but you start to gain a broader perspective around how do these systems interact with one another and how can improving one external system that would be considered external at a smaller control volume scale, as you increase that control volume, you start to see that no, this is no longer just a pure input or pure output, instead, a fruit or a tomato comes off a plant, it goes into a human, the human has outputs as well, how do we tie that output back into the system as well? Go ahead, DJ.

DJ May:

Just explain what you mean by control volume, so when you're talking about roots or plants.

Nate Salpeter:

Control volume is basically, it's a term that's applied to how you draw a boundary on a system. You could think about an individual plant, if you draw a dotted line around an individual plant, that could be the control volume by which everything inside of it, you have interactions, you have nutrient exchanges and gas exchanges, and what are some of the inputs? Some of the inputs across the control volume are things like sunlight and CO2 coming in, and then oxygen going back out, water coming in, those are some examples of inputs and outputs around a control volume of that scale, but at that level, you may have an output that is a tomato and the tomato just disappears but what comes back in at that scale may be represented simply as NPK, as nutrients as just a direct input.

If you draw it at a larger scale, maybe a field scale, and you could do this at the smaller scale as well, maybe it's not NPK that's the input, maybe it's a seed for cover crop, for a nitrogen fixing crop, for instance so that could be visualized as an input. But when you start expanding it and then all of a sudden, you have humans that exist inside the control volume, because you're now big enough, now, all of a sudden, the tomato doesn't leave the control volume, instead, it goes into this other system, which is a human, and then they have an output and that output makes its way back into that same plant, that same field by going through a process like pyrolysis through

with BioForceTech or some other similar process. I mentioned that in the sense of expanding one's viewpoint on what is deemed sustainable or what is deemed a worthwhile technology to pursue, it helps bring in different perspectives around what are some of the solutions that are needed for addressing some of these issues around ecosystems as well.

DJ May:

By expanding the view a little bit, it changes what we look at as solutions because, obviously, carbon markets, that's a huge system.

Nate Salpeter:

For investors, for instance, it expands the thesis by which you can deploy, and it's not like trying to create reason to invest in things, it's more opening up people's eyes to different technologies that really deserve a chance as part of this discussion. We want to avoid just falling into the trappings of, here's the super explicit, super obvious things, systems are complex, things aren't always obvious, and unless you're looking at things from a systems perspective, you're just going to end up being siloed into the same things over again while simultaneously missing the opportunities, both from a need perspective, but also even from potentially an investment perspective in those other areas.

DJ May:

Well, do you have any final thoughts as we wrap up? Is there anything else you want to touch on?

Nate Salpeter:

We hit on a couple of different items, obviously, the carbon itself through BioForceTech, then how do we reduce waste? How do we reduce, we'll call it the level of effort, which has an associated carbon costs to it with something like Inner Plant, the traceability platforms and supply chain platforms are something that's super interesting, they're becoming more and more prevalent. There's a company actually out of Sweden called Scarra, which is just getting off the ground that's doing some interesting work in providing traceability as it applies to sourcing both from buyers and suppliers. Having these platforms that are not just for linking suppliers and buyers, but also adding a level of confidence in the supply chain to what is the carbon impact? How are we measuring it? If you can't measure something, you can't improve it, it's a pretty obvious statement, but measurability is very critical.

That's an exciting area that's just really getting going now, and it doesn't necessarily have to be on the blockchain or anything like that, I'm not going to throw out those things because it just starts with creating an honest, open traceability process, and these are things that have been around, but I think they're becoming more and more prevalent as companies are addressing their sustainability goals as their, not just their goals, but in some cases, they're making outward claims on their packaging.

Here is your impact as a consumer by opting into this versus that, you're reducing by X percent your carbon footprint. You can only make those claims if you have the traceability to back it up, and if you don't, you become also exposed in a number of ways, so it's valuable for the consumer

to know, it's valuable for the companies to achieve their goals and also protect themselves in the process against making erroneous claims. No one wants to intentionally do that, but if you can't trace it, then you shouldn't be probably making those claims in the first place as well, so I am excited about those things as it pertains to marketplaces and it doesn't necessarily just have to be carbon, it could be other elements of different forms of positive regenerative agriculture, doesn't necessarily just have to be the carbon sequestration, but just adding that layer is super exciting for even the end consumer.

DJ May:

Definitely. Well, you hit on a topic we're going to cover quite a bit in terms of measurement and traceability and transparency, so I'm excited that you see that as an opportunity for growth.

Nate Salpeter:

Absolutely. Again, I'm not an expert at a lot of these things, so I'm super excited to hear from the different guests that you're going to have on the podcast. It's really exciting what you all are doing. I'm super honored and thankful that you all decided to have Sweet Farm on and SNØCAP on as part of this, and really appreciate everything that you're doing, DJ.

DJ May:

Well thank you so much. It was great talking with you.

Nate Salpeter:

Likewise. Appreciate it.

DJ May:

If you're looking for more information about these emerging technologies, check out the show notes. If you're curious about carbon and ecosystem services or you have more questions for us to answer, come visit us at decodesix.org.