Dr Phil Gregory: Regenerative & (Biological) Agriculture - a revolution in holistic land and farm management

Interviewed by: Tim Lynch
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Link to the website:
https://www.ourplanet.org/greenplanetfm/dr-phil-gregory-regenerative-biological-agriculture-revolution-in-holistic-land-and-farm-management

Watch/listen on YouTube:
https://www.youtube.com/watch?v=px0JXWPvouM&t=13s

Tim: Regenerative and biological agriculture is starting to go mainstream in New Zealand. Regenerative agriculture is like biological agriculture and is based on the idea that nature given the opportunity is a powerhouse of continuous sustainability.

Today New Zealand farmers are beginning to see the true value of getting back in touch with their land and soil in a more natural way and that by embracing regenerative in biological agricultural methods that focuses on minerals and soil balance, they are increasing grass growth and feed plus building up the soil structure that assists in retaining the soil by holding back erosion. Whilst at the same time, producing healthy livestock and overall as bringing far more satisfaction back into farming.

One of the main reasons is that farmers are proud to produce products that are healthy and in doing so they are intuitively becoming more holistic in the way they see life, their farm, and all biota and even their own bodily health. Regenerative agriculture and biological agriculture focuses on minerals instead of chemicals by bringing balance to the soil structure by way of encouraging the microflora the bacteria and fungi to build up the soil in tandem with humus that is the decomposition of decaying plant material that via the microorganisms then shares as food nutrients with grass roots increasing growth and that encourages these roots to grow far deeper into the soil.

This whole process uses natural methods to establish productive systems that are self-sustaining and regenerative. This new system requires farless external input and by focusing on ecological cycles like those that build up soil rather than mechanistic fertilizers of methods that artificially force growth and for a while may produce rapid plant growth - but the

plant may be very deficient in certain minerals and vitamins plus can produce large amounts of pollution like nitrates.

So with regenerative and biological agriculture building soil structure is essential because that's the key to systems that regenerate rather than degrade. This regenerative and biological agricultural system is more resilient in extreme weather and climate and use far less energy to run and is thus much easier to make carbon zero and that the increased plant in grass growth is pivotal and sequestering CO2 out of the atmosphere and can with conscious choices turnaround farming globally to make it a win-win, win-win situation, healthy plants, healthy soils, healthy animals - and a healthy biosphere.

In the studio this morning I have Phil Gregory, he's a professor emeritus of the University of British Columbia and Canada and we're going to be talking about the hidden universe of soils that could solve global warming and food security and we definitely feel that this a great opportunity for us to make sure that we can take care of our common future particularly for our children. So, Kia Ora and greetings, thank you for driving in this morning, Phil.

Phil: Well, thanks for inviting me in, I'd love to have the opportunity to share my discoveries with you.

Tim: So yes well you started off looking at deep space and stellar objects and whatever's happening light-years away and you do know that we live in a spectacular universe and then also you have realized that underneath our feet there's another spectacular universe.

Phil: So I've been fortunate in the latter part of my career to be part of them, one of the greatest adventures in astronomy the discovery of thousands of planets orbiting other stars right and we hope in 30 years time maybe we'll know if there's life on these planets. It became more and more apparent to me that we you know have to survive that length of time to have that fun.

Tim: Yes, imperative!

Phil: And then you know one day I was browsing through the Scientific American I came across this announcement by the UN Food and Agricultural Organization and the headline was only 60 years of farming left if soil degradation continues. And I thought to myself, “What's this 60 years?” that's...this is no time at all. You know, I was used to climate change and global warming as being something that we're going to make life pretty miserable at the end of the century if we couldn't get our act together but if there's no food production when we...no technology to use then we have nothing we can't do anything and so you may not be aware of but I've got 14 grandchildren and one great-granddaughter and the idea of that 30 years from now, there’s gonna be some crisis in food production, it just staggered me. I had been completely unaware of the degradation of soils that has been going on over the years.

So it hit me hard enough that I decided, look I can't go on with life as normal. I'm retired. I had the luxury of investigating whatever I wish and so I decided I really had to look in into the whole state of affairs of agriculture and desertification, animal grazing, all these issues that are very important to this food security and I basically spent two years going down the track of listening to videos on YouTube, making connections with researchers, going to the library, and that's one thing that came for me is that as a faculty member at a university I have free access to all of its share of the world whereas the agronomists that I met, the professional agronomists I met, unless they're affiliated directly to a University they have to pay you know like 15 - 17 dollars to read one paper. You know, well you need to read hundreds of papers to grade yes how and they said they told me I had a meeting with a group of agronomists who went came to visit my island and wanted a tour of some of the agricultural area there and they said look it's very difficult for us to keep up because no one is willing to give us the money to keep current in the literature and some of the things I had been discovering and in my investigation I found that they were really woefully ignorant about some of the research that had gone on in the last twenty years.

So yeah, it's seen a real eye-opener for me, a complete eye-opener because when I set off I had really no clear sense that I was going to come out the other end with anything but perhaps disappointment or you know well this is you know it's all down to fossil fuels we've got to just stop burning fossil fuels but lurking the background was always the the realization. Well even if we stopped burning all the fossil fuels that carbon and that methane and all that greenhouse gas is gonna stay up there for a long time and that's gonna keep warming the planet for hundreds of years. So not only do we have to stop putting it up there we have to actually bring it back and get it out of the atmosphere. So I just stumbled on one thing after another and then once you start making connections you get into the pipeline they're pointing you in the right direction and one researcher leads me to another and one paper leads me to another and I got very excited about what I was discovering.

Tim: Yes I have been able to interview Graeme Sait, Arden Andersen and Christine Jones and they've been out in the field, they've been talking with farmers for the last 10+ years looking at what the soil structure is all about and they've really been pioneers out in the paddocks so to speak and they know that to make sure that the soil organisms are not been should we say killed off by masses of chemicals and also sunlight when you turn the soil over by ploughing. Can you tell how you came in to just focus on the soil as such in relationship to sequestering CO2?

Phil: Mm-hmm so I used at the beginning I decided well you know there are all these government agencies out there in different countries, what kind of resources, what kind of outreach do they have for farmers and for interested people right and so I didn't find very much within the Canadian government agencies.

But I did find a wealth of material as connected with branches of the US Department of Agriculture in particular the Natural Resources Services section and they had for example many

tutorials on the soil food web. And these were written by Dr. Elaine Ingham, one of the pioneers of this work and so I started realizing that I was seeing Dr. Elaine Ingham's name, cropping up here there and everywhere and I'd have to say even prior to that I got very interested in TED Talks when they started happening and by good fortune I just happened to watch one by Allan Savoury. I'll say amazing yes well that really surprised me that was a shocker for me because like everybody else I grew up almost with the idea that herbivores, the cattle, sheep and goats were desertifying the world right and so to see that it wasn't about animal numbers but it's all about timing about managing plant recovery time that started to make really good sense to me and and he had a way of putting this message out very simply so I would say that the natural resources services of the US Department of Agriculture was - played a big role in connecting the dots for me. And for one of them I started looking at some of the researchers that were working in the agricultural research services branch as well and among those was one of the people that did the no-till studies Don Rakowski and colleagues and...

Tim: When no-till that means no digging.

Phil: That's right. You don't turn the soil over at all. Unfortunately no-till has...the term has become bastardized somewhat and it now means to a lot of farmers well we're not tilling in the season it's only between seasons we're tilling right, but true no-till is you don't till anytime of the year right

Tim: Yes

Phil: Anyway, I came across his name and of course as an academic I give lectures and talks and people always ask me for my PowerPoint presentation. So I make them freely available so I would look just log in okay Dan Rakowski powerpoints and I had all come across a whole bunch of them. And so I what I didn't understand or questions that I have I would simply as a colleague basically academic colleague I'd email him and ask him the questions and he was very forthcoming and you know giving me answers.

So I was very pleasantly surprised he within a few days I had the answers to many of my questions and that generated a whole bunch more. I became interested for example in what's going on in Canada in these areas in the no-till field for example and so maybe something happening at my own University or more in some of the other major universities in the country.

Anyway he pointed me to Saskatchewan farmers in particular to a journal that Green News it was called you know I guess this would be like the nature in science to the grain producer. And so he gave me a reference and I linked onto that and I learned about how there's a Saskatchewan a sustainability organization or something of those lines.

Anyway I learned from this interview that roughly 60% of Saskatchewan crop farmers have now gone completely no-till and they did this and so I decided okay I've got to reach out and meet one of these. So the former chairman of this Saskatchewan soil conservation organization that was it, he had set up this group because they wanted of course if they were going to do no-till

and they were gonna sequester carbon in the ground then maybe there'd be an avenue for getting subsidies from the government for sequestering carbon.

Unfortunately, they're a bit ahead of their time but they weren't ahead of their time in the sense that they said okay if we're gonna aim in that direction we we've got to have proper soil carbon measurements and so they worked with an Ag Canada Group in Saskatoon who came out and did the measurements. And so now they have measurements on something like a hundred and sixty seven farms over a span of 14 years and so they can pretty well prove that over that period of time they've been sequestering about one ton of carbon per hectare per year and so over that 14-year period well - I should prepare with you an amusing aspect of this story because once I learned from this interview.

And I then connected with John Bennett who was the chairman at the time. I wanted to see the white paper that they had written to make the case to the government and so I found the reference to that and I read that through and it all made perfect sense and methodology and everything except for one thing - they thought that it would be useful for the general public if they translated the carbon sequestered in the ground to the effective number of cars that would be taken off the road. As a result of that the equivalent number and they had come to a number of like 21,000 cars over this 14-year period so I thought to myself 21,000 doesn't sound like that many cars not in that 14-year period for 60% of the you know Saskatchewan farmers. So I looked at their numbers carefully and I discovered that they had made a mistake. They had instead of writing down a billion they'd written down a million and part of the calculation that they'd done and so when I corrected the calculation that number of cars removed from the road went from 21 thousand to 21 million. Now that's sounding more interesting

Tim: Well I'm interested now, yes.

Phil: So so I called up John Bennett who is the former chairman of this group and I said I've got some good news and some bad news. Anyway I told him about my findings and that really broke the ice between us you know and after that we've shared numerous conversations and I've been asking on questions well what about 60% of crop farmers in Saskatchewan are doing this surely Ontario farmers, Manitoba farmers and Quebec farmers that they must all be moving in that direction. And he assured me he said no they're not unfortunately because they haven't faced the drought problem that we have and you have to realize that farming is a very risky business.

And so a farmer is he's making a profit or even breaking even he doesn't want to change anything. If you change too much your crop insurance isn't valid anymore - for example and so apparently it was only the Saskatchewan farmers who had got to the point where they could only get one cash crop every two years and with no-till after an initial period of two to three years they all went into one cash crop every year so they went from the red back into the black

Tim: Mm-hmm

Phil: But that left of course opened a lot more questions that I was interested in for example well what about going the next step towards what I call regenerative agriculture and let you become an important development where not only do you sequester carbon but you restore the biology to the soil and you move away from the chemical paradigm to a biological paradigm which is after all the way nature evolved our earth

Tim: That's right

Phil: You don't walk into a forest and see a tractor spraying nitrogen or phosphorus or potassium completely unnecessary the nature has got all the microbes in that soil and that hidden universe are what has been a hidden universe for so long - to mine all the nutrients that the plants need from the rocks and silt and clay and nitrogen from the atmosphere you get the works all for free without having to pay money to plow your field, pay money for the chemicals if we're smart enough to learn and copy nature.

Tim: That's the key in this...it's biomimicry yes yes please carry on Phil.

Phil: So the next question for me to ask John my friend John now, is okay well what about the next step. What about moving away from chemicals and relying on say inoculating the soil with a really good fertilizer and get those microbes back active again. Because when you put NPK than nitrogen, phosphorus and potassium fertilizers on the soil, the plant says Oh golly I've got some party food here I don't need to share with the microbes. Any of my root exudates I can hold onto those because I'm addicted now to NPK.

And so that barter system that existed between the plants feeding the sugars in the carbon the energy pills basically to the microbes and then the microbes in return supplying all the other trace minerals all the other elements that the plant needed that barter system is now broken it's interrupted because they, the plants become addicted to the easy life right - but of course these salts that are being put on these fertilizing salts that are being put on dissolve in water and you know 80% of them wash off into the rivers causing all kinds of problems

Tim: Algae blooms

Phil: Algae blooms, you know nitrates in our water supply are very dangerous if they reduce the amount of oxygen that the blood can transfer through the body and that's - you know there was a Nobel Prize won for the realization that this is a basis of cancer so you know we've created just a mountain of problems with ignorance of the use of these chemicals right.

Tim: We certainly have now you've got some magical stories about how the bacteria and the fungai work can you explain because a lot of their listeners are very keen on what's happening in the garden of life - right and if you could just explain the magic of how these fungal strains tie micro aggregates together etcetera because I find that there's a wonderful way to allow us to

realize just the magic of the transference of minerals into the plant root hairs and away you go you've got right cauliflowers and sweet corn and tomatoes.

Phil: Yeah well I backup just a little bit because first of all you have to have it and be introduced to the cast of characters in this micro world right and and there's a lot of characters involved. And it's a predator-prey relationship that goes on so at the base of this predator-prey relationship. You have things like bacteria and fungi and then you have the predators of the bacteria fungi and then you have the predators of the predators and a very sort of complex diner system of predator and prey which is Nature's Way., this high diversity of creating stability.

So we start then with the bacteria and the fungi. There at the base of this system they're getting fed carbon pellets if you like through the sugars from the plants who are attracting them to their root system. So the bacteria and fungi they will if there's any nitrogen or any phosphorus and potassium they'll love that. They'll just gobble that up and store it in their body together with the carbon they're getting from the plants. And they'll very nicely take any dead plant and a ladder and recycle that. But in addition and this has been quite a surprise really is the realization that they secrete also these biotic glues enzymes and organic acids. And these organic acids in the case particularly in the case of the fungal hyphae the fungal hyphae these invisible strands that go been sneaking outwards which once you have a massive enough at mass of them then that you start seeing them as mycelium networks which you know you might see mold for example and that's a mycelium network.

The individual hyphae are quite invisible but for example if you take some common rock like feldspar and you slice it and you polish it and then you look at it under the microscope you can see all kinds of tiny microscopic tunnels. These are tunnels that have been made by the fungal hyphae. They're actually burrowing into the rock and mining the elements. The basic elements that that rock is made of pulling them back into their bodies and eventually they then transfer that to to the plant. So it's quite magical to see these tunnels.

And you know there was an article in Scientific American that I came across in 2015 where the title was basically the The Biggest Mining Operation in the World is carried out by - fungal networks right. So here they are pulling in all these resources and in return for the carbon but you have to keep in mind that those fungi and bacteria they like those elements as well. They need them in high concentrations to you know to exist in nature. And so they're not readily wanting to get rid of those are giving you know or give them up. And so the way in which you get them to be given up is by having the protozoa, the predators basically of the bacteria and fungi they came along and they don't require such high concentrations of nitrogen for example. They they need say 30 to 1 for protozoa where as the concentration of a carbon and nitrogen the ratio carbon and nitrogen in bacteria is 5 to 1.

So for every 5 carbon there's one nitrogen and that nitrogen is a very important atom and likewise in the you know protozoa like an amoeba for every 30 carbon atoms there's one nitrogen. So when the protozoa eat the bacteria they then have an excess of nitrogen. They

don't need that much as it will be toxic to them to hold on to that. So they poop it out and their poop is happening of course right next to the plant roots. Because the plants are attracting and feeding their prey which sit right next to the - you know on the table wanting the carbon and so basically at any given time in an agricultural field 99% of the elements that the plants need are locked up in the bacteria and fungi. And only at the rate at which the plants needs do the because they're orchestrating that all of this do the predators come along and convert, they eat the right amount of bacteria and fungi, create the right amount of poop which then feeds the goes into the plant and feeds the plant.

And so this is one of the mysteries that the chemical world has not appreciated because the farmer used to thinking about well I got to get the chemistry right in my...in order to grow. Say I want to grow 100 bushels of corn per acre then the the rule of thumb is you need 10, you need a hundred pounds of nitrogen on that field for acre in order to grow that hundred bushels and so when they get a sample and they send it off to the lab, what is measured is just what's the soluble nitrogen in the soil. No measurements are made yet of the biologically stored nitrogen which can then be released at the right rate by the predators. So you know the chemical companies say oh well you're gonna need you've only got 10 pounds you're gonna need 90 pounds if you want to grow a hundred bushels and so then you pour on all this nitrogen and what does a number of ugly things.

Tim: Yes I can see it's overriding us when there are much more simpler ways, eh? Because once you get these plants growing they will send deep roots down and not only that they'll open up to the bacteria and the fungi which will open up the ground and for more air and water to go down and therefore more foliage at the top and this is where we start pulling down all the CO2.

Phil: Yeah this is the the other chapter of what the bacteria and fungi do for you is they want to create an environment that they're happy to live in. You know like they want to create homes for themselves and so the bacteria for example secrete these biotic glues which stick together mineral particles and organic material and also water into what are called micro aggregates so all along the route of healthy soil you'll find all these micro aggregates when you pull it out. And those micro aggregates are kind of like bricks and the fungi come along and they're obviously attracted to the same carbon compound suppliants are putting out they come along and they weave these bricks into buildings structures and with doors and windows and these doors and windows are how the oxygen and the water can percolate down to great depths into the soil.

And so together the bacteria and fungi not only are they participating this bartering system but they're creating a soil structure a structure which is essential for getting the oxygen and water down deep into the ground and allowing plant roots to grow because plant roots will only grow if they have access to water and oxygen and beyond that they do they can't go ...

Tim: Very much higher- because you've had situations where roots can go down to maybe a meter and situations...is that correct?

Phil: You know in the… they go much deeper than that you know when the West was being opened up in North America people were going out and they were doing cross sections. So they would dig down great pits and look at the cross section and they'd take a piece of glass and then they take tracing paper and draw out the root structures of the different grasses. And they found that many of those grasses grew down 30 - 35 feet. That's a long way down right compared to well it started off in the 50s and 60s people thought well roots only went down about six inches. That's right and then they started plowing deeper and okay we can get them down a foot but now there some of these plows are going down four feet right a mass of tractors and that's about the limit of what can be done.

But if you if you create soil structure so that the plants can find air down there they will they'll go very deep. In fact my teacher I ended up taking as part of this journey I decided I wanted to take some of the courses that one of the pioneers in this area had developed Elaine Ingham. Dr. Elaine Ingham who runs a company called The Soil Food Web Inc but she's been a faculty member at a couple of different universities and being really very conversant with agricultural field and and research. And anyway she in one of the courses that I took. She took her class on a trip to some visit some caves which were about a hundred and fifty feet below ground.

You can tell then as a Canadian I should be thinking metric but having had four courses from Dr. Elaine Ingham, everything's in feet and inches. And now you know as Canadians you have to be able to move back and forth freely between these. But when they got down into these caves and one of the students noticed there was a root system sticking down. And and so they pondered on that and wondered well could that be a living root and this far down the tree roots. And so they decided to do an experiment. They decided they would inject the trees above this immediately above this with a dye and then they would see whether or not there was any chance that this dye would come out and appear in the root system of this. And so they left one student down below and the others did the preparation and injected to dye. And then they started thinking well how long would it take if it's going to actually get down that deep. Well I did some quick back of the envelope calculations and decided well we can go for a lunch there's no problem with that.

And so they headed off for lunch and they got to lunch and then there was this phone ringing and it was a student down in the mine and they could barely make out what he was saying. He said you've got to get down here quickly right so they went back down into the cave and basically the heat they found that this dye had became visible in the root system within like ten minutes after it was injected into the tree and this had gone down 150 feet. And so this was definitely a living root and this meant that oxygen from the atmosphere was getting down all that distance. Right so I think there's a lot of mystery still to be fathomed and you know - most certainly - explored and yes it's astonishing really.

Tim: I'm speaking with Phil Gregory professor emeritus of the University of British Columbia in Canada on how the hidden universe of soils could solve global warming by sequestering CO2

and carbon out of the atmosphere and enabling food security for our planet and future. But what I can't understand is when they realize that drought - now there's the Oklahoma dust bowl

Phil: Yes yes

Tim: Now that's a story in the half - solely because these roots of plants but the plants never got the opportunity to put their roots deep down and I don't know how that all came about other than the fact that dust and the wind and then you're losing your topsoil - topsoil at the moment globally we're losing it - I mean this is an imperative to face.

Phil: Well it turned out that when you plow basically you create a compaction layer just below the depth of the plow and at the time of the Dust Bowl era people weren't plowing that deeply I would imagine though more than about foot and and then there would be this hard pan and of course when you're plowing you're slicing and dicing the fungal networks all this very clever structure the buildings of the cities, the underground cities that the microbes have created.

Tim: We're annihilating them.

Phil: Yes, we're just annihilating them right and so that just burns up the fungal glues and the the biotic glues from the bacteria. And so the soil doesn't have any integrity any longer so it's free to be washed away, it's free to be blown away and in those days you know we just had no idea that ploughing was devastating after all the Greeks developed the plow. And you know it's got a long history of being improved upon and mathematicians have been in there working well what's the most efficient design for the plow that requires the least energy to pull it through the earth. And we've been doing that for so long and just to think that it's only being in the last 30 years that we realized - the damage that what's going on.

But it wasn't until that we really came to grips we were able to peer into this universe of the soils to to study and find out well what are all these microbes doing. What is their role in nature - that a key paper on understanding what do these cast of characters doing was written by Elaine Ingham and her husband and two other authors in 1985. And that paper was not received immediately very well because people challenged and thought they they couldn't be right. That this was this bartering system going on and that you know was such a complex network of activity.

But by 1991 this is all turned around people rediscovered their work and verified their work and then there was just an explosion of literature and I put that sort of that explosion of the literature as kind of the the biggest sign of this revolution. And I discovered that explosion by doing a search in my university library I said look I want to look, I want to find all the papers that have ever been published in all journals everywhere in the world which had the term root exudate or plant exudate because that was a key part of the discovery. And when I plotted that up as number of papers in the function a year there was 1938 the first paper and then there was a steady dribble of papers and then 1991 boom! - up they went and then you know continued on up by 2016. Over 300 papers a year on this particular avenue of the **bartering system.** And so

you could clearly see this revolution happen 1991 and and the - the trigger for that the catalyst for that I believe among others probably was this paper by the Inghams and colleagues.

Tim: I see, it was interesting because when James Lovelock - put the Gaia hypothesis - together, that our planet is a super organism it was Lynn Margulis - who was the ex-wife of Carl Sagan

Phil: Yes

Tim: Interesting story

Phil: It is

Tim: She was the one who brought the bacteria into the equation that actually gave the foundation for how Lovelock was able to put the whole story together right and I think that was … I don't know around about the mid 70s towards somewhere around there, but but yes the bacteria and the fung -i interesting one when we do till soil when we do plow it over, the sun microwaves all those organisms that kills them and this is one of the reasons why they've gone into no-till so that there's no way that the Sun can destroy zillions of bacteria. And this is why lots of people use mulch and I've gone in around a tree that is fully mulched and lifted the mulch up up in the middle of summer and all these microorganisms and the moisture they're doing wonderfully well because the mulch is very very thick - a foot thick and non-metric situation 400 mil thick.

So the bacteria are definitely our major friends because some tell the great story about bacteria - **that we human beings a giant taxis for advanced bacteria to get around and and be able to get into space rockets and go out into the universe - right because they've come together and unified and the bacteria also have the ability to work out problems over huge timescales.** And in an interview that I had with James Lovelock he said look we are shifting - we're evolving so fast - not in the right way that we're overwhelming our planet and overwhelming all the natural systems that they can't actually react in time solely because of the exponential curve of everything - particularly pollution but he said if we had plenty of time the bacteria would actually find a way through all this from even all the chemicals, all the toxins could be neutralized and the bacteria would bring the planet back into balance. But because now we are shifting so fast to a tipping point that the bacteria just have not got that time and this is where again - if we get into farming and if we get farmers across our whole planet shifting from a chemical system to regenerative biological agriculture we can save the day for our children and grandchildren.

Phil: Yes it's when I talk about this subject one of the interesting papers that I came across was worked by Dr. Teague and 14 other authors spread out in many different academic institutions and it was kind of a review paper of what is the state affairs of using organic material and using biology to sequester carbon in the soil and I found that mind-blowing that paper first start I'd been used to the idea well maybe agriculture's contributing 14% 15% of the problem to greenhouse gases and what became clear to start with reading that paper is that soil erosion

resulting from agriculture is actually - are you know a really big contributor to greenhouse gases so when you add that you get up to 28% so the real contribution if you add up the numbers correctly and allow for soil erosion you're looking at like 28% of the problem is agriculture. But still a critic might say okay well if you focus on agriculture you're never gonna get there because what about the rest of that seventy-two percent that's fossil fuel-burning of that's what we've really got a focus on and I kind of accepted that until I read further. And then I discovered that from the experimental work that they had been doing they found that if you move to regenerative agriculture both in cropping and regenerative agriculture includes not just no-till but it includes diversifying your crops so we know monocultures anymore but diversified crops you need to use cover crops as well so that there's always green material with roots in the ground year round as much as the years are possible and at the same time you've got to be adding some fertilizers certainly in the early stages to get the inoculate these bacteria back in.

And then an additional level of activity is using livestock as well to graze some of those cover crops and the integral process of the farming so in the old days you know we had farms that involved not only growing crops but had chickens had cows and donkeys had wide range of sheep and many other animals and involved as well. And they are all part of the system so if you to get back to this paper that I was excited about - if you do regenerative agriculture both regenerative growing of crops but also the regenerative management of the animals and I haven't really talked about that and maybe we can talk about that in a moment but if you do that and you were to do that on 100% of the arable land on earth you would actually sequester so much carbon. And of course by changing to that method of agriculture you'd remove that 28% because that would be gone right you wouldn't be doing that type of agriculture anymore so you'd put 120% of the greenhouse gases that are going up from all sources now would get stored in the ground plus you'd saved that 28%. So altogether if you were to do regenerative agriculture under modest assumptions not the best assumption but under modest assumptions over the entire earth on arable land on the earth you would be sequestering 150% of the greenhouse gases that we're currently putting up now.

So you would in a sense have to worry about crashing the you-know- losing all of the carbon in the atmosphere and you know at some point you would have the reverse problem - yes - you'd have to say well we're gonna have glaciers again we're gonna cool the planet too much right that would be delightful dilemma to be in at this particular juncture of time

Tim: How much land would you require?

Phil: So that's under modest assumption so that would be all of the arable lands right so - if you move to 50% then you can basically sequester 75% of the greenhouse gases so that 28% is deceptive because that's for conventional practices if you go to regenerative agriculture you go negative you are storing the effectively 75% of all the greenhouse gases that are being meted by man in all forms of transportation, lighting, you name it, - deforestation

Tim: Deforestation including what's happening up in Siberia the methane...

Phil: The full works, the full shebang. Now those are for fairly conservative assumptions about how much greenhouse gas we can sequester that's based on assumption of three tons of carbon sequestered in every hectare in every year so if you have that working level of carbon

sequestration then this is what you are able to do but there are pioneers in this field like Gabe Brown in Nebraska, Dr. David Johnson in Arizona, there's groups in California as well one comes to mind as a Singing Frogs Farm. These are farmers that have been pioneering in this area and in case of Gabe Brown & Johnson they've been working in conjunction with the US Department of Agriculture has been going out measuring their carbon and basically they've been sequestering not three tons of carbon per hectare per year but they're up to 24 tons of carbon per hectare per year - so that shows us what we could strive for now that's six times larger so instead of the 50% of the earth we now need just a fraction of that right.

Well let's say if you wanted to sequester 150% of the carbon rapidly pull it down - then if it took a whole earth for three tons storage of a hectare per year if you multiply that by six which is closer to what we in principle could do up to limit well we would only need maybe 20% or less of the earth to of the arable land to be converted to regenerative agriculture and we'd have solved this problem - regardless of whether the fossil fuel industries decided to help us along

Tim: What I can't understand is how come the academics of this world have basically done a runner on this I mean where is the intellectual veracity to be able to pinpoint this one say right - because I hear of so many environmental scientists getting depressed solely because they see the outlook in the future is it's just horrible and yet it's right in front of their faces and it's been here for a long time, Phil

Phil: Yes well you know I think part of the problem has to come down to the media as well because when we had that big meeting in Paris COP21 that everybody talks about

Tim: The French yeah ...

Phil: And we were delighted that there was international agreement to some standards we which were aiming for a 1.5 degree rise at the most and well 1.5 degree was their the target but two degrees was sort of considered. Well if we fail at 1.5 will at least get to two so the French scientists who are very advanced in their thinking about regenerative agriculture they worried about the commitments that the national the national commitments that the countries had made. And so they decided they would forecast these commitments to 2030 and then decide are we going to make that 1.5 degrees zone or the two degrees zone. And they came to the conclusion that those national commitments would not do it. And so then they decided all right is agriculture up for that the balance can we make changes to agriculture and forestry that would achieve that difference.

And so the difference was not huge but it was still there and so they came up with a plan and their plan was this four per 1000 initiative and they announced that plan it was you know a big banner on the Eiffel Tower and …. basically the the press did not pick it up, they didn't - I know

where did you hear in New Zealand or North America discussion of this agricultural contribution to solving the problem and only now is it being talked about more and more by people like myself and and Graham Sait for example. And lots of others that are sort of in the know - so I just wanted to point that out that had the media being on its toes they would have taken this banner on the Eiffel Tower. And said well what's this all about let's ask some questions here, let's let's pursue this - but getting back to your point about academia you know why isn't this just rippling through academia, these ideas and why isn't that having a profound effect on the students that we all teach.

So it turns out that you know academia is a collection of specialists and it's extremely hard to go outside of the specialization that you're in and when I first started putting together this material I thought this is going to make such a great talk and at some point I'm gonna at least give it to my own department but I thought I should at least communicate with you know the most relevant faculty in my university which was the Faculty of Lands and Food Services. And so, well okay with people here that I should contact with well there's a you know agricultural center for sustainability. There's people like Suzanne Simard who is very famous for fungal networks and how plants trees share nutrients and signals between between themselves and their saplings and other trees. So I thought okay as a faculty member I should be able to send emails to these people and get responses and and offer to give the presentation - I got no response from anybody. And so in the end of course my own department said great if you want to give a talk about something interesting and different we're up for that.

So I gave it to my own University and one of the profs in the audience who is more in the applied science of things the enduring side things he loved it and he said he believes you know engineering is gonna solve all problems. So he went to the Dean who was a good friend of and said look you've got to get Gregory over here talking to you know we've got to have something like that some branch of engineering that solves these sorts of problems. So the Dean of Engineering said well I'm a good friend of the Dean of the Faculty Lands & Forest - why don't I let him know about this so he passed all this chain of email over to the Dean. That Dean and all these responses were coming back to me within the same day that my colleague first emailed the Dean of Applied Science or Engineering. Any rate so the Dean of Faculty Lands & Forest knew nothing about me - an astronomer, a physicist so he appointed one of his faculty to basically have a discussion meet which may have a discussion with me so that they could kind of you know, decide whether what I had to say was worth messaging that to their students.

Anyway the guy that I met with this gentleman and he loved the stuff that presented and so through his efforts I was then able to speak to that to faculty but it was it was more like luck - you know my direct attempts to do that completely got nowhere right - and so there are these artificial barriers that are present you know between our our various specialties and we'd like to think that you know in addition to having all the specialized knowledge which is very important but we'd like to think that you know universities are centers of learning and and they're able to have a big picture view of the way science is going in the way the universe is unfolding and I'd say that's a big weakness of most of our universities is that it's a difficult challenge for them that

they haven't really solved in many cases now I'd say that's a real challenge and that's probably the reason why there isn't more of this being shared more widely.

Tim: It defies logic to be perfectly frank, Phil, because I can't understand that we are at situation junction in the planetary evolution that we need to actually mobilize the consciousness of particularly the ones who are 'supposedly conscious' to bring about the changes that we need - for the sake of our children and their grandchildren and this is where I'm sort of quite frustrated at certain levels because it is - it could be quite simple but again business doesn't really want to go there either - curiosity to ask questions and to wonder have been stifled in so many ways and we need to find a particular way and there's so much that I wanted to actually cover with you and there was just one thing you have got three videos and **I saw these three videos at your presentation the other day and they are only about five minutes each and they were spectacular they were so simple they were very clear and it spelled it out so that I would want to take those through every school in New Zealand every University in New Zealand and then lock up the parliamentarians in our Parliament and make them see them about three or four times each to really get it ...**

Phil: Yes

Tim: And then New Zealand could actually come and be a pioneering country and really take us into this century with a positive way of regreening and regenerating our planet for our children

Phil: Yeah I mean I I have given this presentation that I've given to the transition people at many schools now and I've got to the point that I decided up I need to make a YouTube video of this to get it out there and so there is a thirty nine minute video called the Magic of Soil and that basically has the heart of the message that I've been trying to put out and includes those videos those delightful videos that you were referring to

Tim: Phil, thank you, thank you for coming to New Zealand thanking you for wanting to share, it's been a pleasure having you here.

Phil: Well thanks very much, Tim, for inviting me, I really enjoyed it.

Tim: And your website?

Phil: Oh my website if you go Google Phil Gregory now if you're in North America that'll be the first thing will come up just Phil Gregory but otherwise if you're elsewhere in the world you need to put UBC behind Phil Gregory and then that'll come up.

Tim: Excellent! Thank you, Phil.

Phil: All right.