Intro to Permaculture - Permaculture Soils Perspective Video Transcript

Music

I'd like to welcome a special guest here. This is Jacob Kollen. He is a former Permaculture student of mine, and he got his Masters Degree now in Soil Science and Hydrology, and he is a self-identified soil nerd. So take it away Jacob. Thank you Andrew.

Let's start this off with a question.

What do you see when you look at the unity symbol? What do you see? I see soil and here's why. My eye focuses on the content, the ink, the material, the mass. In the soil case, it's mineral and organic matter. But it's actually the space that provides the function for soil. Much like a house, when you first look at a house, you start thinking of the material, the sheet rock, two-by-fours, the roofing material. But, it's actually the space, the doors, the floor plan, the windows that provide the house its function. Much like that it's the pore space in soils the dimensions of and total amount of pore space that gives the soil its function. Its ability to support life, more specifically, its ability to hold and release water, its ability to hold and release nutrients, its ability to conduct water from a precipitation event down to the water table.

So let's dwell on this stuff and space concept a little longer…with another question.

What's the difference between a foundation for a building and a foundation for life? Let me illustrate that for you.

And the answer is space. Life happens in spaces. The conversion from solid rock into smaller minerals with space between them is a term called, "weathering." And it is the sum of all biological, physical, and chemical processes that can either break apart rocks or dissolve and reform into secondary minerals. In the soil science perspective, the beach sand, sand, the stuff you pick up at the beach is huge, it's big and to be able to get some perspective on that let me draw you a window.

So sand is huge, and weathering will drive large particles, such as sand, into smaller particles, such as silt and clay. This is one millimeter. Sand has a diameter and a range of 2 millimeters to 0.05 millimeters. Silt, the medium sized particles, are going to be from 0.05 millimeters to 0.002 millimeters. Anything less than 0.002 millimeters is going to be a clay-sized particle.

Weathering is a function of five things: climate, organisms, relief, parent material, and time. Arguably climate is the most important factor when considering weathering. To further illustrate my point, let's look at a map of the distribution of climate zones across the world.

If we took this map, and we faded it into a map of the distribution of soil orders across the world, we would see a striking similarity of distributions. That happens because where there is wet and hot conditions, there's an associated soil order that forms due to it. When it is dry, the weathering rate isn't inhibited, and there is a certain soil that forms there. And where it is cold, you run into jealosauls, really, really frozen soils. There are many different climate zones across the world, but let's focus on the three that are exported in this class: drylands, temperate, and tropical climates. I'm going to draw for you a zoomed in window into what those soils look like.

So in a dryland environment, where the temperatures are cool, and the precipitation is low, our weathering rate is low. We can see that our particle sizes are large, primarily consisting of sand, a little bit of silt and a little bit of clay. These large sand particles produce large pores. These large pores drain under the force of gravity. This soil can conduct water well. It can't hold water up against the force of gravity, so the soil's ability to hold and release water is limited. It's got a slight amount of clay and that means that the soil's ability to hold and release nutrients is low.

Comparing that to a temperate soil, where we have moderate weathering rate due to moderate temperatures and moderate precipitation patterns, we have a nice balance between sand, silt, and clay. I call this texture class alone. It's got some large particles, and therefore, it's got some large pores, and those pores can give the soil's ability to conduct water to a satisfactory nature. We have some medium sized particles, and they have medium sized pores, and those medium sized pores can hold water up against the force of gravity and in a pressure range that plants can access. Soil's ability to hold and release water is favorable in a temperate climate. It also has a moderate amount of clay. It is important to note that these are impure clays. These impure clays have a slight charge to them and that what gives this soil the ability to hold and release nutrients, which is satisfactory.

If we go to a tropical environment, where the weathering rate has driven all of our particle sizes to clay and a little bit of silt, I would just call this clay, these have fine particles, therefore they have fine pores. These fine pores do not drain under the force of gravity; therefore the soil's ability to conduct water is low. The soil's ability to hold water is high, but the ability to release water at a pressure range that plants can access is not there, so the soil's ability to hold and release water is limited. As well, these clays, due to weathering, the clays have dissolved and reformed one too many times, and they have become impure. So their charge that this soil has because of these clays is limited. So the soil's ability to hold and release nutrients is limited in a tropical environment.

At this juncture it is important to note organic matter.

So what happens to you when you die? That is what I want to know. When you die, you lay down on the soil, a certain amount of me would easily, readily decompose, and nutrients would become available. A certain part of me would remain stable and provide a charge to the soil, giving the soil's ability to hold and release nutrients. In drylands environments, organic matter accumulation is low because there's no water available. In tropical environments, the decomposition rate of organic matter is high, so organic matter does not accumulate. In temperate environments, organic matter accumulates.

That is a lot of information, but it's important for me to introduce one more topic to allow for you to objectively evaluate our proposed strategies and that is the topic of landscape position.

So in our landscape, if we went to a stream (in a three dimensional landscape, if we went to a stream) and we went up into the hillside nearby and we cut into that hillside and looked at the cross section, we would see something like this. Where we have a soil surface, a ground surface, a bedrock surface, where the depth transfer is from something like this that has space to something that does not. Then we have this water table. If I did agriculture in this position, what would my depth be until I ran into a root limitation? In this case, the depth is shallow before I run into a water table. And I know what you thinking, water is good, but water also prevents oxygen from getting into my root zone. If you do not have plants that have the ability to get oxygen into the root zone this is a limitation. Up here at the summit, we notice that we have a depth until we hit bedrock, and we are running out of space. So we have this much height before we run into something that looks likes this to something that looks like that.

We've covered three climate zones: drylands, temperate, and tropical. Each has their own issues and a set of strategies to go with them. The strategies are numerous. We could talk about covered crops, keyline design, we could talk about heveaculture; we could talk about composting. But, I am going to take a zoomed out look. In the dryland agriculture, my proposed strategy is to place agriculture at a low point in the landscape, where we have an ample amount of catchment area that can capture water and draw it either to or near your site. In a temperate system, from a soils perspective, just on this model alone, our soil functions are favorable. Actually, annual agriculture could be a sustainable system in a temperate climate. Keep in mind, there are going to be site-specific concerns due to our soils, and this is life science, there more exceptions then there are rules. In a tropical system, our soil's ability to hold and release nutrients is low. The nutrient cycling is occurring above the soil or either just on the top. If we go out there and cut and burn our organic material, the nutrients that are cycling, we would see a response from a year or maybe two. But your soil's ability to regenerate vegetation is extremely limited. So my proposed strategy is to design a perennial agriculture system in a tropical climate so that the plants have a longer time period to interact with the soil and access the soil resources.

There's one more concept that I would like to cover and that is the concept of nutrient mining versus nutrient cycling.

Does your system look like this? This is my nutrient pool: carbon, nitrogen, phosphorus, potassium, and sulfur. It is extracted out of the soil due to our extraction mechanism, a plant. We use the biomass to support a human. We take the end of that product into waste into the landfill. I am seriously talking about food waste. What do you do with your food waste? What do you do with your waste – poo? Does it make it back into this pool or does it end up in a landfill? This is a linear system, and it is limited to the number of humans that we can support by how quickly we deplete this resource. We can look at our soil, minerals, and nutrients like this or we can take a different model.

Or do we look at it as a cycle? We have a nutrient pool of our soil resources that can be up taken by a microbe. The microbe can be eaten by another microbe, and there's going to be a lot of nutrient cycling in this feedback loop right here. There's a bit of excess nutrients that are in the soil water that just happen to be available and up taken into a plant. The plant dies, decomposes, and returns back to the nutrient pool, where we the humans are simply a little side diversion.

Thank you for your time. I appreciate. Bye bye.