The Great Simplification

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[00:00:00] **Carlos Nobre:** If you exceed the tipping point within 30 to 50 years we are going to lose between 50 and 70 percent of the forest. We may reach the tipping point by 2050 if we continue the way we're doing deforestation. and global warming. If we were able to get to zero deforestation, there are many thousands of species we call secondary forests.

[00:00:24] They grow so fast, but we have to get zero deforestation, and then to create a large scale forest restoration.

[00:00:35] **Nate Hagens:** Today's guest is Carlos. Carlos Nobre, an earth scientist from Brazil, who is currently a senior researcher at the University of Sao Paulo with his work primarily focusing on the Amazon jungle and its impact on the earth system. Carlos is also the co chair of the science panel for the Amazon, and he was formerly the chair of the large scale biosphere atmosphere experiment in Amazonia.

[00:01:00] He's also a member of the British Academy of Sciences as well as the World Academy of Sciences. Through his work. Work on the Amazon Carlo has also developed the Amazonia 4. 0 initiative, an innovative project to demonstrate the feasibility of a new socio bioeconomy of standing forests and flowing rivers in the Amazon.

[00:01:23] this is the first of several interviews I have focusing on the critical importance of maintaining the forest in the Amazon, how close we are to, long term tipping points flipping into a savannah, and what people in Brazil and what people in the world need to do, to, forestall and eliminate these risks.

[00:01:46] Carlos joins me to discuss how the Amazon is a foundational system, not only for regional ecosystems in South America, but for global weather systems and the entire biosphere. I hope you learn and enjoy this conversation, enjoy in quotes, with Carlos Nobre. Carlos Nobre, welcome to the program.

[00:02:10] Thank you. Thank you very much for the invitation. Thank you for your lifetime of work on the Amazon, and the situation in Brazil and the forest. I really want to understand what's going on with the tipping points, with the Amazon forest, with the relationship and climate change. I want to get to all those questions.

[00:02:31] I have so much to ask you because you're the first Guest, that we've had, on, the Amazon. But first, how did you get started in this? I, remember reading your warnings about the Amazon long ago. H How did you get started in this work?

[00:02:45] **Carlos Nobre:** Well, I started long time ago. In fact, I graduated this.

[00:02:51] electronics engineer, 1974. And then I look for a job in the Amazon. So I went, found a job there, Brazilian Amazonian Research Institute. And I was working as an engineer there, but I really was in love with the Amazon. And that time, 1975, only 0. 5 percent of the Amazon had been deforested. So 99. 5 percent was still intact.

[00:03:18] Yes, 99. 5. And then When I was there, the director of that institute said, Carlos, why don't you go to do a PhD? You should become a scientist. So I was excited and then I came here to the US. I did my PhD at MIT 77 And then I went back, found a job in Southeastern Brazil, but I dedicated from, let's say, January 1983 up to today, most of my research is related to the Amazon.

[00:03:53] And of course, from 1975 to today, the Amazon is everywhere. in a great risk. So I've been doing a lot of research about the Amazon. How many times have you gone into the forest itself? Hundreds of times. Yes. Yes. Hundreds of times. I mean, when I was younger, also I was doing field research in the Amazon.

[00:04:16] There were times I spent one, one and a half months in the field research in the forest. So now I'm I go many times to the Amazon, but less than 30, 40 years ago.

[00:04:29] **Nate Hagens:** So we're going to get into some data, and charts and statistics, but what are like one or two of your key memories in the Amazon or your favorite animal or creature that lives there?

[00:04:39] Of course,

[00:04:40] **Carlos Nobre:** when I was there in the Amazon doing the research in the forest, oh boy, it was beautiful to see the biodiversity I've seen. jaguars, hundreds of bird species, and also the beautiful rivers, you know, a lot of fish. So, you know, it was interesting to, to be there and seeing, I think I've seen more than 500 different animals in, during my visit to the Amazon.

[00:05:09] But of course, my research was not only in the forest. What happens when you deforest? So, for instance, we install many towers. 50 meters tall towers in the forest and 20 meters in the pasture, livestock farming, cattle. And it was quite interesting because in the forest I would see hundreds of animal species in this pasture.

[00:05:36] Only cows. No, the biodiversity, you know, that pasture is not the ecosystem, the evolution of millions and millions of years. So it was very interesting to see how biodiversity would be affected if we continue the forest in the Amazon.

[00:05:53] **Nate Hagens:** I have so many questions. So you just mentioned the millions of years.

[00:05:57] How old is the Amazon and how did it evolve over time briefly?

[00:06:02] **Carlos Nobre:** Yeah. When you look at tropical forests. That's more than a hundred million years. However, the climate in the Amazon, as we know today, it really was just real, became a reality after the Andes mountains were eroded. coming up, uplifting. It started 40 million years ago.

[00:06:26] 5 to 7 million years ago it was the final. So once the Andes were there, so the climate changed in the Amazon, much more rain, so the forest extended. So I would say 10, 20 million years is the more recent forest. And that's an important evolution because the climate is so stable. And the force evolved also interact with the climate, so it's not only large scale climate.

[00:06:57] No, the forest interacts with the climate. The forest is very efficient recycling water. So this recycling of water in the Amazon, 30 to 40 percent of rainfall depends on water recycling. 30 to 40 percent of rainfall in the Amazon or

[00:07:13] **Nate Hagens:** elsewhere?

[00:07:14] **Carlos Nobre:** No, in the Amazon, near the Atlantic coast is less because there's a lot of moisture coming from the Atlantic Ocean.

[00:07:22] It's about 20%. But when you are close to the Andes, Over Western Amazon, 50 percent of the rainfall depends on the recycling of water. Well, that's why they call it a rain forest. No, of course. I mean, totally, 2. 2, 2. 3 meters of rainfall, per year.

[00:07:42] **Nate Hagens:** Wow.

[00:07:43] **Carlos Nobre:** Yeah. Over. Western Amazon near the Andes, this is more than three meters, and there is a very efficient recycling of water.

[00:07:53] This is a unique evolution of the Amazon forest. For instance, that's the only forest in the planet that you have more Water transpiration by the plants during the dry season, then during the wet season. How does that work? Okay, that's very important evolution. There is lots of rain during the wet season.

[00:08:20] The dry season historically, it's three to four months, but still there is rain during The dry season. For instance, the driest month in southern Amazon, the rain is 50 millimeters. So, what happens is during the wet season, there's tremendous amount of rain. Ecological evolution in the Amazon transformed the soil, so the soil absorbs a lot of water.

[00:08:52] So, it's not like, you know, rainfall and the water runoff to the river. So, it absorbs, goes deep up to 7 12 meters, and then one fourth of the trees evolved also with deep rooting system that goes all the way to 7 12 meters. So, during the dry season, There is less solar radiation because there is less cloudiness, so there is more energy for transpiration of the plants.

[00:09:24] And these deep roots, they pull the water, but not only through, for the trees there. They also distribute the water near the surface, so the other trees are fed with this water. Then, Transpiration of the plants is more, just to give you some figures. During the wet season, the transpiration is 3 to 3. 5 liters of water per square meter per day.

[00:09:57] During the dry season is 4 to 4. 5

[00:10:01] **Nate Hagens:** liters of water. Because the environmental conditions are drawing down the water bank that's in the soil that was built from the prior season.

[00:10:09] **Carlos Nobre:** Yes, of course, you know, the, most of the trees have shallow rooting systems, but as I said, one fourth of the trees are very deep, so this is very ecological evolution and the science shows very clearly because let's say in most of southern Amazon, dry season was, June, July, August, September, and at the end of September, the transpiration was so high, the end of the dry season, really would, really moist, the moisture would reach the atmosphere at a very fast rate, and that was the transition towards the wet season, so that's an ecological evolution, very important, also, you know, from the time top of the forest to the floor.

[00:11:05] The difference is 30 degrees maximum temperatures and 26 degrees at the bottom and the, soil. So those are the ranges of temperature of maximum photosynthesis. This is ecological evolution. So the forest moved towards creating the ecological evolution for maximum, photosynthesis.

[00:11:28] So this is very important.

[00:11:30] **Nate Hagens:** This has been stable on its own. It's its own stable ecosystem outside of the global climate situation. So they're, intertwined, right? So how does this water system in the Amazon affect global, weather and climate patterns, from what you just described?

[00:11:49] **Carlos Nobre:** Well, of course, it's very important because, you know, over tens of millions of years, the Amazon forest, removed a large amount of carbon, dioxide, from the atmosphere.

[00:12:03] Today, there is about 150, perhaps even close to 200 billion tons of carbon. This is stored in the trees. The trees and in the soil. So, of course, this is very stable for maintaining the temperature at a certain value. As I said, this optimal photosynthesis. If the temperature reaches 43 degrees, it's zero photosynthesis on the leaves.

[00:12:35] So it's very interesting, ecological evolution for tens of millions of years. Never the temperature in the Amazon reached that. And of course, removing carbon dioxide from the atmosphere becomes also very important. Not to let, global warming, at least for tens of millions of years. That's the evolution.

[00:12:56] So this is also very important factor, really, to maintain those temperatures, not 43 degrees, not very cool. Also, when it's very cool, there is no photosynthesis.

[00:13:11] **Nate Hagens:** But I've read somewhere that, what happens in the Amazon actually significantly affects the weather patterns in the United States, for example.

[00:13:20] How does that work? Yes, there is some

[00:13:23] **Carlos Nobre:** recent research, you know. The first thing I mentioned is importance of removing carbon dioxide from the atmosphere. But of course, as I said, you know, this 2. 2, 2. 3 meters of rainfall a year, you know, what's rainfall? I mean, you have water vapor that goes up the atmosphere.

[00:13:45] So, they use, as I mentioned, most of the solar energy for evaporation, the water evaporates, and when there is condensation to, create the cloud droplets, So that energy is released, so that warms that atmosphere, that keeps the pressures there, low pressures. What science, some recent studies were showing, is that if we lose the Amazon, then we reduce not less than 30 percent the rainfall.

[00:14:22] All over the Amazon Basin. And then that reduction of the rainfall. So as I said, you know, with the evaporation, condensation, release of heat, creates a system of low pressure. And this low pressure also draws much more water vapor from the Atlantic Ocean. If you decrease 30%, 40 percent rainfall, so this low pressure system changes a lot, it becomes higher pressure and this will, start atmospheric wave, starts in the Amazon, moves to the north, And this is a wave, low, high pressure, and it will reach low, the border of U.

[00:15:15] S., Mexico, and then high pressure over western U. S., around California. So these studies indicate if we lose the Amazon, the parts of the California will become even drier. It's dry, most of the central, southern California. So that would

be one, one of the. impact of losing the forest. When you say losing the forest, what do you mean by that?

[00:15:42] Unfortunately, the Amazon is very, close to what we call a tipping point. Quote unquote savannization. The forest, as I say, keeps tremendous amount of carbon. The forest is so dense with trees, with, you know, leaves. Just to tell you, the top of the forest, absorbs 96 percent of solar radiation. Only 4 percent of solar radiation reaches the bottom.

[00:16:14] **Nate Hagens:** Wow. So unless you're in a pasture,

[00:16:18] **Carlos Nobre:** Oh, yes. Unless you're in a pasture. I'm saying the forest. That's a tremendous ecological evolution. Why this evolution? This is really something very good because, unlike, you know, sequoia forests in western U. S. and, or boreal forests in Canada. Because there is so little solar radiation reaching the forest floor, it's very wet.

[00:16:45] So there is not much solar radiation for evaporation of the soil water. So that's so wet. The trees, the trunks, the branches, the soil is so wet. So ecological evolution of millions and millions of years, lightning strikes. So there is a lightning strike. It ignites a fire everywhere in the world. But because everything on the bottom of the Amazon forest is so wet, When the vegetation is very, wet, it's not flammable.

[00:17:23] So when there is a lightning strike, maximum it will lead to one, two trees to die. That's it. Does not expand. So this is ecological evolution, very important for the Amazon forest.

[00:17:37] **Nate Hagens:** And it's created stable conditions, which we are now disrupting. before I came here, I, and I'll post this for the viewers, I looked at a, aerial, picture of the Amazon today, of actually of all of South America.

[00:17:49] And the smoke is like almost the size of Brazil on, the Western side of South America. So we're in a drought right now, second year in a row. is the soil still wet? Is it still 96%? Are the conditions changing rapidly or what can you tell us? Yes, unfortunately, because

[00:18:08] **Carlos Nobre:** of global warming, before global warming, we would have one severe drought every two decades.

[00:18:19] And for millions of years, we would have a very severe drought every 200 to 1, 000 years. In this scale, 200 to 1, 000 years, yes, there would be a severe drought, part of the Amazon forest would become very dry, and when there would be A lightning strike striking that dry forest that a fire would really destroy sometimes 4, 000, 10, 000.

[00:18:52] There are studies showing even 15, 000 square kilometers. But that was something once every thousand years. Now, Before global warming, we were talking about one more severe drought every two decades. Now, 2005, 2010, 2015, 2016, and record breaking drought in the history of Amazon, 2023, 2024. So, that's global warming.

[00:19:19] Global warming, you know, science has predicted that for many decades. You know, I've always worked in that. We are predicting global warming would induce severe droughts. What's the driver of the severe droughts? Two, the Pacific, Equatorial Pacific, El Nino phenomena. El Nino phenomena are becoming much stronger.

[00:19:45] For instance, 2015 16, the record breaking El Nino in strength, 2023 2024, the third largest, El Nino. And so they induced drought in the Amazon. But this is historic for millions of years. But now, two, the Droughts per decade. So that's bringing a tremendous, imbalance to the forest. The elements that we are saying about the tipping points, you know, I was the first scientist, almost 35 years ago, I published the first scientific articles in 1990 in Science, in 1991, Journal of Climate.

[00:20:29] I came here, spent one year at the University of Maryland, we did that study, but that was 1990s, there was an increase in deforestation, so I decided to do that research, what It's going to happen to the Amazon forest if deforestation becomes very large.

[00:20:46] **Nate Hagens:** In 1990s, it had gone from 99. 5 down to what in the 1990s, the amount of forest cover?

[00:20:53] You said it was 0. 5 when you first got your PhD. 89

[00:20:57] **Carlos Nobre:** was 7%. So my calculation did, if you have a large scale deforestation in the Amazon, the dry season over southern Amazon would reach six months. The ecological evolution when in the tropics, when you have Six months dry season. This is the tropical savanna.

[00:21:20] That's the ecological evolution. Tens and tens of millions of years. So my study show if we deforest the Amazon a lot, all Southern Amazon will become a degraded savanna. I said that I created the quote unquote savannaization of the Amazon, but that was a projection in the future. So unfortunately, You were right.

[00:21:45] I was right. Not only because that was one study, you remember, not by 1989 when I was at University of Maryland. Still, we are not talking much about the risk of climate change. The first IPCC report came in 1990. I was part of that. The first COP, COP 1993, the ECHO 92 meeting in Rio, all those things.

[00:22:13] So at that time, I only look at deforestation. And then myself, my PhD students, we put together deforestation, global warming, etc. We publish many, studies. In a study we published in 2016, we put deforestation and global warming. And then our studies show if deforestation exceeds 20, range 2025, and global warming 2 degrees, 2.

[00:22:44] 5 degrees, we will really go tipping point in the Amazon, impossible to revert. So today we are at 18 percent deforestation, and we are, unfortunately, as you know, for the first time in 120, 000 years, the temperature reached 1. 5 degrees 2023, continuing 1. 5 degrees, so we are at the edge. Shh. And, you know, and it's not only a projection, the data are showing we are at the edge.

[00:23:19] Why? Because the dry season over 2. 3 million square kilometers, all Southern Amazon, is four to five weeks lengthier in 40 years. One, week longer per decade. So in two, three more decades, it reached six months. Impossible to maintain the forest. Second, Southeastern Amazon is one of the only forests in the planet.

[00:23:52] The forest, the Amazon forest has become a carbon source. You know, globally speaking, all forests remove 30, 32 percent of all Carbon dioxide emissions on the planet, our emissions, you know, the 1990s, the Amazon forest was removing

1. 5, 2 billion tons of carbon dioxide. Still, the forest removes. However, that part, the forest has becoming a carbon source, tremendous stream mortality.

[00:24:24] So when we look at all those figures, and also, highly deforested areas in Southern Amazon. The temperature is two, three degrees warmer. So all of Southern Amazon is at the edge of the

[00:24:36] **Nate Hagens:** tipping point. So the whole Amazon forest is not yet a carbon source, but part of the forest is. yes. And what happens if we go through the tipping point, if we get to 20 percent of deforestation and 2 degrees Celsius, what happens?

[00:24:52] tips, and then does it just really go fast after that? Yes, you know,

[00:24:57] **Carlos Nobre:** if you exceed the tipping point, then there is a self destruct. degradation, continuous self degradation, and many studies show within 30 to 50 years that's impossible to stop that degradation. And within 30 to 50 years, we are going to lose between 50 and 70 percent of the forest.

[00:25:20] Only near the Andes, because near the Andes, the rainfall is very more than three meters, even reducing the rainfall, but still it's sufficient. And there is almost zero dry season, even if there is a little bit of dry season, but still that climate will be consistent with the forest. But this is perhaps 30 percent only.

[00:25:42] In our recent study we published in Nature, showing We may reach the tipping point by 2050, if we continue the way we're doing deforestation and global warming. At some moments, we could see a little bit of that good, some good news when Amazonian countries were able to reduce deforestation. But unfortunately, we, in the, Brazilian Amazon, we had a good reduction of deforestation, from 2000 to, Five to 2012, we are really moving towards much less deforestation, but then unfortunately increased a lot.

[00:26:23] 2015, 2022. We are very concerned because this is, let me tell you another big problem. I know it's not a scientific problem, but, it is a political problem that, All over the planet, there is a increase in the populist politicians. all over the planet. Why? I'm not a scientist. I cannot answer that question.

[00:26:54] It's hard for me. Well, you are a

[00:26:55] **Nate Hagens:** scientist.

[00:26:56] **Carlos Nobre:** You're not a brain scientist or social scientist. I'm not a social scientist. I mean, I don't understand why, and this is far right wing and far left wing. People don't want to hear these uncomfortable truths. They want to hear nice things. Yeah. So yeah, I heard about that, but it's hard.

[00:27:17] Why people accept this populist politicians? Because Brazil. And many Amazonian countries had populist politicians. Fortunately, now we don't have any more. But these populist politicians, they were totally in favor of disappearing the forest. Forests have no value. So, so that's, you know, fortunately now, 2023, 2024, For the first time in 11 years, we got a large scale reduction of deforestation all over the Amazonian countries, 50 percent in 2023, and continued reduction

[00:27:57] **Nate Hagens:** in 2024.

[00:27:57] So there's still deforestation, but it's just growing at a smaller level, is that what you mean? Yes, much

[00:28:03] **Carlos Nobre:** smaller level, and also all Almost all Amazonian countries. We had an Amazonian country summit in August 2023 in the Amazonian city of Belém in Brazil. And the countries, almost all countries, signed agreements to get to zero deforestation by 2030.

[00:28:27] So most Amazonian countries are moving very quickly. quick forests in Brazil from January 2023 to July 2024, we got 64 percent reduction in deforestation.

[00:28:42] **Nate Hagens:** So if you were a benevolent alien scientist that was hovering above the earth and looking at what's unfolding on our planet, you might logically conclude that the Amazon forest is one of the natural wonders of this planet and that it has a special role in that.

[00:29:01] and the health and stability of the conditions of the Holocene, would you agree with me? Yes, Yeah. so given what you just said, there's two, at least two core

dynamics. One is Brazil, and the countries that have the Amazon, have a role to play in economic limiting deforestation and keeping the health of the evapotranspiration and that whole cycle.

[00:29:31] But the rest of the world has a responsibility with respect to climate change and emissions to limit those or keep those down so that Amazon doesn't go into the tipping point that screws up the weather system for the whole world. Is that correct? Absolutely correct.

[00:29:46] **Carlos Nobre:** We are so concerned because as I said, all, Almost all Amazonian countries said zero deforestation degradation by 2030.

[00:29:57] And also, very important, forest restoration. We are starting large scale forest restoration projects in the Amazon. However, you know, of course, reducing emissions from the Amazon deforestation, it's very good. Forest restoration will remove also carbon dioxide from the atmosphere. But that's not sufficient to avoid the temperature.

[00:30:23] continue to go up. For instance, not even the science predicted that we would reach 1. 5 degrees warming by 2023. Yeah. Science was saying 2023 might reach 1. 3 because we had 1. 2 in 2022, and then a very strong El Nino, then all of a sudden 1. 5, continues 1. 5. El Nino, this El Nino disappeared by in May this year, Continue warmer, August was the warmest year in 120, 000 since the last interglacial period.

[00:31:05] So, there is a tremendous risk if, and we are talking a lot, thousands of scientists are trying to explain, if we, Maintain 1. 5 degrees this coming year, 2025, and then science may say, I'm not saying, science is saying that, I say, if we continue three years with 1. 5, the science may say we reach 1. 5 and we're still increasing emissions, all greenhouse gases, if we reach 1.

[00:31:39] 5 now and we Continue. If we go to COP26, they say, in Glasgow 2021, not to exceed 1. 5. Globally, we have to reduce 43 percent emissions by 2030 and get to net zero by 2050. However, if we reach 1. 5 now, if we do that, We may reach 2. 5 by 2050, not 1. 5. So that's why it's a tremendous risk for the Amazon as well.

[00:32:16] **Nate Hagens:** Okay, I have a lot of questions here. So, you mentioned, lightning strikes, historically, and they burn a few thousand acres. But lightning strike is not what's causing most of the fires now, is it? it's conscious people burning them, right?

[00:32:31] **Carlos Nobre:** Unfortunately, historically, since Brazilian government, the dictatorship in 1970s decided to go and get rid of the forest, they had that Tremendous ideas that colonizers from Europe that came 500 years ago, you know, tropical forests are places of the hell.

[00:32:55] even, you know, a lot of books in the 1970s, 80s, they call green hell to red deserts because, you know, the military had this impression that they had to get rid of the forest. Since 1970s, they start going deforestation, deforest, let the trunks there dry out for two months and satisfy. Then they use, you know, all the things that come from the, you know, all those elements.

[00:33:28] They are really the fertilizers for a very poor soil. So then grow, A pasture brings the cows, cattle ranches. However, unfortunately, now we had the record breaking fires in the Amazon, 2023 2024. Yes, you can say, well, this is also due to record breaking drought, heat waves. However, we now are seeing that almost all fires are criminal fires.

[00:34:05] They are organized crime in the Amazon, setting fires, why? Because there was a tremendous reduction of deforestation. So, deforestation was part of their business, all

[00:34:16] **Nate Hagens:** illegal. Oh, so we did deforest, the boomerang effect, these people have to make a livelihood somehow, so they're setting fires to start other businesses with farming and fertilizer and such.

[00:34:31] **Carlos Nobre:** Yes, because there was this tremendous reduction of deforestation in the Brazilian Amazon in Colombia and Amazon as well. 90 percent of deforestation is

[00:34:40] **Nate Hagens:** illegal. Can it be enforced or is it just too far distant and there's not the ability to enforce it to punish the people? There should be

[00:34:50] **Carlos Nobre:** abilities to enforce.

[00:34:53] However, in the previous government in Brazil, the former president also populist politician, far right wing politician, was encouraging everybody to deforest. Now, with the current present in Brazil and most Amazonian countries, they are combating. So that's why I say a great reduction, 64 percent reduction in Brazilian deforestation.

[00:35:24] So the organized crime, which for decades they were doing deforestation, you know, because the satellite monitoring systems detect deforestation immediately. The geostationary system sends, data every 10 minutes. So to deforest, they have to. To get people there, they are there for days to weeks to deforest, you know, 100 hectares, something like that.

[00:35:54] So the satellite is monitoring, the law enforcement agencies are receiving that data, so that's one of the reasons, reduction of deforestation.

[00:36:05] **Nate Hagens:** The Amazon is really important to the world. So it's almost like its jurisdiction is within Brazil and the countries around it, but it's necessary to the stability of the world.

[00:36:16] So couldn't the world help with funding or technology or something to not only reduce deforestation and some of this illegal activity, but help Brazil reforest? You said there's a 64 percent reduction in deforestation, but that's still deforestation. We have to get to reforestation, right? So couldn't, doesn't the world have a responsibility to help with this?

[00:36:42] What are your thoughts on that?

[00:36:44] **Carlos Nobre:** absolutely. For instance, We, Brazil, launch at COP28 a project of restoration. It's called Arc of Restoration. It's to restore 24 million hectares in the Brazilian Amazon, mostly southern Amazon, the forest degraded and, The estimate cost is 40 billion, Brazil wants to do that from now 6 million by 2030, 18 additional million hectares, 2030, 2050.

[00:37:21] In fact, I mean, for the whole Amazon, we need to restore much more all Amazonian countries. Let's say, ideally, 1 million square kilometers. There are 2

million square kilometers, 50 percent deforested, 50 percent degraded. Estimates of a cost to do that, 150 billion. But that would remove tremendous amount of CO2, would protect biodiversity, would also, really combat the tipping point, because this forest restoration will recycle water, lower temperature.

[00:38:01] Well, no, this 150 billion, well, that's nothing, I mean, of certainly all countries, for instance, the Green Climate Fund, it's only 100 billion a year, it should be much more, you know, many countries like my country, President Lula and many others are saying we should create these funds, but they should reach, you know, people say, Actually, for saving all forests, the planet, all ecosystems, not only the tropical, we may need 1 trillion a year for all the planet.

[00:38:36] So that's what I'm saying. It's very important. Develop developed countries to support because really, and you know, even for his 1 million hectare, 1 million square kilometers in the Amazon, that will remove 1. 2 billion tons of carbon dioxide.

[00:38:56] **Nate Hagens:** The irony is a trillion dollars, we need that wealth from a fossil fuel based economy in order to save the impacts from the fossil based economy.

[00:39:06] but let me ask you this. Let's just do some bookend speculation here. What would happen to the rest of the world if there were a partial or total collapse of the Amazon forest, just assuming that climate stays where it is, just the loss of the Amazon, what would that mean for the rest of the Earth's, weather, natural systems?

[00:39:27] Tremendous risk.

[00:39:28] **Carlos Nobre:** Tremendous risk. If we cross the tipping point, and then, it will, be within 30 to 50 years, 50 to 70 percent of the forest will degrade. So that will mean emissions of 300 to 350 billion tons of carbon dioxide. That were stable or a sink and now are a source. Yeah. It will become a big source.

[00:39:57] Only that emission may become a source. make it almost impossible to maintain a global temperature of 1. 5 degrees. However, a tremendous risk, in

addition to this climate risk, is biodiversity. The Amazon forest has the highest biodiversity on the planet. Science knows 13 percent of all plant and animal species.

[00:40:22] For instance, 16, 000 tree species are known in the Amazon, 50, 000 plant species, 3, 000 fish species, et cetera, et cetera. So those were nature's solutions over time. Nature's solutions. But there is a tremendous risk for ourselves, humans, because for the first time since the. colonizers came to South America 500 years ago.

[00:40:52] Now, 2024, epidemic. The science shows more than 25 zoonosis, virus, coronavirus, hantavirus, arenavirus, that they were there, they became zoonosis because of the degradation that we put the forest. And unfortunately, for the first time now, one of these virus became an epidemic in Brazil. This year, 14, 000 Brazilians caught the virus.

[00:41:25] Caught that disease. It's a virus. It's, there's a Spanish name, Oropushi virus, and one insect is transmitter. So, and, you know, the infected people are not only in the Amazon, all over Brazil now. So it's spread. So far, it's epidemic. And the studies show more than 25 cases of zoonosis. and many scientific studies show if we degrade all tropical forests, we are going to have one to two pandemics per decade in the planet, like COVID.

[00:42:02] So that's another, I'm just saying, of course, you know, maintaining the forest, you know, if we lose the Amazon, there's tremendous risk. And, okay, that's the second one, biodiversity. And the third one is the, Other ecosystem service, very important, which is the Amazon recycle water so efficiently that it really exports a tremendous amount of water vapor south of the Amazon.

[00:42:30] This is the Amazon, river flows into the Atlantic Ocean, something like 18 billion tons. of water per day, so called fly rivers or aerial rivers. It's 17 billion tons. So that feeds all the rainfall systems in Central South America, even in Southeastern South America, Uruguay, Paraguay, parts of Argentina, Southern Brazil, and particularly Central Brazil.

[00:43:03] The biome in Central South America is tropical savanna. an evolution over 40 million years since the Andes started uplifting. And, so the studies are

showing even this tropical savanna will become At least 50 percent of the tropical savanna will become semi arid type of vegetation. So if we

[00:43:29] **Nate Hagens:** lost the Amazon, how long would it take over evolutionary time to recover?

[00:43:36] If we go through the tipping points, do you have any knowledge on that? Well, that's very,

[00:43:42] **Carlos Nobre:** serious

[00:43:42] **Nate Hagens:** because

[00:43:43] **Carlos Nobre:** if we reach, three, four degrees warming the planet, so we are going to lose the Amazon. And then. Because if we, you know, also there are more than 20 tipping points. the Amazon is one of them.

[00:44:01] The other one is permafrost. if we exceed two degrees, you interview Jorgen Rockström. Certainly he told you about the risks of melting the permafrost. We are going to lose more than 200 billion tons of greenhouse gases. So if we do that, then the temperature may go three, four degrees. And then it's the planet will be very hot for thousands of years.

[00:44:36] thousands and thousands of years. Or longer. Or longer. It's funny because some climate, change deniers, they say, oh, this is very good because we are going to make it More CO2 is good for plants. No, they say it's good for plants, no question about that. However, they say other things. They say we are going to avoid the next glacial.

[00:44:59] But Glacier is 20, 000 years ahead. So, but you know, this is ridiculous because then you lose most of the biodiversity in the planet. If the temperature reaches 4 degrees, 5 degrees, we are going to start the sixth, species extinction, the planet.

[00:45:20] **Nate Hagens:** Well, or we've already started it, depending on your definition.

[00:45:24] **Carlos Nobre:** For instance, as you know, coral reefs, we are seeing that we are seeing a lot of other species. So it's ridiculous that if we reach four or five degrees, this starts the species extinction. And yes, I mean, studies show if the CO2 concentration in the atmosphere reaches, close to 600 parts per million, now we are reaching 430, 430, close to 430, so if we reach 600, so not even the next glacial.

[00:45:58] So it's, so you see, this is, you know, it's, the six species extinctions.

[00:46:05] **Nate Hagens:** And also for

[00:46:06] **Carlos Nobre:** us,

[00:46:07] **Nate Hagens:** I had Corey Bradshaw from Australia on recently, and he said at three degrees Celsius, we lose 50 percent of the species on earth. Yes. So let me ask you a different question. If for some reason we totally left the Amazon alone, what would you do?

[00:46:21] Right now, I know that's a hypothetical. How long would the evapotranspiration cycle, the photosynthesis to grow back, how long would it take to get us back to the level when you started your PhD from a 17 percent drop to recover most of that? You know, let me tell you, if

[00:46:43] **Carlos Nobre:** we were able to get to zero deforestation, degradation, then fortunately, The evolution of the tropical forest over tens of millions of years is Fantastic, because the secondary forest, there are many thousands of species we call secondary forest.

[00:47:04] Those are the species that grow like crazy. I mean, they grow so fast. They grow, for instance, the secondary species may reach 7, 10 meters in 2 to 3 years. And they recycle water. So the secondary forest species make the forest to function very well. Decrease the temperature, recycle water, and then of course they grow very fast, and within 15 to 30 years, then the primary forest species, they start growing very also, not very fast, but they grow.

[00:47:39] And after 50 years, you have a primary forest again. So this is ecological evolution of the Amazon. And that's what I'm saying. You don't have to wait 30 years. Immediately, three years later, the forest is already doing all those ecological

services. So, but we have to get zero deforestation and then to create A large scale forest restoration, and also, unfortunately, because there are areas with very large deforestation.

[00:48:13] Let's say there are one area with pastures there, and the nearest forest is 30 kilometers. So, unfortunately, in that, natural regeneration is very slow.

[00:48:26] **Nate Hagens:** Is there a synergistic ecological impact from the distribution of the forest versus pasture patches? Like if it's kind of cookie cutter, forest, pasture, forest, pasture, forest, pasture, it loses the ecological function.

[00:48:45] And it might be better if you have the same amount of pasture in the same amount of forest that they're clumped. together. Is there something going on there or not really? Well, there is a lot of

[00:48:55] **Carlos Nobre:** research, which is called, regenerative agriculture. And the regenerative agriculture also has livestock farming, but then you have a small area with pasture and you have around that area the biome, let's say, the Amazon, the forest, so that's much better because when you do that, the forest around the pasture maintains a lower temperature, maintains much higher temperature.

[00:49:29] evapotranspiration. So that's better. But what I'm saying, I mean, to save the Amazon, we have to abandon at least 50 percent of the pasture and let the forest regrow. What was, I was explaining in many areas, highly deforested, we have to reforest because you saw natural regeneration is beautiful. This is the nature based solution, You know, when you have 30 kilometers from distant from the forest, then the, natural regeneration is very slow because you know, the, birds, all the animals taking the seeds 30 kilometers, they don't.

[00:50:10] So that's why I'm saying for the Amazon, we need at least 56%. It has to be reforestation. The project that Brazil has, Ark of Restoration, requires a large 73 species, native species. So. I think that's the solution.

[00:50:28] **Nate Hagens:** So what can people do both in Brazil and around the world to help, the odds of reforestation happening in the Amazon?

[00:50:37] Well, first,

[00:50:39] **Carlos Nobre:** of course, ecosystem services. Currently, unfortunately, only there is carbon. ecosystem services. People don't see the value of maintaining biodiversity. And also all the Amazonia countries in South America, not only Amazonia, the recycle of water, the so called flying rivers is fantastic, even for the agriculture in other parts of South America, at least for the carbon markets.

[00:51:10] Now, forest restoration has a tremendous also economic impact, carbon markets. So everybody globally, we should say, I think European union is absolutely correct saying, well, we do not buy any product exported to European union from the forest area, January, 2021. This would the main product be soy or beef, or there are other products.

[00:51:39] Well, from the, Amazon, from lowlands in the Amazon, it's mostly soy grains and beef. So, you know, that's very important. That's very important. But, a more important challenge is the fact that the economic potential of what we call A social bioeconomy of standing forests and flowing rivers. That means the economic potential of using hundreds of products from biodiversity is much better than, livestock farming.

[00:52:15] For instance, we run a study showing profits of agroforestry systems. Existing is not a future projection. Existing is, 300 to $700 per hectare per year. There are some cooperatives there selling more than 50 products of the forest, maintaining the forest. This is not mono monocultures. The forest agroforestry systems, the profits of.

[00:52:46] livestock farming in the Amazon is very low, 50 to 100.

[00:52:50] **Nate Hagens:** So economically it could work out to value ecosystem services, reduce the monoculture, reduce the deforestation. Yes. So what's the barrier to that happening? The barrier is

[00:53:01] **Carlos Nobre:** that As you look globally, beef consumption is increasing all over the planet.

[00:53:10] So, you know, unfortunately, you know, in the Amazon, livestock farming is the main driver of deforestation, the cattle ranches. And also, for our health, having many more products from the biodiversity is much

[00:53:26] **Nate Hagens:** better. So if people around the world understood the severity of this crisis and they don't live in Brazil and they are busy with their jobs and trying to pay the bills, but if they made the one change of not eating beef or especially not beef, well, you couldn't say not beef from Brazil because the soy is grown in Brazil and the beef is grown somewhere else.

[00:53:46] So would giving up beef make a significant difference on the deforestation of the Amazon? Full stop that question. Absolutely.

[00:53:53] **Carlos Nobre:** Absolutely. And IPCC. in many reports has been saying reduce beef consumption, and IPCC was looking both reducing deforestation in the tropical forests, but also, as we know, the emissions of methane.

[00:54:10] You know, the cows, yeah, or methane. So, you know, yes, if we do that also, but also that would be very important for global consumers understand the potential of this new social by economy, hundreds of forest

[00:54:28] **Nate Hagens:** products. I don't eat beef anymore. I don't eat pork. The reason that I gave up pork long ago, 15 years ago, is my girlfriend, was a vegan and I love dogs, so I, I imagined in my mind that, truckload of pigs, going to be slaughtered was dogs.

[00:54:50] And it made me so sad viscerally that I never pork again. But I'm just wondering if hearing your story and hearing the urgency of what the Amazon tipping points mean for the world. I mean, I'm not advocating this. I'm trying to describe the science, but this actually is part of the science. If people viscerally imagine when they're eating beef, they pictured some hectares of, the biodiverse rainforest going up in flames or something like that, if that wouldn't emotionally trigger some discipline or behavior change. It should, I

[00:55:24] **Carlos Nobre:** have to tell you my story. I'm not eating beef for 17 years. Myself, like most Brazilians, you know, eating, you know, barbecue is such a tradition thing in Brazilian culture. So I was in 2007, 2007. I was giving a talk in a university in Sao Paulo, and then I showed slides with the driver of deforestation, a cattle ranch, the cows, and then a student raised his hand and said, Professor, Do you eat beef?

[00:56:04] And I said, yes, this is traditional barbecues. My wife, you know, makes this barbecues every Sunday. And he says, are you sure the beef that you're eating is not from the Amazon deforestation? I said, I don't know. Coming day, the next day, I went to supermarkets where my wife purchased beef. I asked, they did not know.

[00:56:28] They asked the supermarket manager. One week later, the manager told me, I'm sorry, we do not have traceability of our beef. I stopped that day because, you know, that's, you know, beef is the main driver of deforestation in the Amazon. And I fully agree with you. People should understand 65 percent of all tropical forest deforestation is for cattle ranches.

[00:56:56] So please stop eating beef.

[00:56:59] **Nate Hagens:** What other recommendations do you have for listeners who are becoming aware, maybe at the 11th hour of our ecological plight? What other advice do you have for the people? Please support

[00:57:10] **Carlos Nobre:** Amazonian countries to save the forest, the largest tropical forest, the largest biodiversity.

[00:57:19] Also with fantastic indigenous communities, other local communities. It's interesting because the Afro descendant communities, they were for 300 years slaves, you know, they were brought from Africa to the U. S. to, Amazonian countries, South American countries. And then at one point in Brazil, mostly in Brazil, but also in Colombia, they, you know, still slavery was there and they, Abandoned, and then they went to the forest, to the Amazon forest, and they start creating their communities, Afro descendant communities, it's very interesting, they learn with the indigenous people.

[00:58:06] They never did any deforestation. It's interesting because as slaves in, let's say in Brazil, they were, you know, the Portuguese were asking them to do all the deforestation. So they went to the Amazon, create a very large number of communities. They learn with the indigenous people, always maintain the forest.

[00:58:27] So it was, you know, we, really, we, have to move in that direction. and indigenous communities in the Amazon. They arrived there 14, 000 years ago.

Always maintain the forest. We know they use 2, 300 products, 1, 400 medicinal plants, 250 fruits. It's

[00:58:50] **Nate Hagens:** fantastic. How many indigenous people are there now in the Amazon and how does that compare to long ago?

[00:58:57] Yes. When

[00:58:58] **Carlos Nobre:** the Portuguese and Spanish came to the Amazon, there were About 8 to 10 million indigenous people. There were something like 1, 300 ethnic groups, 1, 000 languages, and always all these communities maintained in the forest. And then, of course, you know, it's very, because the assassination that they did was not really shooting, no, it was mostly with, virus, the, you know, Europeans brought virus and the Portuguese, mostly a measle virus was the main one.

[00:59:42] Well, no, you wouldn't believe out of this 10, 8, 10 million people. in the, there, by, in Brazil, by 20, 40, 2050, there were only 50, 000 indigenous people, only 50, Sorry, 1940, 1940. So now, fortunately. In the Amazon, we have already 2. 2 million indigenous people, much less than when we came, the Europeans came, but still growing, They are having an average of three to four children.

[01:00:20] **Nate Hagens:** So they have a high fertility rate. Are they still, is there any research showing that they're continuing the traditions of protecting the forest? Yes. they continue

[01:00:27] **Carlos Nobre:** the tradition. By and large, 95 percent of indigenous people, they want to continue with their tradition, with their knowledge, only 5 percent the other way.

[01:00:39] However, it's so 95%. So now we have to learn a lot with these indigenous people. And unfortunately, it's, you know, Increasing the population now, unfortunately now, most Amazonian countries, they want to title new indigenous territories, et cetera, but listen, the big challenge in my country, Brazil, the new government, the new minister of environment, Marina Silva, for the first time in history, we have a ministry of indigenous people, Her name is Sonia Guajajara, a

indigenous leader, a woman leader, and now the agribusiness in Brazil, they want that we do not title, any new indigenous territories.

[01:01:29] They're totally against. So we have this political battle in Brazil. Government wants to increase tremendously the indigenous territories. The agribusiness continues with their dream, like, like the Portuguese, expanding and expanding. cattle expanding, soy

[01:01:48] **Nate Hagens:** expanding agriculture. So what is your work? You're doing bioeconomy.

[01:01:53] What, is your main project now to stem these trends and reverse them?

[01:01:58] **Carlos Nobre:** Yes. I was, you know, for many decades as a scientist, looking at the tipping point, the negative tipping point. And I was saying, well, we are very close to tipping point, very close to tipping point. And then starting 2019, 2020, I said, well, you know, almost 40 years of my career working only about the negative tipping points.

[01:02:24] Then I decided to the rest of my career to try to advance on positive tipping points. So basically we. are doing several, initiatives now. One is, it was my suggestion to Brazil Development Bank for the Arc of Restoration, this 24 million hectares of restoration. But also, I created the project called Amazonia 4.

[01:02:52] 0. So, we want to demonstrate the feasibility of doing a past development of Amazonia communities to do a project. Value adding, bio industrialization of forest products. So we create a laboratory for that. value adding to the cocoa value chain to produce chocolate. And also, there is another product people know more in Brazil, not that it's so much exported.

[01:03:25] It's a close relative to cocoa. Cocoa, scientifically, is teobroma cocoa, and there is another one that's called teobroma grandiflorum. It's a beautiful fruit. In the indigenous language, it's cupuaçu. also can produce fantastic chocolate, and also a lot of the pulp, also the fruit is fantastic. So we did capacity development of two communities already, and they are, we are starting.

[01:03:58] construct, a biofactory for one of these communities to produce chocolate of those two species. And also you're going to do a capacity development for the first time in Brazilian history, now in November, December. Indigenous community. There is an indigenous community in southwestern Amazon. they are known as Paiter Suruí.

[01:04:21] This is a sad story. In 1969, there were 1, 800 indigenous people in that community. They had very few contacts with people. 1969. And then the Brazilian government was starting a road there. And one person there working in the road went and contacted them. And that person brought mitzvah. Out of 1, 900, only 8, 280 did not die, almost extinct.

[01:04:57] So this is a community, they are producers of cocoa. Now we are going to do capacity development. They want also to have a biofactory to produce chocolate. So this is Amazonia 4. 0. And also we are planning now, also one of these laboratories for Brazil nuts. Also for genome sequencing. We designed a laboratory to go to Amazon communities, do capacity development for them to do the DNA sequencing of plants, animals, but also, microorganisms because of risk of epidemics and pandemics.

[01:05:34] So that's the idea of the Amazonia 4. 0. And also. Part of the Amazon 4. 0 is we want to develop in the Amazon the so called Amazonia Institute of Technology, A M I T, to, I did my PhD at MIT. The idea would be to have in the Amazon an institute quality of MIT for this new social bi economy. You know, doing capacity development, undergraduate, graduate.

[01:06:02] You know, we are finishing the design. We're going to release now 28, 29 November in the Amazon, in Manaus, 25 advanced laboratories, many, courses. So we want to get funding. We estimated the cost to, for this is 400, 000. But this is Pan Amazonia, not only in Brazil, and we want to have, you know, 1, 500 students per year, undergraduate, graduate students.

[01:06:34] So that's also, I would say, my last project in my career, to construct the Brazilian MIT, the Amazonian MIT.

[01:06:43] **Nate Hagens:** So let me summarize, or attempt to summarize. We are close to tipping points, in the Amazon and the, world's stability from the Holocene. we need to stop the deforestation in the Amazonian forest.

[01:06:59] We can do that. and we are doing that. It's slowing down, but we need to get to zero. deforestation. One of the biggest things we can do is stop eating meat, unless, or stop eating beef, unless you know that it's not from the Amazon. we need to change the economic model away from monoculture to incorporate the ecosystem services and the broader, diversity of life and products you mentioned, cocoa.

[01:07:26] And then globally, we need to reduce our emissions because the emissions are creating tipping points that are outside of the control of the Brazilian people, and then new. intellectual, development and social development from the people, in South America. Thank you very much. Fantastic summary.

[01:07:45] So, I have a few closing questions, Carlos, that I ask all my guests. I might guess the answer, that you were about to give us, but what do you care most about in the world?

[01:07:55] **Carlos Nobre:** I think, you know, my generation, I'm 73 years old. My generation was the generation That science showed the risk for the planet, climate change, all other changes, all the, as the planetary guardians say, all the planetary boundaries, we are having a tremendous risk, not only climate, but biodiversity, water, freshwater, pollution, all those things.

[01:08:25] You know, unfortunately, my generation did not do anything to save the planet, so I think I want to communicate with the new generation, particularly young people all over the planet, please take the leadership, don't do what my generation did, really take the leadership and let's look for sustainable planet.

[01:08:50] Is it possible? Yes. Technology today for renewable energy, we do not have to, you know, 70 percent or more of emissions from fossil fuels. also regenerative agriculture, much less emissions, maintaining the biodiversity. So I have really to say, you know, please, new generation do something, but my generation did not do it.

[01:09:13] And you see emissions are still increasing. If

[01:09:19] **Nate Hagens:** you had a magic wand and could do one thing with no recourse to your security or reputation, what is one thing you could do, even if it was magic, to improve human and planetary futures? One thing that

[01:09:34] **Carlos Nobre:** I will do, because I love the forests, the tropical forests, and I love the Amazon, I would say, let's save the Amazon.

[01:09:43] Let's tomorrow zero deforestation and, let's restore all the forests. Let's value the indigenous people, local communities. that's the love we all have to the Amazon. Thank you for your time today and for your lifetime of work on these issues. Carlos Nobre. Thank you very much and congratulations.

[01:10:05] Very important podcast that you make and I'm sure you are going to really motivate the younger generations to do something that my generation never did.

[01:10:16] **Nate Hagens:** We find ourselves no less than at the precipice of a battle between power and life. so I, will continue to try and, onwards, my friend. Thank you very much.

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