What would it take to bend the biodiversity curve?
Navin Ramankutty

Let me start my remarks with the Planetary Boundaries framework, which assessed how current Earth system functioning compares to states or rates of change that have been seen over the 10,000 years of the Holocene, the time period of most relevance to thinking about sustainability in the Anthropocene. The planetary boundaries analysis showed that human activities have greatly exceeded the safe operating space for humans and the planet across multiple indicators – climate change, biodiversity loss, and nutrient pollution. Of these 3 major problems, biodiversity loss and nitrogen pollution are the ones that really stand out, as being in areas of high risk, while even climate change is assessed to be in the zone of 'increasing risk'. Rates of species extinctions today are 100-1000 times greater than the background rate during the Holocene.

But of course, this is not to dismiss climate change, which is a systemic risk, and a threat multiplier. But even if we solve the climate problem, the biodiversity problem (and the nitrogen problem) are going to continue. Many people imagine that if only we had a pollutant-free source of infinite energy, say nuclear fusion, we could solve the world's problems. I often worry that while nuclear fusion will give us carbon-free energy, it might in fact worsen our biodiversity and nutrient pollution problems because we will fewer limits on human consumption. Anyway, not to belabor this point, but we do have multiple problems to tackle at the same time, and I will return to this later.

Back to biodiversity. The biggest cause of biodiversity loss is habitat loss for plants and animals because of land use change. And the biggest cause of land use change is human food production. So the main (or only) leverage for dealing with biodiversity loss is through modifying our food production.

What are different ways of doing that? We essentially have two options. We can try to limit the amount of land we use for agriculture. But this requires more intensified food production which will increase nutrient pollution, greenhouse gases such as nitrous oxide, water use, all of which also harm biodiversity.

Alternately, we could try to improve biodiversity on existing agricultural lands. We can do this by creating small amounts of suitable habitat on agricultural lands, for example, hedgerows and flower strips that may provide breeding habitat for smaller species and invite pollinators, or through ecological management practices that limit pesticide use, or through increasing the diversity of the farm and landscape through having different crops, and mix of farms, trees, and wetlands across the landscape.

These two alternate strategies and their trade-offs are encapsulated by a raging debate over the last 20 years, popularly known as 'land sparing versus land sharing'. There's lot more research to be done here, but work to date suggests that, for a given amount of food being produced, land sparing is better than land sharing.

But much of this conversation on which alternative is better has missed an important point of how much better. For example, many people think that organic farming will solve the biodiversity problem. My students and I have examined the benefits of alternative agricultural practices such as organic farming and smaller-farms. With organic agriculture, our review of the literature found that organic farms have 1-34% greater species richness and 40-50% greater abundance across different

taxa. The abundance result seems particularly encouraging. But these numbers are when comparing equal areas of organic to conventional farms. For the same area, organic farms, on average, have 20% lower production. In other words, there is a trade-off between the biodiversity benefits and crop yields. Very few studies controlled for the yield effects when studying the biodiversity benefits of organic farming. But those that did control for yields found no difference in biodiversity between organic and conventional farms. In other words, for growing the same amount of food, organic farms are not discernibly better than conventional farms.

So ultimately, and I don't have a fully quantitative assessment of this for biodiversity, my educated opinion is that no matter what we do in terms of changing our food production practices, we are fiddling at the margins. In other words, we have been having a raging debate comparing two alternatives, neither of which will make a big difference to slowing biodiversity loss. The sheer magnitude of the number of people on this planet, and more importantly, our consumption, is driving biodiversity loss, and small changes at the margin will not make a big difference. This is maybe why, despite everything we have doing over the years in terms of setting aside protected areas and landscape corridors and so on, biodiversity just keeps crashing and we are heading into the 6th Great Extinction. This is not to dismiss the continued importance of preserving natural areas for the tigers and elephants, and the importance of bringing birds and bees back to our working landscapes. But I am pessimistic that business-as-usual will make a big difference. Where does that leave us?

Many people are saying that we need transformative change. What does this mean? For me it means that we need to take a much harder look at the very basis of our human metabolism. 10 billion people consuming as we do just cannot engineer our way out of the biodiversity crisis, as well as the climate and nitrogen pollution crisis. We need to not only look at how we produce our food, but we also need to look at our consumption. All the crops we produce on this planet currently only deliver 60% in terms of calories, the rest is lost to the metabolism of livestock and to bio products. We also need to look at food waste, given estimates that 30% is wasted. A study in 2020 from IIASA examined different scenarios for "bending the biodiversity curve". They showed that only an integrated strategy that couples production, consumption, and strategic conservation measures can reverse biodiversity loss. Because that's what we need to do, not just slow down biodiversity loss, but reverse it.

Further, transformative change is important because our human metabolism touches on multiple environmental crises – climate change, biodiversity loss, and nutrient pollution – at the same time. Without transformative change, we might end up solving one problem while making another worse. I am not a scholar of transformative change, but I understand the frustrations of many scholars and practisioners who are seeing little benefits for all our actions so far.

As we think about what transformative change means, we are also increasingly called upon to learn from the peoples who lived in harmony with nature for 10s of 1000s of years. Indigenous People have a very different relationship with the land, centered on respect and reciprocity – to never take anything more from the land without giving back. I was greatly inspired by reading the book 'Braiding Sweetgrass' by Robin Wall Kimmerer – it changed the way I think about many of our current problems, and also provided much needed hope and inspiration. So transformative change is not just about changing production and consumption practices. It is about changing minds and cultural norms. Without that we will simply stumble from one problem to another.

Whenever the topic of learning from Indigenous Peoples come up, there is the common refrain, "but we cannot go back". Yes, it's true that human population numbers were much smaller – around 10 million at most 10,000 years ago and 0.5 billion just 400 years ago when Europeans made contact with North American Indigenous Peoples. So yes, there is no going back. There is path dependency to our problem. Human civilizations have essentially gorged on natural resources and grown our numbers and we are approaching 10 billion people. But if there is no going back, there is only going forward. The Planetary Boundaries used the Holocene as a benchmark, but maybe that is not a good benchmark for the Anthropocene. Can we go forward in a way that is both nature and human positive? Are lessons of the past relevant in going forward? What new lessons do we need to learn? I don't have answers to these questions, so that's the perfect place to stop talking.