

Earth Institute professor looks back at human history to understand how we got to 7 billion and counting

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Environmental geographer Ruth DeFries is a pioneer in the study of how humans have transformed the surface of the Earth. Using satellite data, she explores how changes in Earth's vegetation can affect climate, ecosystems and the relative ability of humans and other species to survive on this planet.

Her new book, *The Big Ratchet: How Humanity Thrives in the Face of Natural Crisis*, takes the very long view of [human history](#), describing how, for at least 10,000 years, we have continually created new

technologies that have allowed our numbers to grow. But each new invention creates a new problem, which we solve with yet another innovation that in turn creates the next problem – whether it's [climate change](#), loss of habitat for other species or global pandemics.

"Societies adapt, learn and alter course when conditions change," said DeFries, the Denning Professor of Sustainable Development in the Department of Ecology, Evolution and Environmental Biology. All species seek to expand their territory and grow in numbers, of course, but what sets us apart is "the extraordinary ability of our species to twist food from nature," she writes. "Through trial and error we have found new ways to extract more food with less work."

These trials and errors have enabled population to boom, especially over the last century, as our numbers doubled to 7 billion. Today we struggle with an abundance of food, which in turn leads to new crises: obesity, for one thing, along with insufficient food for the millions who don't have enough to eat because the surplus is unevenly distributed.

DeFries compiles datasets that have changed the scale and focus of ecosystem research, allowing her and other researchers to make better projections of future climate change and contribute to understanding how human activities are altering habitat needed to conserve biodiversity.

"Our role is to provide input for sustainable decisions about land use," says DeFries, who, joined the Columbia faculty in 2008. She has received a Fulbright award and been elected to the National Academy of Sciences and the American Association for the Advancement of Science. In 2007 she won a MacArthur "genius" grant for her work.

Your book discusses the idea that there's a limit to

how far we can manipulate nature before something goes wrong. Is that a new idea?

No, it can be traced back to Plato and Socrates, and most likely to thinkers long before them. We often talk about the [18th century scholar Thomas] Malthus in relation to ecological catastrophe because of his predictions of famine at the start of the Industrial Revolution. But predictions of catastrophe and collapse haven't turned out the way they've been prophesized. It's human nature to extrapolate into the future from what you see around you without taking into account human ingenuity. The predictions seem logical, but history tells a different story.

Your book describes a historical cycle you call "ratchet, hatchet, pivot." Can you explain that?

A ratchet is a tool that creates motion in one direction so that once you have that motion, you can't go backward. We keep ratcheting up ways to manipulate nature to produce more food. This allows civilization to support more and more people. But after manipulating nature on such a grand scale, it's inevitable that new problems result, whether it's disease or famine or pollution—the hatchet. The solution is the pivot. Then the cycle starts again.

What would be an example of a ratchet, a hatchet and the subsequent pivot?

For most of human history, the biggest issues were famine and shortage. The domestication of crops was probably the biggest ratchet in history. The hatchet was that diets became starchier. People became shorter, life expectancy dropped, and there was tooth decay, and smallpox and

tuberculosis from crowding. The pivot has been long and slow. Whenever people could afford to raise livestock, they have increased the animal products in their diets. We have also devised antibiotics and vaccinations to counteract diseases caused by crowding. A more recent example of food-related ratchets is the introduction of the potato from the New World to Europe in the 16th century. Because it's nutritious and grows easily, it allowed populations to grow. In Ireland people relied almost solely on potatoes, and they were planted closely together. However, the potatoes were genetic clones, so when a fungus hit in the 1840s, it caused the Irish potato famine, which killed at least a million people. Ireland then stopped relying so much on the potato. Potatoes are not planted so closely together anymore, and there are new varieties. People emigrated from Ireland to other countries. While it was a tragic event, the aftermath shows the resilience of humans to overcome and move on.

In the 20th century the ratchets seemed to turn faster than ever. How different is our age from earlier periods?

The hatchets falling now have more to do with abundance. Today the share of family income devoted to food is lower than at any other time in modern history. In the past the hatchets had to do with shortage—shortage of fertilizer, shortage of food. Now, we see too much of certain things. Obesity is spreading worldwide. Too much nitrogen is causing pollution, too many greenhouse gases. Our problems have mainly to do with the abundance we have created. We haven't learned yet how to manage and live with it.

On the other hand, we also see the destruction of ecosystems, such as seas emptied of fish, taking place

at a faster pace than ever. Isn't that the opposite of abundance?

Resources may be declining faster now, but the phenomenon [of resource depletion] is not qualitatively different. People have always taken as much as they can. All species do the same thing. We just do it more efficiently now because we have better technology.

As of 2007, for the first time in history half of us now live in cities. Are we still connected to nature?

In a couple of decades, more than 70 percent of us will live in cities. That is a qualitatively different relationship with nature. Most of us are not growing our own food; someone else is. In the United States less than 3 percent of people are farmers. But to me, it's science fiction to think that even if every single one of us lived in cities, that we would be disconnected from nature. Even if you go into a grocery store and pull your shrink-wrapped chicken or whatever off the shelf, we still rely on the planetary support machinery even though so many parts of that machinery are out of our control. Then again, I try hard not to hang onto this romantic notion that once upon a time, people lived in harmony with nature. While we can do a much better job of maintaining the ecosystems that we have, it's not realistic to think that we can go back to some fictitious harmony with nature.

Does it bother you to see so much of the planet converted to our own uses?

It does, because we can do better. We can all live well; there's enough food in the world to feed everyone right now. Yet a billion people still don't get enough food. We just haven't learned to use our abundance

efficiently. If we did, then we wouldn't need to be destroying so much of nature.

Do you think your book will anger environmentalists?

A There's a line of thinking that the Earth has a finite carrying capacity and once we hit that, we will have some enormous catastrophe. The story is more complex. We have overcome problems time and time again. We need people whom we might call alarmists in order to move forward toward solutions. I think someone like [Silent Spring author] Rachel Carson did a huge service by calling attention to the problems created by pesticides. But then again, if there's too much doomsday thinking, which I think there is today, then people turn off. On the other side, you have people who say we have infinite resources, that technology and free enterprise will fix anything. Yes, technology can solve problems, but solutions just don't arise spontaneously. There's a lot of hard work. I'm trying to step away from either extreme.

What do you do to live more efficiently?

I try my best. I compost. I eat very little red meat, and I'm very conscious about wasting [food](#); I've been labeled "the tofu mom" by my kids. I try not to drive too much. I put my efforts into working with my students—they're already making the world a better place. But as far as what anyone else should do—I don't want to get preachy.

So, is there hope?

I do think there's hope. Solutions create new problems, and problems will generate new solutions. But we can't predict the future; the only guide that we have is what's happened in the past.

More information: Preview: Read the prologue to *Big Ratchet*:
[news.columbia.edu/files_columb ... atchet_Prologue.pdf#](https://news.columbia.edu/files_columb...atchet_Prologue.pdf#)

Provided by Columbia University

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